LEARNING MODULE

1

Currency Exchange Rates: Understanding Equilibrium Value

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LEARNING OUTCOMES

Mastery	*The candidate should be able to:*
☐	calculate and interpret the bid–offer spread on a spot or forward currency quotation and describe the factors that affect the bid–offer spread
☐	identify a triangular arbitrage opportunity and calculate its profit, given the bid–offer quotations for three currencies
☐	explain spot and forward rates and calculate the forward premium/discount for a given currency
☐	calculate the mark-to-market value of a forward contract
☐	explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect)
☐	describe relations among the international parity conditions
☐	evaluate the use of the current spot rate, the forward rate, purchasing power parity, and uncovered interest parity to forecast future spot exchange rates
☐	explain approaches to assessing the long-run fair value of an exchange rate
☐	describe the carry trade and its relation to uncovered interest rate parity and calculate the profit from a carry trade
☐	explain how flows in the balance of payment accounts affect currency exchange rates
☐	explain the potential effects of monetary and fiscal policy on exchange rates
☐	describe objectives of central bank or government intervention and capital controls and describe the effectiveness of intervention and capital controls
☐	describe warning signs of a currency crisis

1 INTRODUCTION

Exchange rates are well known to follow a random walk, whereby fluctuations from one day to the next are unpredictable. The business of currency forecasting can be a humbling experience. Alan Greenspan, former chair of the US Federal Reserve Board, famously noted that "having endeavored to forecast exchange rates for more than half a century, I have understandably developed significant humility about my ability in this area."

Hence, our discussion is not about predicting exchange rates but about the tools the reader can use to better understand long-run equilibrium value. This outlook helps guide the market participant's decisions with respect to risk exposures, as well as whether currency hedges should be implemented and, if so, how they should be managed. After discussing the basics of exchange rate transactions, we present the main theories for currency determination—starting with the international parity conditions—and then describe other important influences, such as current account balances, capital flows, and monetary and fiscal policy.

Although these fundamentals-based models usually perform poorly in predicting future exchange rates in the short run, they are crucial for understanding long-term currency value. Thus, we proceed as follows:

- We review the basic concepts of the foreign exchange market covered in the CFA Program Level I curriculum and expand this previous coverage to incorporate more material on bid–offer spreads.
- We then begin to examine determinants of exchange rates, starting with longer-term interrelationships among exchange rates, interest rates, and inflation rates embodied in the international parity conditions. These parity conditions form the key building blocks for many long-run exchange rate models.
- We also examine the foreign exchange (FX) carry trade, a trading strategy that exploits deviations from uncovered interest rate parity and discuss the relationship between a country's exchange rate and its balance of payments.
- We then examine how monetary and fiscal policies can *indirectly* affect exchange rates by influencing the various factors described in our exchange rate model.
- The subsequent section focuses on *direct* public sector actions in foreign exchange markets, both through capital controls and by foreign exchange market intervention (buying and selling currencies for policy purposes).
- The last section examines historical episodes of currency crisis and some leading indicators that may signal the increased likelihood of a crisis.

2 FOREIGN EXCHANGE MARKET CONCEPTS

☐ calculate and interpret the bid–offer spread on a spot or forward currency quotation and describe the factors that affect the bid–offer spread

We begin with a brief review of some of the basic conventions of the FX market that were covered in the CFA Program Level I curriculum. In this section, we cover (1) the basics of exchange rate notation and pricing, (2) arbitrage pricing constraints on spot rate foreign exchange quotes, and (3) forward rates and covered interest rate parity.

An exchange rate is the price of the *base* currency expressed in terms of the *price* currency. For example, a USD/EUR rate of 1.1650 means the euro, the base currency, costs 1.1650 US dollars (an appendix defines the three-letter currency codes). The exact notation used to represent exchange rates can vary widely between sources, and occasionally the same exchange rate notation will be used by different sources to mean completely different things. *The reader should be aware that the notation used here may not be the same as that encountered elsewhere.* To avoid confusion, we will identify exchange rates using the convention of "P/B," referring to the price of the base currency, "B," expressed in terms of the price currency, "P."

NOTATION CONVENTIONS

Notation is generally not standardized in global foreign exchange markets, and there are several common ways of expressing the same currency pair (e.g., JPY/USD, USD:JPY, $/¥). What is common in FX markets, however, is the concept of a "base" and a "price" currency when setting exchange rates. We will sometimes switch to discussing a "domestic" and a "foreign" currency, quoted as foreign/domestic (f/d). This is only an illustrative device for more easily explaining various theoretical concepts. The candidate should be aware that currency pairs are not described in terms of "foreign" and "domestic" currencies in professional FX markets. This is because what is the "foreign" and what is the "domestic" currency depend on where one is located, which can lead to confusion. For instance, what is "foreign" and what is "domestic" for a Middle Eastern investor trading CHF against GBP with the New York branch of a European bank, with the trade ultimately booked at the bank's headquarters in Paris?

The spot exchange rate is usually used for settlement on the second business day after the trade date, referred to as $T + 2$ settlement (the exception being CAD/USD, for which standard spot settlement is $T + 1$). In foreign exchange markets—as in other financial markets—market participants are presented with a two-sided price in the form of a bid price and an offer price (also called an ask price) quoted by potential counterparties. The bid price is the price, defined in terms of the price currency, at which the counterparty is willing to buy one unit of the base currency. Similarly, the offer price is the price, in terms of the price currency, at which that counterparty is willing to sell one unit of the base currency. For example, given a price request from a client, a dealer might quote a two-sided price on the spot USD/EUR exchange rate of 1.1648/1.1652. This means that the dealer is willing to pay USD 1.1648 to buy one EUR and that the dealer is willing to sell one EUR for USD 1.1652.

There are two points to bear in mind about bid–offer quotes:

1. *The offer price is always higher than the bid price.* The bid–offer spread—the difference between the offer price and the bid price—is the compensation that counterparties seek for providing foreign exchange to other market participants.
2. *The party in the transaction who requests a two-sided price quote has the option (but not the obligation) to deal at either the bid (to sell the base currency) or the offer (to buy the base currency) quoted by the dealer.* If the party chooses to trade at the quoted prices, the party is said to have either "*hit the*

bid" or "*paid the offer*." If the base currency is being sold, the party is said to have hit the bid. If the base currency is being bought, the party is said to have paid the offer.

We will distinguish here between the bid–offer pricing *a client receives from a dealer* and the pricing *a dealer receives from the interbank market*. Dealers buy and sell foreign exchange among themselves in what is called the interbank market. This global network for exchanging currencies among professional market participants allows dealers to adjust their inventories and risk positions, distribute foreign currencies to end users who need them, and transfer foreign exchange rate risk to market participants who are willing to bear it. The interbank market is typically for dealing sizes of at least 1 million units of the base currency. Of course, the dealing amount can be larger than 1 million units; indeed, interbank market trades generally are measured in terms of multiples of a million units of the base currency. Please note that many non-bank entities can now access the interbank market. They include institutional asset managers and hedge funds.

The bid–offer spread a dealer provides to most clients typically is slightly wider than the bid–offer spread observed in the interbank market. Most currencies, except for the yen, are quoted to four decimal places. The fourth decimal place (0.0001) is referred to as a "pip." The yen is typically quoted to just two decimal places; in yen quotes, the second decimal place (0.01) is referred to as a pip.

For example, if the quote in the interbank USD/EUR spot market is 1.1649/1.1651 (two pips wide), the dealer might quote a client a bid–offer of 1.1648/1.1652 (four pips wide) for a spot USD/EUR transaction. When the dealer buys (sells) the base currency from (to) a client, the dealer is typically expecting to quickly turn around and sell (buy) the base currency in the interbank market. This offsetting transaction allows the dealer to divest the risk exposure assumed by providing a two-sided price to the client and to hopefully make a profit. Continuing our example, suppose the dealer's client hits the dealer's bid and sells EUR to the dealer for USD 1.1648. The dealer is now long EUR (and short USD) and wants to cover this position in the interbank market. To do this, the dealer sells the EUR in the interbank market by hitting the interbank bid. As a result, the dealer *bought* EUR from the client at USD 1.1648 and then *sold* the EUR in the interbank for USD 1.1649. This gives the dealer a profit of USD 0.0001 (one pip) for every EUR transacted. This one pip translates into a profit of USD 100 per EUR million bought from the client. If, instead of hitting his bid, the client paid the offer (1.1652), then the dealer could pay the offer in the interbank market (1.1651), earning a profit of one pip.

The size of the bid–offer spread quoted to dealers' clients in the FX market can vary widely across exchange rates and is not constant over time, even for a single exchange rate. The size of this spread depends primarily on three factors:

- the bid–offer spread in the interbank foreign exchange market for the two currencies involved,
- the size of the transaction, and
- the relationship between the dealer and the client.

We examine each factor in turn.

The size of the bid–offer spread quoted in the interbank market depends on the liquidity in this market. Liquidity is influenced by several factors:

1. *The currency pair involved.* Market participation is greater for some currency pairs than for others. Liquidity in the major currency pairs—for example, USD/EUR, JPY/USD, and USD/GBP—can be quite high. These markets are almost always deep, with multiple bids and offers from market participants around the world. In other currency pairs, particularly some of

the more obscure currency cross rates (e.g., MXN/CHF), market participation is much thinner and consequently the bid–offer spread in the interbank market will be wider.

2. *The time of day.* The interbank FX markets are most liquid when the major FX trading centers are open. Business hours in London and New York—the two largest FX trading centers—overlap from approximately 8:00 a.m. to 11:00 a.m. New York time. The interbank FX market for most currency pairs is typically most liquid during these hours. After London closes, liquidity is thinner through the New York afternoon. The Asian session starts when dealers in Tokyo, Singapore, and Hong Kong SAR open for business, typically by 7:00 p.m. New York time. For most currency pairs, however, the Asian session is not as liquid as the London and New York sessions. Although FX markets are open 24 hours a day on business days, between the time New York closes and the time Asia opens, liquidity in interbank markets can be very thin because Sydney, Australia, tends to be the only active trading center during these hours. For reference, the chart below shows a 24-hour period from midnight (00:00) to midnight (24:00) London time, corresponding standard times in Tokyo and New York, and, shaded in grey, the *approximate* hours of the most liquid trading periods in each market.

Standard Time and Approximate FX Trading Hours in Major Markets: Midnight to Midnight (London Time)

Tokyo	09:00	13:00	17:00	21:00	01:00 Day+1	05:00 Day+1	09:00 Day+1
London	00:00	04:00	08:00	12:00	16:00	20:00	24:00
New York	19:00 Day–1	23:00 Day–1	03:00	07:00	11:00	15:00	19:00

3. *Market volatility.* As in any financial market, when major market participants have greater uncertainty about the factors influencing market pricing, they will attempt to reduce their risk exposures and/or charge a higher price for taking on risk. In the FX market, this response implies wider bid–offer spreads in both the interbank and broader markets. Geopolitical events (e.g., war, civil strife), market crashes, and major data releases (e.g., US non-farm payrolls) are among the factors that influence spreads and liquidity.

The size of the transaction can also affect the bid–offer spread shown by a dealer to clients. Typically, the larger the transaction, the further away from the current spot exchange rate the dealing price will be. Hence, a client who asks a dealer for a two-sided spot CAD/USD price on, for example, USD 50 million will be shown a wider bid–offer spread than a client who asks for a price on USD 1 million. The wider spread reflects the greater difficulty the dealer faces in offsetting the foreign exchange risk of the position in the interbank FX market. Smaller dealing sizes can also affect the bid–offer quote shown to clients. "Retail" quotes are typically for dealing sizes smaller than 1 million units of the base currency and can range all the way down to foreign exchange transactions conducted by individuals. The bid–offer spreads for these retail transactions can be very large compared with those in the interbank market.

The relationship between the dealer and the client can also affect the size of the bid–offer spread shown by the dealer. For many clients, the spot foreign exchange business is only one business service among many that a dealer provides to that client. For example, the dealer firm might also transact in bond and/or equity securities with the same client. In a competitive business environment, in order to win the client's business for these other services, the dealer might provide a tighter (i.e., smaller)

bid–offer spot exchange rate quote. The dealer might also give tighter bid–offer quotes in order to win repeat FX business. A client's credit risk can also be a factor. A client with a poor credit profile may be quoted a wider bid–offer spread than one with good credit. Given the short settlement cycle for spot FX transactions (typically two business days), however, credit risk is not the most important factor in determining the client's bid–offer spread on spot exchange rates.

3 ARBITRAGE CONSTRAINTS ON SPOT EXCHANGE RATE QUOTES

☐ identify a triangular arbitrage opportunity and calculate its profit, given the bid–offer quotations for three currencies

The bid–offer quotes a dealer shows in the interbank FX market must respect two arbitrage constraints; otherwise the dealer creates riskless arbitrage opportunities for other interbank market participants. We will confine our attention to the interbank FX market because arbitrage presumes the ability to deal simultaneously with different market participants and in different markets, the ability to access "wholesale" bid–offer quotes, and the market sophistication to spot arbitrage opportunities.

First, the bid shown by a dealer in the interbank market cannot be higher than the current interbank offer, and the offer shown by a dealer cannot be lower than the current interbank bid. If the bid–offer quotes shown by a dealer are inconsistent with the then-current interbank market quotes, other market participants will buy from the cheaper source and sell to the more expensive source. This arbitrage will eventually bring the two prices back into line. For example, suppose that the current spot USD/EUR price in the interbank market is 1.1649/1.1651. If a dealer showed a misaligned price quote of 1.1652/1.1654, then other market participants would pay the offer in the interbank market, *buying* EUR at a price of USD 1.1651, and then *sell* the EUR to the dealer by hitting the dealer's bid at USD 1.1652—thereby making a riskless profit of one pip on the trade. This arbitrage would continue as long as the dealer's bid–offer quote violated the arbitrage constraint.

Second, the cross-rate bids (offers) posted by a dealer must be lower (higher) than the implied cross-rate offers (bids) available in the interbank market. A currency dealer located in a given country typically provides exchange rate quotations between that country's currency and various foreign currencies. If a particular currency pair is not explicitly quoted, it can be inferred from the quotes for each currency in terms of the exchange rate with a third nation's currency. For example, given exchange rate quotes for the currency pairs A/B and C/B, we can back out the implied cross rate of A/C. This implied A/C cross rate must be consistent with the A/B and C/B rates. This again reflects the basic principle of arbitrage: If identical financial products are priced differently, then market participants will buy the cheaper one and sell the more expensive one until the price difference is eliminated. In the context of FX cross rates, there are two ways to trade currency A against currency C: (1) using the cross rate A/C or (2) using the A/B and C/B rates. Because, in the end, both methods involve selling (buying) currency C in order to buy (sell) currency A, the exchange rates for these two approaches must be consistent. If the exchange rates are not consistent, the arbitrageur will buy currency C from a dealer if it is undervalued (relative to the cross rate) and sell currency A. If currency C is overvalued by a dealer (relative to the cross rate), it will be sold and currency A will be bought.

To illustrate this **triangular arbitrage** among three currencies, suppose that the interbank market bid–offer in USD/EUR is 1.1649/1.1651 and that the bid–offer in JPY/USD is 105.39/105.41. We need to use these two interbank bid–offer quotes to calculate the market-implied bid–offer quote on the JPY/EUR cross rate.

Begin by considering the transactions required to *sell* JPY and *buy* EUR, going through the JPY/USD and USD/EUR currency pairs. We can view this process intuitively as follows:

Sell JPY Buy EUR	=	Sell JPY Buy USD	then	Sell USD Buy EUR

Note that "Buy USD" and "Sell USD" in the expressions on the right-hand side of the equal sign will cancel out to give the JPY/EUR cross rate. In equation form, we can represent this relationship as follows:

$$\left(\frac{\text{JPY}}{\text{EUR}}\right) = \left(\frac{\text{JPY}}{\cancel{\text{USD}}}\right)\left(\frac{\cancel{\text{USD}}}{\text{EUR}}\right).$$

Now, let's incorporate the bid–offer rates in order to do the JPY/EUR calculation. A rule of thumb is that when we speak of a bid or offer exchange rate, we are referring to the bid or offer for the currency in the denominator (the base currency).

i. The left-hand side of the above equal sign is "Sell JPY, Buy EUR." In the JPY/EUR price quote, the EUR is in the denominator (it is the base currency). Because we want to buy the currency in the denominator, we need an exchange rate that is an offer rate. Thus, we will be calculating the *offer* rate for JPY/EUR.

ii. The first term on the right-hand side of the equal sign is "Sell JPY, Buy USD." Because we want to buy the currency in the denominator of the quote, we need an exchange rate that is an offer rate. Thus, we need the *offer* rate for JPY/USD.

iii. The second term on the right-hand side of the equal sign is "Sell USD, Buy EUR." Because we want to buy the currency in the denominator of the quote, we need an exchange rate that is an offer rate. Thus, we need the *offer* rate for USD/EUR.

Combining all of this conceptually and putting in the relevant offer rates leads to a JPY/EUR offer rate of

$$\left(\frac{\text{JPY}}{\text{EUR}}\right)_{offer} = \left(\frac{\text{JPY}}{\boxed{\text{USD}}}\right)_{offer}\left(\frac{\boxed{\text{USD}}}{\text{EUR}}\right)_{offer} = 105.41 \times 1.1651 = 122.81.$$

Perhaps not surprisingly, calculating the implied JPY/EUR *bid* rate uses the same process as above but with "Buy JPY, Sell EUR" for the left-hand side of the equation, which leads to

$$\left(\frac{\text{JPY}}{\text{EUR}}\right)_{bid} = \left(\frac{\text{JPY}}{\boxed{\text{USD}}}\right)_{bid}\left(\frac{\boxed{\text{USD}}}{\text{EUR}}\right)_{bid} = 105.39 \times 1.1649 = 122.77.$$

As one would expect, the implied cross-rate bid (122.77) is less than the offer (122.81).

This simple formula seems relatively straightforward: To get the implied *bid* cross rate, simply multiply the *bid* rates for the other two currencies. However, depending on the quotes provided, it may be necessary to *invert* one of the quotes in order to complete the calculation.

This is best illustrated with an example. Consider the case of calculating the implied GBP/EUR cross rate if you are given USD/GBP and USD/EUR quotes. Simply using the provided quotes will not generate the desired GBP/EUR cross rate:

$$\frac{\text{GBP}}{\text{EUR}} \neq \left(\frac{\text{USD}}{\text{GBP}}\right)\left(\frac{\text{USD}}{\text{EUR}}\right).$$

Instead, because the USD is in the numerator in both currency pairs, we will have to invert one of the pairs to derive the GBP/EUR cross rate.

The following equation represents the cross-rate relationship we are trying to derive:

$$\frac{\text{GBP}}{\text{EUR}} = \left(\frac{\text{GBP}}{\text{USD}}\right)\left(\frac{\text{USD}}{\text{EUR}}\right).$$

But we don't have the GBP/USD quote. We can, however, invert the USD/GBP quote and use that in our calculation. Let's assume the bid–offer quote provided is for USD/GBP and is 1.2302/1.2304. With this quote, if we want to *buy* GBP (the currency in the denominator), we will buy GBP at the offer and the relevant quote is 1.2304. We can invert this quote to arrive at the needed GBP/USD quote: 1 ÷ 1.2304 = 0.81274. Note that, in this example, when we buy the GBP, we are also selling the USD. When we invert the provided USD/GBP offer quote, we obtain 0.81274 GBP/USD. This is the price at which we sell the USD—that is, the GBP/USD *bid*. It may help here to remember our rule of thumb from above: When we speak of a bid or offer exchange rate, we are referring to the bid or offer for the currency in the denominator (the base currency).

Similarly, to get a GBP/USD *offer*, we use the inverse of the USD/GBP *bid* of 1.2302: 1 ÷ 1.2302 = 0.81288. (Note that we extended the calculated GBP/USD 0.81274/0.81288 quotes to five decimal places to avoid truncation errors in subsequent calculations.)

We can now finish the calculation of the bid and offer cross rates for GBP/EUR. Using the previously provided 1.1649/1.1651 as the bid–offer in USD/EUR, we calculate the GBP/EUR *bid* rate as follows:

$$\left(\frac{\text{GBP}}{\text{EUR}}\right)_{bid} = \left(\frac{\text{GBP}}{\boxed{\text{USD}}}\right)_{bid}\left(\frac{\boxed{\text{USD}}}{\text{EUR}}\right)_{bid} = 0.81274 \times 1.1649 = 0.9468.$$

Similarly, the implied GBP/EUR *offer* rate is

$$\left(\frac{\text{GBP}}{\text{EUR}}\right)_{offer} = \left(\frac{\text{GBP}}{\boxed{\text{USD}}}\right)_{offer}\left(\frac{\boxed{\text{USD}}}{\text{EUR}}\right)_{offer} = 0.81288 \times 1.1651 = 0.9471.$$

Note that the implied *bid* rate is less than the implied *offer* rate, as it must be to prevent arbitrage.

We conclude this section on arbitrage constraints with some simple observations:

- The arbitrage constraint on implied cross rates is similar to that for spot rates (posted bid rates cannot be higher than the market's offer; posted offer rates cannot be lower than the market's bid). The only difference is that this second arbitrage constraint is applied *across* currency pairs instead of involving a *single* currency pair.
- In reality, any violations of these arbitrage constraints will quickly disappear. Both human traders and automatic trading algorithms are constantly on alert for any pricing inefficiencies and will arbitrage them away almost instantly. If Dealer 1 is buying a currency at a price higher than the price at which Dealer 2 is selling it, the arbitrageur will buy the currency from Dealer 2 and resell it to Dealer 1. As a result of buying and selling pressures, Dealer 2 will raise his offer prices and Dealer 1 will reduce her bid prices to the point where arbitrage profits are no longer available.
- Market participants do not need to calculate cross rates *manually* because electronic dealing machines (which are essentially just specialized computers) will automatically calculate cross bid–offer rates given any two underlying bid–offer rates.

EXAMPLE 1

Bid–Offer Rates

The following are spot rate quotes in the interbank market:

USD/EUR	1.1649/1.1651
JPY/USD	105.39/105.41
CAD/USD	1.3199/1.3201
SEK/USD	9.6300/9.6302

1. What is the bid–offer on the SEK/EUR cross rate implied by the interbank market?

   A. 0.1209/0.1211

   B. 8.2656/8.2668

   C. 11.2180/11.2201

   Solution

   C is correct. Using the provided quotes and setting up the equations so that the cancellation of terms results in the SEK/EUR quote,

   $$\frac{\text{SEK}}{\text{EUR}} = \frac{\text{SEK}}{\text{USD}} \times \frac{\text{USD}}{\text{EUR}}.$$

   Hence, to calculate the SEK/EUR bid (offer) rate, we multiply the SEK/USD and USD/EUR bid (offer) rates to get the following:

Bid:	11.2180 = 9.6300 × 1.1649.
Offer:	11.2201 = 9.6302 × 1.1651.

2. What is the bid–offer on the JPY/CAD cross rate implied by the interbank market?

   A. 78.13/78.17

   B. 79.85/79.85

   C. 79.84/79.86

   Solution

   C is correct. Using the intuitive equation-based approach,

   $$\frac{\text{JPY}}{\text{CAD}} = \frac{\text{JPY}}{\text{USD}} \times \left(\frac{\text{CAD}}{\text{USD}}\right)^{-1} = \frac{\text{JPY}}{\cancel{\text{USD}}} \times \frac{\cancel{\text{USD}}}{\text{CAD}}.$$

   This equation shows that we have to invert the CAD/USD quotes to get the USD/CAD bid–offer rates of 0.75752/0.75763. That is, given the CAD/USD quotes of 1.3199/1.3201, we take the inverse of each and interchange bid and offer, so that the USD/CAD quotes are (1/1.3201)/(1/1.3199), or 0.75752/0.75763. Multiplying the JPY/USD and USD/CAD bid–offer rates then leads to the following:

Bid:	79.84 = 105.39 × 0.75752.
Offer:	79.86 = 105.41 × 0.75763.

3. If a dealer quoted a bid–offer rate of 79.81/79.83 in JPY/CAD, then a triangular arbitrage would involve buying:

   A. CAD in the interbank market and selling it to the dealer, for a profit of JPY 0.01 per CAD.

   B. JPY from the dealer and selling it in the interbank market, for a profit of CAD 0.01 per JPY.

   C. CAD from the dealer and selling it in the interbank market, for a profit of JPY 0.01 per CAD.

   Solution

   C is correct. The implied interbank cross rate for JPY/CAD is 79.84/79.86 (the answer to Question 2). Hence, the dealer is offering to sell the CAD (the base currency in the quote) too cheaply, at an offer rate that is below the interbank bid rate (79.83 versus 79.84, respectively). Triangular arbitrage would involve buying CAD from the dealer (paying the dealer's offer) and selling CAD in the interbank market (hitting the interbank bid), for a profit of JPY 0.01 (79.84 – 79.83) per CAD transacted.

4. If a dealer quoted a bid–offer of 79.82/79.87 in JPY/CAD, then you could:

   A. not make any arbitrage profits.

   B. make arbitrage profits buying JPY from the dealer and selling it in the interbank market.

   C. make arbitrage profits buying CAD from the dealer and selling it in the interbank market.

   Solution

   A is correct. The arbitrage relationship is not violated: The dealer's bid (offer) is not above (below) the interbank market's offer (bid). The implied interbank cross rate for JPY/CAD is 79.84/79.86 (the solution to Question 2).

5. A market participant is considering the following transactions:

Transaction 1	Buy CAD 100 million against the USD at 15:30 London time.
Transaction 2	Sell CAD 100 million against the KRW at 21:30 London time.
Transaction 3	Sell CAD 10 million against the USD at 15:30 London time.

   Given the proposed transactions, what is the *most likely* ranking of the bid–offer spreads, from tightest to widest, under normal market conditions?

   A. Transactions 1, 2, 3

   B. Transactions 2, 1, 3

   C. Transactions 3, 1, 2

   Solution

   C is correct. The CAD/USD currency pair is most liquid when New York and London are both in their most liquid trading periods at the same time (approximately 8:00 a.m. to 11:00 a.m. New York time, or about 13:00 to 16:00 London time). Transaction 3 is for a smaller amount than Transaction 1. Transaction 2 is for a less liquid currency pair (KRW/CAD is traded less than CAD/USD) and occurs outside of normal dealing hours in all three major centers (London, North America, and Asia); the transaction is also for a large amount.

FORWARD MARKETS

4

☐ explain spot and forward rates and calculate the forward premium/discount for a given currency

Outright forward contracts (often referred to simply as forwards) are agreements to exchange one currency for another on a future date at an exchange rate agreed upon today. Any exchange rate transaction that has a settlement date longer than $T + 2$ is a forward contract.

Forward exchange rates must satisfy an arbitrage relationship that equates the investment return on two alternative but equivalent investments. To simplify the explanation of this arbitrage relationship and to focus on the intuition behind forward rate calculations, we will ignore the bid–offer spread on exchange rates and money market instruments. In addition, we will alter our exchange rate notation from price/base currency (P/B) to "foreign/domestic currency" (f/d), making the assumption that the domestic currency for an investor is the base currency in the exchange rate quotation. Using this (f/d) notation will make it easier to illustrate the choice an investor faces between domestic and foreign investments, as well as the arbitrage relationships that equate the returns on these investments when their risk characteristics are equivalent.

Consider an investor with one unit of domestic currency to invest for one year. The investor faces two alternatives:

A. One alternative is to invest cash for one year at the domestic risk-free rate (i_d). At the end of the year, the investment would be worth $(1 + i_d)$.

B. The other alternative is to convert the domestic currency to foreign currency at the spot rate of $S_{f/d}$ and invest for one year at the foreign risk-free rate (i_f). At the end of the period, the investor would have $S_{f/d}(1 + i_f)$ units of foreign currency. These funds then must be converted back to the investor's domestic currency. If the exchange rate to be used for this end-of-year conversion is set at the start of the period using a one-year forward contract, then the investor will have eliminated the foreign exchange risk associated with converting at an unknown future spot rate. If we let $F_{f/d}$ denote the forward rate, the investor would obtain $(1/F_{f/d})$ units of the domestic currency for each unit of foreign currency sold forward. Hence, in domestic currency, at the end of the year, the investment would be worth $S_{f/d}(1 + i_f)(1/F_{f/d})$.

The two investment alternatives above (A and B) are risk free and therefore must offer the same return. If they did not offer the same return, investors could earn a riskless arbitrage profit by borrowing in one currency, lending in the other, and using the spot and forward exchange markets to eliminate currency risk. Equating the returns on these two investment alternatives—that is, putting investments A and B on opposite sides of the equal sign—leads to the following relationship:

$$(1 + i_d) = S_{f/d}(1 + i_f)\left(\frac{1}{F_{f/d}}\right).$$

To see the intuition behind forward rate calculations, note that the right-hand side of the expression (for investment B) also shows the chronological order of this investment: Convert from domestic to foreign currency at the spot rate ($S_{f/d}$); invest this foreign currency amount at the foreign risk-free interest rate $(1 + i_f)$; and then at maturity, convert the foreign currency investment proceeds back into the domestic currency using the forward rate $(1/F_{f/d})$.

For simplicity, we assumed a one-year horizon in the preceding example. However, the argument holds for any investment horizon. The risk-free assets used in this arbitrage relationship are typically bank deposits quoted using the appropriate Market Reference Rate for each currency involved. The day count convention MRR deposits may be Actual/360 or Actual/365. The notation Actual/360 means that interest is calculated as if there were 360 days in a year. The notation Actual/365 means interest is calculated as if there were 365 days in a year. The main exception to the Actual/360 day count convention is the GBP, for which the convention is Actual/365. For the purposes of our discussion, we will use Actual/360 consistently in order to avoid complication. Incorporating this day count convention into our arbitrage formula leads to

$$\left(1 + i_d\left[\frac{\text{Actual}}{360}\right]\right) = S_{f/d}\left(1 + i_f\left[\frac{\text{Actual}}{360}\right]\right)\left(\frac{1}{F_{f/d}}\right).$$

This equation can be rearranged to isolate the forward rate:

$$F_{f/d} = S_{f/d}\left(\frac{1 + i_f\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right). \tag{1}$$

Equation 1 describes **covered interest rate parity**. Our previous work shows that covered interest rate parity is based on an arbitrage relationship among risk-free interest rates and spot and forward exchange rates. Because of this arbitrage relationship between investment alternatives, Equation 1 can also be described as saying that the covered (i.e., currency-hedged) interest rate differential between the two markets is zero.

The covered interest rate parity equation can also be rearranged to give an expression for the forward premium or discount:

$$F_{f/d} - S_{f/d} = S_{f/d}\left(\frac{\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right)(i_f - i_d).$$

The domestic currency will trade at a forward premium ($F_{f/d} > S_{f/d}$) if, and only if, the foreign risk-free interest rate exceeds the domestic risk-free interest rate ($i_f > i_d$). Equivalently, in this case, the foreign currency will trade at a lower rate in the forward contract (relative to the spot rate), and we would say that the foreign currency trades at a forward discount. In other words, if it is possible to earn more interest in the foreign market than in the domestic market, then the forward discount for the foreign currency will offset the higher foreign interest rate. Otherwise, covered interest rate parity would not hold and arbitrage opportunities would exist.

When the foreign currency is at a higher rate in the forward contract, relative to the spot rate, we say that the foreign currency trades at a forward premium. In the case of a forward premium for the foreign currency, the foreign risk-free interest rate will be less than the domestic risk-free interest rate. Additionally, as can be seen in the equation above, the premium or discount is proportional to the spot exchange rate ($S_{f/d}$), proportional to the interest rate differential ($i_f - i_d$) between the markets, and approximately proportional to the time to maturity (Actual/360).

Although we have illustrated the covered interest rate parity equation (Equation 1) in terms of foreign and domestic currencies (using the notation *f*/*d*), this equation can also be expressed in our more standard exchange rate quoting convention of price and base currencies (P/B):

$$F_{P/B} = S_{P/B}\left(\frac{1 + i_P\left[\frac{\text{Actual}}{360}\right]}{1 + i_B\left[\frac{\text{Actual}}{360}\right]}\right).$$

When dealing in professional FX markets, it may be more useful to think of the covered interest rate parity equation and the calculation of forward rates in this P/B notation rather than in foreign/domestic (*f*/*d*) notation. Domestic and foreign are relative concepts that depend on where one is located, and because of the potential for confusion, these terms are not used for currency quotes in professional FX markets.

EXAMPLE 2

Calculating the Forward Premium (Discount)

The following table shows the mid-market rate (i.e., the average of the bid and offer) for the current CAD/AUD spot exchange rate as well as for AUD and CAD 270-day MRR (annualized):

Spot (CAD/AUD)	0.9000
270-day MRR (AUD)	1.47%
270-day MRR (CAD)	0.41%

1. The forward premium (discount) for a 270-day forward contract for CAD/AUD would be *closest* to:

   A. −0.0094.

   B. −0.0071.

   C. +0.0071.

   Solution

   B is correct. The equation to calculate the forward premium (discount) is as follows:

$$F_{P/B} - S_{P/B} = S_{P/B}\left(\frac{\left[\frac{\text{Actual}}{360}\right]}{1 + i_B\left[\frac{\text{Actual}}{360}\right]}\right)(i_P - i_B).$$

   Because AUD is the base currency in the CAD/AUD quote, putting in the information from the table gives us

$$F_{P/B} - S_{P/B} = 0.9000\left(\frac{\left[\frac{270}{360}\right]}{1 + 0.0147\left[\frac{270}{360}\right]}\right)(0.0041 - 0.0147) = -0.0071.$$

In professional FX markets, forward exchange rates are typically quoted in terms of points—the difference between the forward exchange rate quote and the spot exchange rate quote, scaled so that the points can be directly related to the last decimal place in the spot quote. Thus, the forward rate quote is typically shown as the bid–offer on the spot rate and the number of forward points at each maturity, as shown in Exhibit 1 ("Maturity" is defined in terms of the time between spot settlement—usually T + 2—and the settlement of the forward contract).

Exhibit 1: Sample Spot and Forward Quotes (Bid–Offer)

Maturity	Spot Rate
Spot (USD/EUR)	1.1649/1.1651
	Forward Points
1 month	–5.6/–5.1
3 months	–15.9/–15.3
6 months	–37.0/–36.3
12 months	–94.3/–91.8

Note the following:

- As always, the offer in the bid–offer quote is larger than the bid. In this example, the forward points are negative (i.e., the forward rate for the EUR is at a discount to the spot rate) but the bid is a smaller number (–5.6 versus –5.1 at the one-month maturity).
- The absolute number of forward points is a function of the term of the forward contract: A longer contract term results in a larger number of points.
- Because this is an OTC market, a client is not restricted to dealing *only* at the dates/maturities shown. Dealers typically quote standard forward dates, but forward deals can be arranged for any forward date the client requires. The forward points for these non-standard (referred to as "broken") forward dates will typically be interpolated on the basis of the points shown for the standard settlement dates.
- The quoted points are already scaled to each maturity—they are not annualized—so there is no need to adjust them.

To convert any of these quoted forward points into a forward rate, divide the number of points by 10,000 (to scale it down to the same four decimal places in the USD/EUR spot quote) and then add the result to the spot exchange rate quote (because the JPY/USD exchange rate is quoted to only two decimal places, forward points for the dollar–yen currency pair are divided by 100). Be careful, however, about which side of the market (bid or offer) is being quoted. For example, suppose a market participant is *selling* the EUR forward against the USD and is given a USD/EUR quote. The EUR is the base currency; thus, the market participant must use the *bid* rates (i.e., hit the bid). Using the data in Exhibit 1, the three-month forward *bid* rate in this case would be based on the spot bid and the forward points bid and hence would be

$$1.1649 + (-15.9/10{,}000) = 1.16331.$$

The market participant would be selling EUR three months forward at a price of USD 1.16331 per EUR.

5 THE MARK-TO-MARKET VALUE OF A FORWARD CONTRACT

☐ calculate the mark-to-market value of a forward contract

Next, we consider the mark-to-market value of forward contracts. As with other financial instruments, the mark-to-market value of forward contracts reflects the profit (or loss) that would be realized from closing out the position at current market prices. To close out a forward position, we must offset it with an equal and opposite forward position using the spot exchange rate and forward points available in the market when the offsetting position is created. When a forward contract is initiated, the mark-to-market value of the contract is zero, and no cash changes hands. From that moment onward, however, the mark-to-market value of the forward contract will change as the spot exchange rate changes and as interest rates change in either of the two currencies.

Let's look at an example. Suppose that a market participant bought GBP 10 million for delivery against the AUD in six months at an "all-in" forward rate of 1.8100 AUD/GBP. (The all-in forward rate is simply the sum of the spot rate and the scaled forward points.) Three months later, the market participant wants to close out this forward contract. This would require selling GBP 10 million three months forward using the AUD/GBP spot exchange rate and forward points in effect at that time. Before looking at this exchange rate, note that the offsetting forward contract is defined in terms of the original position taken. The original position in this example was "long GBP 10 million," so the offsetting contract is "short GBP 10 million." However, there is ambiguity here: To be long GBP 10 million at 1.8100 AUD/GBP is equivalent to being short AUD 18,100,000 (10,000,000 × 1.8100) at the same forward rate. To avoid this ambiguity, for the purposes of this discussion, we will state what the relevant forward position is for mark-to-market purposes. The net gain or loss from the transaction will be reflected in the alternate currency.

Assume the bid–offer quotes for spot and forward points three months prior to the settlement date are as follows:

Spot rate (AUD/GBP)	1.8210/1.8215
Three-month points	130/140

To sell GBP (the base currency in the AUD/GBP quote), we will be calculating the *bid* side of the market. Hence, the appropriate all-in three-month forward rate to use is

$$1.8210 + 130/10{,}000 = 1.8340.$$

This means that the market participant originally bought GBP 10 million at an AUD/GBP rate of 1.8100 and subsequently sold that amount at a rate of 1.8340. These GBP amounts will net to zero at the settlement date (GBP 10 million both bought and sold), but the AUD amounts will not, because the forward rate has changed. The AUD cash flow at the settlement date will be

$$(1.8340 - 1.8100) \times 10{,}000{,}000 = +\text{AUD } 240{,}000.$$

This is a cash *inflow* because the market participant was long the GBP with the original forward position and the GBP subsequently appreciated (the AUD/GBP rate increased).

This cash flow will be paid at the settlement day, which is still three months away. To calculate the mark-to-market value of the dealer's position, we must discount this cash flow to the present. The present value of this amount is found by discounting the settlement day cash flow by the three-month discount rate. Because this amount is in AUD, we use the three-month AUD discount rate. Suppose that three-month AUD MRR is 2.40% (annualized). The present value of this future AUD cash flow is then

$$\frac{\text{AUD } 240{,}000}{1 + 0.024\left(\frac{90}{360}\right)} = \text{AUD } 238{,}569.$$

This result is the mark-to-market value of the original long GBP 10 million six-month forward when it is closed out three months prior to settlement.

To summarize, the process for marking to market a forward position is relatively straightforward:

1. Create an offsetting forward position that is equal to the original forward position. (In the example above, the market participant was long GBP 10 million forward, so the offsetting forward contract would be to sell GBP 10 million.)
2. Determine the appropriate all-in forward rate for this new, offsetting forward position. If the base currency of the exchange rate quote is being sold (bought), then use the bid (offer) side of the market.
3. Calculate the cash flow at the settlement day. This amount will be based on the original contract size times the difference between the original forward rate and that calculated in Step 2. If the currency the market participant was originally long (short) subsequently appreciated (depreciated), then there will be a cash *inflow* (*outflow*). (In the above example, the market participant was long the GBP, which subsequently appreciated, leading to a cash inflow at the settlement day.)
4. Calculate the present value of this cash flow at the future settlement date. The currency of the cash flow and the discount rate must match. (In the example above, the cash flow at the settlement date was in AUD, so an AUD MRR was used to calculate the present value.)

The factors that affect the bid–offer spread for forward points are the same as those we discussed for spot bid–offer rates: the interbank market liquidity of the underlying currency pair, the size of the transaction, and the relationship between the client and the dealer. For forward bid–offer spreads, we can also add a fourth factor: the term of the forward contract. Generally, the longer the term of the forward contract, the wider the bid–offer spread. This relationship holds because as the term of the contract increases,

- liquidity in the forward market tends to decline,
- the exposure to counterparty credit risk increases, and
- the interest rate risk of the contract increases (forward rates are based on interest rate differentials, and a longer duration means greater price sensitivity to movements in interest rates).

EXAMPLE 3

Forward Rates and the Mark-to-Market Value of Forward Positions

A dealer is contemplating trade opportunities in the CHF/GBP currency pair. The following are the current spot rates and forward points being quoted for the CHF/GBP currency pair:

Spot rate (CHF/GBP)	1.2939/1.2941
One month	–8.3/–7.9
Two months	–17.4/–16.8
Three months	–25.4/–24.6
Four months	–35.4/–34.2
Five months	–45.9/–44.1
Six months	–56.5/–54.0

1. The current all-in bid rate for delivery of GBP against the CHF in three months is *closest* to:

   A. 1.29136.

   B. 1.29150.

   C. 1.29164.

   Solution

   A is correct. The current all-in three-month bid rate for GBP (the base currency) is equal to 1.2939 + (−25.4/10,000) = 1.29136.

2. The all-in rate that the dealer will be quoted today by another dealer to sell the CHF six months forward against the GBP is *closest* to:

   A. 1.28825.

   B. 1.28835.

   C. 1.28870.

   Solution

   C is correct. The dealer will sell CHF against the GBP, which is equivalent to buying GBP (the base currency) against the CHF. Hence, the *offer* side of the market will be used for forward points. The all-in forward price will be 1.2941 + (−54.0/10,000) = 1.28870.

3. Some time ago, Laurier Bay Capital, an investment fund based in Los Angeles, hedged a long exposure to the New Zealand dollar by selling NZD 10 million forward against the USD; the all-in forward price was 0.7900 (USD/NZD). Three months prior to the settlement date, Laurier Bay wants to mark this forward position to market. The bid–offer for the USD/NZD spot rate, the three-month forward points, and the three-month MRRs (annualized) are as follows:

Spot rate (USD/NZD)	0.7825/0.7830
Three-month points	−12.1/−10.0
Three-month MRR (NZD)	3.31%
Three-month MRR (USD)	0.31%

   The mark-to-market value for Laurier Bay's forward position is *closest* to:

   A. −USD 87,100.

   B. +USD 77,437.

   C. +USD 79,938.

   Solution

   C is correct. Laurier Bay sold NZD 10 million forward to the settlement date at an all-in forward rate of 0.7900 (USD/NZD). To mark this position to market, the fund would need an offsetting forward transaction involving buying NZD 10 million three months forward to the settlement date. The NZD amounts on the settlement date net to zero. For the offsetting forward contract, because the NZD is the base currency in the USD/NZD quote, buying NZD forward means paying the offer for both the spot rate and the forward points. This scenario leads to an all-in three-month forward rate of 0.7830 − 0.0010 = 0.7820. On the settlement day, Laurier Bay will receive USD 7,900,000 (NZD 10,000,000 × 0.7900 USD/NZD) from the original forward contract and pay out USD 7,820,000 (NZD 10,000,000 × 0.7820 USD/

NZD) based on the offsetting forward contract. The result is a net cash flow on the settlement day of 10,000,000 × (0.7900 – 0.7820) = +USD 80,000. This is a cash inflow because Laurier Bay sold the NZD forward and the NZD depreciated against the USD. This USD cash inflow will occur in three months. To calculate the mark-to-market value of the original forward position, we need to calculate the present value of this USD cash inflow using the three-month USD discount rate (we use USD MRR for this purpose):

$$\frac{\text{USD } 80,000}{1 + 0.0031\left(\frac{90}{360}\right)} = +\text{USD } 79,938.$$

4. Now, suppose that instead of having a long exposure to the NZD, Laurier Bay Capital had a long forward exposure to the USD, which it hedged by selling USD 10 million forward against the NZD at an all-in forward rate of 0.7900 (USD/NZD). Three months prior to settlement date, it wants to close out this short USD forward position.

   Using the above table, the mark-to-market value for Laurier Bay's short USD forward position is *closest* to:

   A. –NZD 141,117.

   B. –NZD 139,959.

   C. –NZD 87,100.

   Solution

   B is correct. Laurier Bay initially sold USD 10 million forward, and it will have to buy USD 10 million forward to the same settlement date (i.e., in three months' time) in order to close out the initial position. Buying USD using the USD/NZD currency pair is the same as selling the NZD. Because the NZD is the base currency in the USD/NZD quote, selling the NZD means calculating the *bid* rate:

   $$0.7825 + (-12.1/10,000) = 0.78129.$$

   At settlement, the USD amounts will net to zero (USD 10 million both bought and sold). The NZD amounts will not net to zero, however, because the all-in forward rate changed between the time Laurier Bay initiated the original position and the time it closed out this position. At initiation, Laurier Bay contracted to sell USD 10 million and receive NZD 12,658,228 (i.e., 10,000,000/0.7900) on the settlement date. To close out the original forward contract, Laurier Bay entered into an offsetting forward contract to receive USD 10 million and pay out NZD 12,799,345 (i.e., 10,000,000/0.78129) at settlement. The difference between the NZD amounts that Laurier Bay will receive and pay out on the settlement date equals

   $$\text{NZD } 12,658,228 - \text{NZD } 12,799,345 = -\text{NZD } 141,117.$$

   This is a cash *outflow* for Laurier Bay because the fund was *short* the USD in the original forward position and the USD subsequently *appreciated* (i.e., the NZD subsequently depreciated, because the all-in forward rate in USD/NZD dropped from 0.7900 to 0.78129). This NZD cash outflow occurs in three months' time, and we must calculate its present value using the three-month NZD MRR:

   $$\frac{-\text{NZD } 141,117}{1 + 0.0331\left(\frac{90}{360}\right)} = -\text{NZD } 139,959.$$

INTERNATIONAL PARITY CONDITIONS

6

☐ explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect)

Having reviewed the basic tools of the FX market, we now turn our focus to how they are used in practice. At the heart of the trading decision in FX markets lies a view on equilibrium market prices. An understanding of equilibrium pricing will assist the investor in framing decisions regarding risk exposures and how they should be managed.

In this and the following sections, we lay out a framework for developing a view on equilibrium exchange rates. We begin by examining international parity conditions, which describe the inter-relationships that jointly determine *long-run* movements in exchange rates, interest rates, and inflation. These parity conditions are the basic building blocks for describing long-term equilibrium levels for exchange rates. In subsequent sections, we expand beyond the parity conditions by discussing other factors that influence a currency's value.

Always keep in mind that exchange rate movements reflect complex interactions among multiple forces. In trying to untangle this complex web of interactions, we must clearly delineate the following concepts:

1. Long run versus short run: Many of the factors that determine exchange rate movements exert subtle but persistent influences over long periods of time. Although a poor guide for short-term prediction, longer-term equilibrium values act as an anchor for exchange rate movements.
2. Expected versus unexpected changes: In reasonably efficient markets, prices will adjust to reflect market participants' expectations of future developments. When a key factor—say, inflation—is trending gradually in a particular direction, market pricing will eventually come to reflect expectations that this trend will continue. In contrast, large, unexpected movements in a variable (for example, a central bank intervening in the foreign exchange market) can lead to immediate, discrete price adjustments. This concept is closely related to risk. For example, a moderate but steady rate of inflation will not have the same effect on market participants as an inflation rate that is very unpredictable. The latter clearly describes a riskier financial environment. Market pricing will reflect risk premiums—that is, the compensation that traders and investors demand for being exposed to unpredictable outcomes. Whereas expectations of long-run equilibrium values tend to evolve slowly, risk premiums—which are closely related to confidence and reputation—can change quickly in response to unexpected developments.
3. Relative movements: An exchange rate represents the relative price of one currency in terms of another. Hence, for exchange rate determination, the level or variability of key factors in any particular country is typically much less important than the *differences* in these factors across countries. For example, knowing that inflation is increasing in Country A may not give much insight into the direction of the A/B exchange rate without also knowing what is happening with the inflation rate in Country B.

As a final word of caution—and this cannot be emphasized enough—*there is no simple formula, model, or approach that will allow market participants to precisely forecast exchange rates.* Models that work well in one period may fail in others. Models that work for one set of exchange rates may fail to work for others.

Nonetheless, market participants must have a market view to guide their decisions, even if this view requires significant revision as new information becomes available. The following sections provide a framework for understanding FX markets, a guide for thinking through the complex forces driving exchange rates. As with all theory, however, it does not eliminate the need for insightful analysis of actual economic and market conditions.

International Parity Conditions

International parity conditions form the building blocks of most models of exchange rate determination. The key international parity conditions are as follows:

1. covered interest rate parity,
2. uncovered interest rate parity,
3. forward rate parity,
4. purchasing power parity, and
5. the international Fisher effect.

Parity conditions show how expected inflation differentials, interest rate differentials, forward exchange rates, current spot exchange rates, and expected future spot exchange rates would be linked in an ideal world. These conditions typically make simplifying assumptions, such as zero transaction costs, perfect information that is available to all market participants, risk neutrality, and freely adjustable market prices.

Although empirical studies have found that the parity conditions rarely hold in the short term, they do help form a broadly based, long-term view of exchange rates and accompanying risk exposures. The exception to the rule that parity conditions do not hold in the short term is covered interest rate parity, which is the only parity condition that is enforced by arbitrage. We examine this parity condition first.

7 COVERED AND UNCOVERED INTEREST RATE PARITY AND FORWARD RATE PARITY

- ☐ explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect)
- ☐ describe relations among the international parity conditions
- ☐ evaluate the use of the current spot rate, the forward rate, purchasing power parity, and uncovered interest parity to forecast future spot exchange rates

We have already discussed covered interest rate parity in our examination of forward exchange rates. Under this parity condition, *an investment in a foreign money market instrument that is completely hedged against exchange rate risk should yield exactly the same return as an otherwise identical domestic money market investment.* Given the spot exchange rate and the domestic and foreign yields, the forward exchange rate must equal the rate that gives these two alternative investment strategies—invest either in a domestic money market instrument or in a fully currency-hedged foreign money market instrument—exactly the same holding period return. If one strategy gave a higher holding period return than the other, then an investor could short-sell

the lower-yielding approach and invest the proceeds in the higher-yielding approach, earning riskless arbitrage profits in the process. In real-world financial markets, such a disparity will be quickly arbitraged away so that no further arbitrage profits are available. Covered interest rate parity is thus said to be a no-arbitrage condition.

For covered interest rate parity to hold exactly, it must be assumed that there are zero transaction costs and that the underlying domestic and foreign money market instruments being compared are identical in terms of liquidity, maturity, and default risk. Where capital is permitted to flow freely, spot and forward exchange markets are liquid, and financial market conditions are relatively stress free, covered interest rate differentials are generally found to be close to zero and covered interest rate parity holds.

Uncovered Interest Rate Parity

According to the **uncovered interest rate parity** condition, the *expected* return on an uncovered (i.e., unhedged) foreign currency investment should equal the return on a comparable domestic currency investment. Uncovered interest rate parity states that *the change in spot rate over the investment horizon should, on average, equal the differential in interest rates between the two countries. That is, the expected appreciation/depreciation of the exchange rate will just offset the yield differential.*

To explain the intuition behind this concept, let's switch, as we did with the examples for covered interest rate parity, from the standard price/base currency notation (P/B) to foreign/domestic currency notation (f/d) in order to emphasize the choice between foreign and domestic investments. As before, we also will assume that for the investor, the base currency is the domestic currency. (In *covered* interest rate parity, we assumed the investor transacted at a forward rate that was locked in at strategy initiation. In *uncovered* interest rate parity, the investor is assumed to transact at a future spot rate that is unknown at the time the strategy is initiated and the investor's currency position in the future is not hedged—that is, uncovered.)

For our example, assume that this investor has a choice between a one-year domestic money market instrument and an unhedged one-year foreign-currency-denominated money market investment. Under the assumption of uncovered interest rate parity, the investor will compare the *known* return on the domestic investment with the *expected* all-in return on the unhedged foreign-currency-denominated investment (which includes the foreign yield as well as any movements in the exchange rate, in $S_{f/d}$ terms). The choice between these two investments will depend on which market offers the higher expected return on an unhedged basis.

For example, assume that the return on the one-year foreign money market instrument is 10% while the return on the one-year domestic money market instrument is 4%. From the investor's perspective, the 4% expected return on the one-year domestic investment in domestic currency terms is known with complete certainty. This is not the case for the uncovered investment in the foreign currency money market instrument. In domestic currency terms, the investment return on an uncovered (or unhedged) foreign-currency-denominated investment is equal to $\left(1 + i_f\right)\left(1 - \%\Delta S_{f/d}\right) - 1$.

Intuitively, the formula says that the investor's return on a foreign investment is a function of both the foreign interest rate and the change in the spot rate, whereby a depreciation in the foreign currency reduces the investor's return. The percentage change in $S_{f/d}$ enters with a minus sign because an *increase* in $S_{f/d}$ means the foreign currency *declines* in value, thereby reducing the all-in return from the domestic currency perspective of our investor. This all-in return depends on *future* movements in the $S_{f/d}$ rate, which cannot be known until the end of the period. This return can be approximated by $\cong i_f - \%\Delta S_{f/d}$.

Note that this approximate formula holds because the product ($i \times \%\Delta S$) is small compared with the interest rate (i) and the percentage change in the exchange rate ($\%\Delta S$). For simplicity of exposition, we will use the ≅ symbol when we introduce an approximation but will subsequently treat the relationship as an equality (=) unless the distinction is important for the issue being discussed.

Using the previous example, consider three cases:

1. The $S_{f/d}$ rate is expected to remain unchanged.
2. The domestic currency is expected to appreciate by 10%.
3. The domestic currency is expected to appreciate by 6%.

In the first case, the investor would prefer the foreign-currency-denominated money market investment because it offers a 10% (= 10% – 0%) expected return, while the comparable domestic investment offers only 4%. In the second case, the investor would prefer the domestic investment because the expected return on the foreign-currency-denominated investment is 0% (= 10% – 10%). In the third case, uncovered interest rate parity holds because both investments offer a 4% (for the foreign investment, 10% – 6%) expected return. In this case, the risk-neutral investor is assumed to be indifferent between the alternatives.

Note that in the third case, in which uncovered interest rate parity holds, while the *expected* return over the one-year investment horizon is the same for both instruments, that expected return is *just a point on the distribution* of possible total return outcomes. The all-in return on the foreign money market instrument is uncertain because the *future* $S_{f/d}$ rate is uncertain. Hence, when we say that the investor would be indifferent between owning domestic and foreign investments because they both offer the same *expected* return (4%), we are assuming that the investor is *risk neutral* (risk-neutral investors base their decisions solely on the expected return and are indifferent to the investments' risk). Thus, uncovered interest rate parity assumes that there are enough risk-neutral investors to force equality of expected returns.

Using our example's foreign/domestic (f/d) notation, uncovered interest rate parity says the expected change in the spot exchange rate over the investment horizon should be reflected in the interest rate differential:

$$\%\Delta S^{e}_{f/d} = i_f - i_d, \tag{2}$$

where ΔS^e indicates the change in the spot rate expected for *future* periods. Note that Equation 2 cannot hold simultaneously for $S_{f/d}$ and $S_{d/f}$ (= $1/S_{f/d}$) because their percentage changes are not of exactly equal magnitude. This reflects our earlier approximation. Using the exact return on the unhedged foreign instrument would alleviate this issue but would produce a less intuitive equation.

In our example, if the yield spread between the foreign and domestic investments is 6% ($i_f - i_d = 6\%$), then this spread implicitly reflects the expectation that the domestic currency will strengthen versus the foreign currency by 6%.

Uncovered interest rate parity assumes that the country with the *higher* interest rate or money market yield will see its currency *depreciate*. The depreciation of the currency offsets the initial higher yield so that the (expected) all-in return on the two investment choices is the same. Hence, if the uncovered interest rate parity condition held consistently in the real world, it would rule out the possibility of earning excess returns from going long a high-yield currency and going short a low-yield currency: The depreciation of the high-yield currency would exactly offset the yield advantage that the high-yield currency offers. Taking this scenario to its logical conclusion, if uncovered interest rate parity held at all times, investors would have no incentive to shift capital from one currency to another because expected returns on otherwise identical money market investments would be equal across markets and risk-neutral investors would be indifferent among them.

Most studies have found that over short- and medium-term periods, the rate of depreciation of the high-yield currency is less than what would be implied by uncovered interest rate parity. In many cases, high-yield currencies have been found to *strengthen*, not weaken. There is, however, evidence that uncovered interest rate parity works better over very long-term horizons.

Such findings have significant implications for foreign exchange investment strategies. If high-yield currencies do not depreciate in line with the path predicted by the uncovered interest rate parity condition, then high-yield currencies should exhibit a tendency to outperform low-yield currencies over time. If so, investors could adopt strategies that overweight high-yield currencies at the expense of low-yield currencies and generate attractive returns in the process. Such approaches are known as FX carry trade strategies. We will discuss them in greater detail later.

Forward Rate Parity

Forward rate parity states that the forward exchange rate will be an unbiased predictor of the future spot exchange rate. It does not state that the forward rate will be a perfect forecast, just an unbiased one; the forward rate may overestimate or underestimate the future spot rate from time to time, but on average, it will equal the future spot rate. Forward rate parity builds upon two other parity conditions, covered interest rate parity and uncovered interest rate parity.

The covered interest rate parity condition describes the relationship among the spot exchange rate, the forward exchange rate, and interest rates. Let's keep using the foreign/domestic exchange rate notation (f/d) to simplify the explanation. The arbitrage condition that underlies covered interest rate parity (illustrated earlier) can be rearranged to give an expression for the forward premium or discount:

$$F_{f/d} - S_{f/d} = S_{f/d}\left(\frac{\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right)(i_f - i_d).$$

The domestic currency will trade at a forward premium ($F_{f/d} > S_{f/d}$) if, and only if, the foreign risk-free interest rate exceeds the domestic risk-free interest rate ($i_f > i_d$).

For the sake of simplicity, we assume that the investment horizon is one year, so that

$$F_{f/d} - S_{f/d} = S_{f/d}\left(\frac{i_f - i_d}{1 + i_d}\right).$$

Because the $1 + i_d$ denominator will be close to 1, we can approximate the above equation as follows:

$$F_{f/d} - S_{f/d} \cong S_{f/d}(i_f - i_d).$$

This covered interest rate parity equation can be rearranged to show the forward discount or premium as a percentage of the spot rate:

$$\frac{F_{f/d} - S_{f/d}}{S_{f/d}} \cong i_f - i_d.$$

We have also shown that if uncovered interest rate parity holds, then the expected change in the spot rate is equal to the interest rate differential:

$$\%\Delta S^e_{f/d} = i_f - i_d.$$

We can link the covered interest rate parity and uncovered interest rate parity equations as follows:

$$\frac{F_{f/d} - S_{f/d}}{S_{f/d}} = \%\Delta S^e_{f/d} = i_f - i_d.$$

Thus, the forward premium (discount) on a currency, expressed in percentage terms, equals the expected percentage appreciation (depreciation) of the domestic currency (assuming that the uncovered interest rate parity condition holds).

In theory, then, *the forward exchange rate will be an unbiased forecast of the future spot exchange rate if both covered and uncovered interest rate parity hold:*

$$F_{f/d} = S^{e}_{f/d}.$$

This condition is often referred to as **forward rate parity**.

We know covered interest rate parity must hold because it is enforced by arbitrage. *The question of whether forward rate parity holds is thus dependent upon whether uncovered interest rate parity holds.*

How might uncovered interest rate parity be enforced? It is not enforced by arbitrage because there is no combination of trades that will lock in a (riskless) profit. It could, however, hold if speculators willing to take risk enter the market. If the forward rate is above (below) speculators' expectations of the future spot rate, then risk-neutral speculators will buy the domestic currency in the spot (forward) market and simultaneously sell it in the forward (spot) market. These transactions would push the forward premium into alignment with the consensus expectation of the future spot rate. If the speculators' expectations are correct, they will make a profit.

Note, however, that spot exchange rates are volatile and determined by a complex web of influences: Interest rate differentials are only one among many factors. So, speculators can also lose. Because speculators are rarely, if ever, truly risk neutral and without an arbitrage relationship to enforce it, uncovered interest rate parity is often violated. *As a result, we can conclude that forward exchange rates are typically poor predictors of future spot exchange rates in the short run.* Over the longer term, uncovered interest rate parity and forward rate parity have more empirical support.

EXAMPLE 4

Covered and Uncovered Interest Rate Parity: Predictors of Future Spot Rates

An Australia-based fixed-income asset manager is deciding how to allocate money between Australia and Japan. Note that the base currency in the exchange rate quote (AUD) is the domestic currency for the asset manager.

JPY/AUD spot rate (mid-market)	71.78
One-year forward points (mid-market)	–139.4
One-year Australian deposit rate	3.00%
One-year Japanese deposit rate	1.00%

1. Based on uncovered interest rate parity, over the next year, the expected change in the JPY/AUD rate is *closest* to a(n):

   A. decrease of 6%.

   B. decrease of 2%.

   C. increase of 2%.

   Solution

   B is correct. The expected depreciation of the Australian dollar (decline in the JPY/AUD rate) is equal to the interest rate differential between Australia and Japan (3% – 1%).

2. The *best* explanation of why this prediction may not be very accurate is that:

   A. covered interest rate parity does hold in this case.

   B. the forward points indicate that a riskless arbitrage opportunity exists.

   C. there is no arbitrage condition that forces uncovered interest rate parity to hold.

   Solution

   C is correct. There is no arbitrage condition that forces uncovered interest rate parity to hold. In contrast, arbitrage virtually always ensures that covered interest rate parity holds. This is the case for our table, where the –139 point discount is calculated from the covered interest rate parity equation.

3. Using the forward points to forecast the future JPY/AUD spot rate one year ahead assumes that:

   A. investors are risk neutral.

   B. spot rates follow a random walk.

   C. it is not necessary for uncovered interest rate parity to hold.

   Solution

   A is correct. Using forward rates (i.e., adding the forward points to the spot rate) to forecast future spot rates assumes that uncovered interest rate parity and forward rate parity hold. Uncovered interest rate parity assumes that investors are risk neutral. If these conditions hold, then movements in the spot exchange rate, although they *approximate* a random walk, will not actually be a random walk because current interest spreads will determine expected exchange rate movements.

4. Forecasting that the JPY/AUD spot rate one year from now will equal 71.78 assumes that:

   A. investors are risk neutral.

   B. spot rates follow a random walk.

   C. it is necessary for uncovered interest rate parity to hold.

   Solution

   B is correct. Assuming that the current spot exchange rate is the best predictor of future spot rates assumes that exchange rate movements follow a random walk. If uncovered interest rate parity holds, the current exchange rate will not be the best predictor unless the interest rate differential happens to be zero. Risk neutrality is needed to enforce uncovered interest rate parity, but it will not make the current spot exchange rate the best predictor of future spot rates.

5. If the asset manager completely hedged the currency risk associated with a one-year Japanese deposit using a forward rate contract, the one-year all-in holding return, in AUD, would be *closest* to:

   A. 0%.

   B. 1%.

   C. 3%.

   Solution

   C is correct. A fully hedged JPY investment would provide the same return as the AUD investment: 3%. This represents covered interest rate parity, an arbitrage condition.

6. The fixed-income manager collects the following information and uses it, along with the international parity conditions, to estimate investment returns and future exchange rate movements.

	Today's One-Year MRR	Currency Pair	Spot Rate Today
JPY	0.10%	JPY/USD	105.40
USD	0.10%	USD/GBP	1.2303
GBP	3.00%	JPY/GBP	129.67

If covered interest rate parity holds, the all-in one-year investment return to a Japanese investor whose currency exposure to the GBP is fully hedged is *closest* to:

A. 0.10%.

B. 0.17%.

C. 3.00%.

Solution

A is correct. If covered interest rate parity holds (and it very likely does, because this is a pure arbitrage relationship), then the all-in investment return to a Japanese investor in a one-year, fully hedged GBP MRR position would be identical to a one-year JPY MRR position: 0.10%. No calculations are necessary.

7. If uncovered interest rate parity holds, today's expected value for the JPY/GBP currency pair one year from now would be *closest* to:

A. 126.02.

B. 129.67.

C. 130.05.

Solution

A is correct. If uncovered interest rate parity holds, then forward rate parity will hold and the expected spot rate one year forward is equal to the one-year forward exchange rate. This forward rate is calculated in the usual manner, given the spot exchange rates and MRRs:

$S^e = F = 129.67(1.001/1.03) = 126.02$.

8. If uncovered interest rate parity holds, between today and one year from now, the expected movement in the JPY/USD currency pair is *closest* to:

A. −1.60%.

B. +0.00%.

C. +1.63%.

Solution

B is correct. Given uncovered interest rate parity, the expected change in a spot exchange rate is equal to the interest rate differential. At the one-year term, there is no difference between USD MRR and JPY MRR.

PURCHASING POWER PARITY

8

- ☐ explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect)
- ☐ describe relations among the international parity conditions
- ☐ evaluate the use of the current spot rate, the forward rate, purchasing power parity, and uncovered interest parity to forecast future spot exchange rates

So far, we have looked at the relationship between exchange rates and interest rate differentials. Now, we turn to examining the relationship between exchange rates and inflation differentials. The basis for this relationship is known as **purchasing power parity (PPP)**.

Various versions of PPP exist. The foundation for all of the versions is the law of one price. According to the **law of one price**, identical goods should trade at the same price across countries when valued in terms of a common currency. To simplify the explanation, as we did with our examples for covered and uncovered interest rate parity, let's continue to use the foreign/domestic currency quote convention (*f*/*d*) and the case where the base currency in the P/B notation is the domestic currency for the investor in the *f*/*d* notation.

The law of one price asserts that the foreign price of good *x*, P_f^x, should equal the exchange rate–adjusted price of the identical good in the domestic country, P_d^x:

$$P_f^x = S_{f/d} \times P_d^x.$$

For example, for a euro-based consumer, if the price of good *x* in the euro area is EUR 100 and the nominal exchange rate stands at 1.15 USD/EUR, then the price of good *x* in the United States should equal USD 115.

The **absolute version of PPP** simply extends the law of one price to the broad range of goods and services that are consumed in different countries. Expanding our example above to include all goods and services, not just good *x*, the broad price level of the foreign country (P_f) should equal the currency-adjusted broad price level in the domestic country (P_d):

$$P_f = (S_{f/d})(P_d).$$

This equation implicitly assumes that all domestic and foreign goods are tradable and that the domestic and foreign price indexes include the same bundle of goods and services with the same exact weights in each country. Rearranging this equation and solving for the nominal exchange rate ($S_{f/d}$), the absolute version of PPP states that the nominal exchange rate will be determined by the ratio of the foreign and domestic broad price indexes:

$$S_{f/d} = P_f/P_d.$$

The absolute version of PPP asserts that the equilibrium exchange rate between two countries is determined entirely by the ratio of their national price levels. However, it is highly unlikely that this relationship actually holds in the real world. The absolute version of PPP assumes that goods arbitrage will equate the prices of all goods and service across countries, but if transaction costs are significant and/or not all goods and services are tradable, then goods arbitrage will be incomplete. Hence, sizable and persistent departures from absolute PPP are likely.

However, if it is assumed that transaction costs and other trade impediments are constant over time, it might be possible to show that *changes* in exchange rates and *changes* in national price levels are related, even if the relationship between exchange rate *levels* and national price *levels* does not hold. According to the **relative version of PPP**, the percentage change in the spot exchange rate ($\%\Delta S_{f/d}$) will be completely determined by the difference between the foreign and domestic inflation rates ($\pi_f - \pi_d$):

$$\%\Delta S_{f/d} \cong \pi_f - \pi_d. \quad (3)$$

Intuitively, the relative version of PPP implies that the exchange rate changes to offset changes in competitiveness arising from inflation differentials. For example, if the foreign inflation rate is assumed to be 9% while the domestic inflation rate is assumed to be 5%, then the $S_{f/d}$ exchange rate must rise by 4% ($\%\Delta S_{f/d}$ = 9% – 5% = 4%) in order to maintain the relative competitiveness of the two regions: The currency of the high-inflation country should depreciate relative to the currency of the low-inflation country. If the $S_{f/d}$ exchange rate remained unchanged, the higher foreign inflation rate would erode the competitiveness of foreign companies relative to domestic companies.

Conversion from Absolute Levels to a Rate of Change

We will occasionally need to convert from a relationship expressed in levels of the relevant variables to a relationship among rates of change. If $X = (Y \times Z)$, then

$$(1 + \%\Delta X) = (1 + \%\Delta Y)(1 + \%\Delta Z)$$

and

$$\%\Delta X \approx \%\Delta Y + \%\Delta Z$$

because $(\%\Delta Y \times \%\Delta Z)$ is "small." Similarly, it can be shown that if $X = (Y/Z)$, then

$$(1 + \%\Delta X) = (1 + \%\Delta Y)/(1 + \%\Delta Z)$$

and

$$\%\Delta X \approx \%\Delta Y - \%\Delta Z.$$

Applying this conversion to the equation for absolute PPP gives Equation 3.

Whereas the relative version of PPP focuses on *actual* changes in exchange rates being driven by *actual* differences in national inflation rates, the ***ex ante* version of PPP** asserts that the *expected* changes in the spot exchange rate are entirely driven by *expected* differences in national inflation rates. *Ex ante* PPP tells us that countries that are expected to run *persistently* high inflation rates should expect to see their currencies depreciate over time, while countries that are expected to run relatively low inflation rates on a sustainable basis should expect to see their currencies appreciate over time. *Ex ante* PPP can be expressed as

$$\%\Delta S^e_{f/d} = \pi^e_f - \pi^e_d, \quad (4)$$

where it is understood that the use of expectations (the superscript *e*) indicates that we are now focused on *future* periods. That is, $\%\Delta S^e_{f/d}$ represents the expected percentage change in the spot exchange rate, while π^e_d and π^e_f represent the expected domestic and foreign inflation rates over the same period.

Studies have found that while *over shorter horizons nominal exchange rate movements may appear random, over longer time horizons nominal exchange rates tend to gravitate toward their long-run PPP equilibrium values.*

Exhibit 2 illustrates the success, or lack thereof, of the relative version of PPP at different time horizons: 1 year, 5 years, 10 years, and 15 years for a selection of countries over the period 1990-2020. Each chart plots the inflation differential (vertical axis) against the percentage change in the exchange rate (horizontal axis). If PPP holds, the points should fall along an upward-sloping diagonal line. The first panel of Exhibit 2 indicates no clear relationship between changes in exchange rates and inflation differentials at the one-year time horizon. As the time horizon is lengthened to five years and beyond, however, a strong positive relationship becomes apparent. Hence, *PPP appears to be a valid framework for assessing long-run fair value in the FX markets, even though the path to PPP equilibrium may be slow.*

Exhibit 2: Effect of Relative Inflation Rates on Exchange Rates at Different Time Horizons

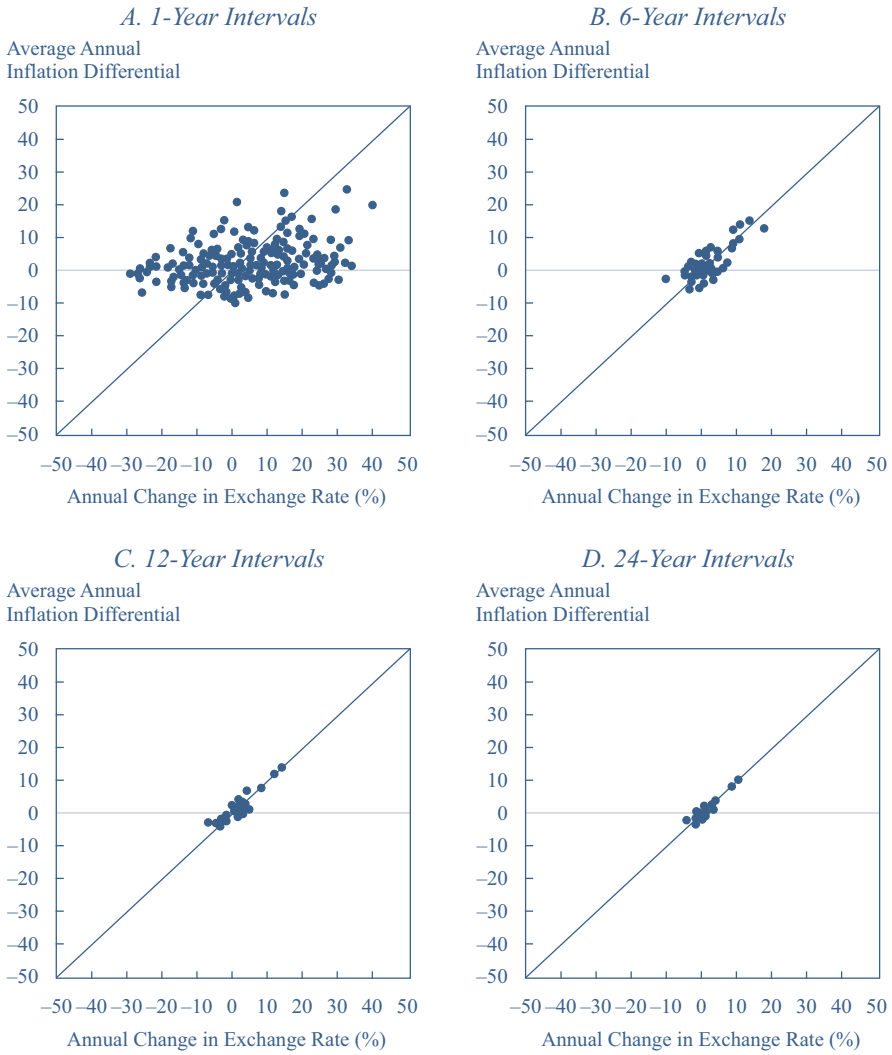
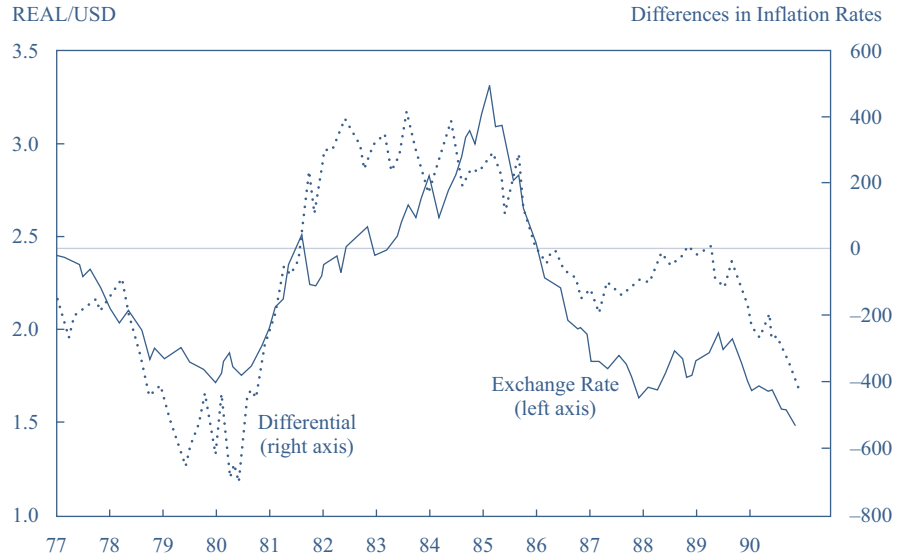


Exhibit 3 illustrates the success of the relative version of PPP even in the short run when differences in inflation rates between countries are large. Note that the Brazilian Real-USD exchange rate changes rapidly in the period 1980-1993, mirroring the very large differences in relative inflation between hyperinflationary Brazil and low inflation rate United States. It also indicates that the majority countries did not have large

inflation differentials with the United States, and so 1-year changes in exchange rates cluster near the origin. This mirrors the upper left panel in Exhibit 2 above, which excludes Brazil from the sample of countries.

Exhibit 3: Effect of Large Differences in Inflation Rates on Exchange Rates over 1-Year Time Horizons



9 THE FISHER EFFECT, REAL INTEREST RATE PARITY, AND INTERNATIONAL PARITY CONDITIONS

- ☐ explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect)
- ☐ describe relations among the international parity conditions
- ☐ evaluate the use of the current spot rate, the forward rate, purchasing power parity, and uncovered interest parity to forecast future spot exchange rates
- ☐ explain approaches to assessing the long-run fair value of an exchange rate

So far, we have examined the relationships between exchange rates and interest rate differentials and between exchange rates and inflation differentials. Now, we will begin to bring these concepts together by examining how exchange rates, interest rates, and inflation rates interact.

According to what economists call the Fisher effect, one can break down the nominal interest rate (i) in a given country into two parts: (1) the real interest rate (r) in that particular country and (2) the expected inflation rate (π^e) in that country:

$$i = r + \pi^e.$$

To relate this concept to exchange rates, we can write the Fisher equation for both the domestic country and a foreign country. If the Fisher effect holds, the nominal interest rates in both countries will equal the sum of their respective real interest rates and expected inflation rates:

$$i_d = r_d + \pi_d^e.$$
$$i_f = r_f + \pi_f^e.$$

Let's take a closer look at the macroeconomic forces that drive the trend in nominal yield spreads. Subtracting the top equation from the bottom equation shows that the nominal yield spread between the foreign and domestic countries ($i_f - i_d$) equals the sum of two parts: (1) the foreign–domestic real yield spread ($r_f - r_d$) and (2) the foreign–domestic expected inflation differential ($\pi_f^e - \pi_d^e$):

$$i_f - i_d = (r_f - r_d) + \left(\pi_f^e - \pi_d^e\right).$$

We can rearrange this equation to solve for the *real* interest rate differential instead of the *nominal* interest rate differential:

$$(r_f - r_d) = \left(i_f - i_d\right) - \left(\pi_f^e - \pi_d^e\right).$$

To tie this material to our previous work on exchange rates, recall our expression for uncovered interest rate parity:

$$\%\Delta S_{f/d}^e = i_f - i_d.$$

The nominal interest rate spread ($i_f - i_d$) equals the expected change in the exchange rate ($\%\Delta S_{f/d}^e$).

Recall also the expression for *ex ante* PPP:

$$\%\Delta S_{f/d}^e = \pi_f^e - \pi_d^e.$$

The difference in expected inflation rates equals the expected change in the exchange rate. Combining these two expressions, we derive the following:

$$i_f - i_d = \pi_f^e - \pi_d^e.$$

The nominal interest rate spread is equal to the difference in expected inflation rates. We can therefore conclude that if uncovered interest rate parity and *ex ante* PPP hold,

$$(r_f - r_d) = 0.$$

The real yield spread between the domestic and foreign countries ($r_f - r_d$) will be zero, and the level of real interest rates in the domestic country will be identical to the level of real interest rates in the foreign country.

The proposition that real interest rates will converge to the same level across different markets is known as the **real interest rate parity** condition.

Finally, if real interest rates are equal across markets, then it also follows that the foreign–domestic nominal yield spread is determined solely by the foreign–domestic expected inflation differential:

$$i_f - i_d = \pi_f^e - \pi_d^e.$$

This is known as the **international Fisher effect**. The reader should be aware that some authors refer to uncovered interest rate parity as the "international Fisher effect." We reserve this term for the relationship between nominal interest rate differentials and expected inflation differentials because the original (domestic) Fisher effect is a relationship between interest rates and expected inflation.

The international Fisher effect and, by extension, real interest rate parity assume that currency risk is the same throughout the world. However, not all currencies carry the same risk. For example, an emerging country may have a high level of indebtedness, which could result in an elevated level of currency risk (i.e., likelihood of currency depreciation). In this case, because the emerging market currency has higher risk, subtracting the expected inflation rate from the nominal interest rate will result in a calculated real interest rate that is higher than in other countries. Economists typically separate the nominal interest rate into the real interest rate, an inflation premium, and a risk premium. The emerging country's investors will require a risk premium for holding the currency, which will be reflected in nominal and real interest rates that are higher than would be expected under the international Fisher effect and real interest rate parity conditions.

EXAMPLE 5

PPP and the International Fisher Effect

An Australia-based fixed-income investment manager is deciding how to allocate her portfolio between Australia and Japan. (As before, the AUD is the domestic currency.) Australia's one-year deposit rate is 3%, considerably higher than Japan's 1% rate, but the Australian dollar is estimated to be roughly 10% overvalued relative to the Japanese yen based on purchasing power parity. Before making her asset allocation, the investment manager considers the implications of interest rate differentials and PPP imbalances.

1. All else equal, which of the following events would restore the Australian dollar to its PPP value?

   A. The Japanese inflation rate increases by 2%.

   B. The Australian inflation rate decreases by 10%.

   C. The JPY/AUD exchange rate declines by 10%.

   Solution

   C is correct. If the Australian dollar is overvalued by 10% on a PPP basis, with all else held equal, a depreciation of the JPY/AUD rate by 10% would move the Australian dollar back to equilibrium.

2. If real interest rates in Japan and Australia were equal, then under the international Fisher effect, the inflation rate differential between Japan and Australia would be *closest* to:

   A. 0%.

   B. 2%.

   C. 10%.

   Solution

   B is correct. If the real interest rates were equal, then the difference in nominal yields would be explained by the difference in inflation rates (3% – 1%).

3. According to the theory and empirical evidence of purchasing power parity, which of the following would *not* be true if PPP holds in the long run?

   A. An exchange rate's equilibrium path should be determined by the long-term trend in domestic price levels relative to foreign price levels.

B. Deviations from PPP might occur over short- and medium-term periods, but fundamental forces should eventually work to push exchange rates toward their long-term PPP path.

C. High-inflation countries should tend to see their currencies appreciate over time.

Solution

C is correct. According to PPP, high-inflation countries should see their currencies depreciate (at least, over the longer term) in order to re-equilibrate real purchasing power between countries.

4. Which of the following would *best* explain the failure of the absolute version of PPP to hold?

A. Inflation rates vary across countries.

B. Real interest rates are converging across countries.

C. Trade barriers exist, and different product mixes are consumed across countries.

Solution

C is correct. The absolute version of PPP assumes that all goods and services are tradable and that the domestic and foreign price indexes include the same bundle of goods and services with the same exact weights in each country.

International Parity Conditions: Tying All the Pieces Together

As noted above, the various parity relationships usually do not hold over short time horizons. However, studies show that over longer time periods, there is a discernible interaction among nominal interest rates, exchange rates, and inflation rates across countries, such that the international parity conditions serve as an anchor for longer-term exchange rate movements. We now summarize the key international parity conditions and describe how they are all linked.

1. According to covered interest rate parity, arbitrage ensures that nominal interest rate spreads equal the percentage forward premium (or discount).
2. According to uncovered interest rate parity, the expected percentage change of the spot exchange rate should, on average, be reflected in the nominal interest rate spread.
3. If both covered and uncovered interest rate parity hold—that is, the nominal yield spread equals both the forward premium (or discount) and the expected percentage change in the spot exchange rate—then the forward exchange rate will be an unbiased predictor of the future spot exchange rate.
4. According to the *ex ante* PPP approach to exchange rate determination, the expected change in the spot exchange rate should equal the expected difference between domestic and foreign inflation rates.
5. Assuming the Fisher effect holds in all markets—that is, the nominal interest rate in each market equals the real interest rate plus the expected inflation rate—and also assuming that real interest rates are broadly the same across all markets (real interest rate parity), then the nominal yield spread between domestic and foreign markets will equal the domestic–foreign expected inflation differential, which is the international Fisher effect.

6. If *ex ante* PPP and the international Fisher effect hold, then expected inflation differentials should equal both the expected change in the exchange rate and the nominal interest rate differential. This relationship implies that the expected change in the exchange rate equals the nominal interest rate differential, which is uncovered interest rate parity.

In sum, if all the key international parity conditions held at all times, then the expected percentage change in the *spot* exchange rate would equal

- the forward premium or discount (expressed in percentage terms),
- the nominal yield spread between countries, and
- the difference between expected national inflation rates.

In other words, *if all these parity conditions held, it would be impossible for a global investor to earn consistent profits on currency movements*. If forward exchange rates accurately predicted the future path of spot exchange rates, there would be no way to make money in forward exchange speculation. If high-yield currencies fell in value versus low-yield currencies exactly in line with the path implied by nominal interest rate spreads, all markets would offer the same currency-adjusted total returns over time. Investors would have no incentive to shift funds from one market to another based solely on currency considerations.

EXAMPLE 6

The Relationships among the International Parity Conditions

1. Which of the following is a no-arbitrage condition?

   A. Real interest rate parity
   B. Covered interest rate parity
   C. Uncovered interest rate parity

   Solution

   B is correct. Covered interest rate parity is enforced by equating the investment return on two riskless investments (domestic and currency-hedged foreign).

2. Forward rates are unbiased predictors of future spot rates if two parity conditions hold. Which of the following is *not* one of these conditions?

   A. Real interest rate parity
   B. Covered interest rate parity
   C. Uncovered interest rate parity

   Solution

   A is correct. Both covered and uncovered interest rate parity must hold for the forward rate to be an unbiased predictor of the future spot rate. Real interest rate parity is not required.

3. The international Fisher effect requires all but which of the following to hold?

   A. *Ex ante* PPP
   B. Absolute PPP

C. Real interest rate parity

Solution

B is correct. The international Fisher effect is based on real interest rate parity and *ex ante* PPP (not absolute PPP).

4. The forward premium/discount is determined by nominal interest rate differentials because of:

   A. the Fisher effect.

   B. covered interest parity.

   C. real interest rate parity.

   Solution

   B is correct. The forward premium/discount is determined by covered interest rate arbitrage.

5. If all of the key international parity conditions held at all times, then the expected percentage change in the spot exchange rate would equal all *except* which of the following?

   A. The real yield spread

   B. The nominal yield spread

   C. The expected inflation spread

   Solution

   A is correct. If all the international parity conditions held, the real yield spread would equal zero, regardless of expected changes in the spot exchange rate.

THE CARRY TRADE

10

☐ describe the carry trade and its relation to uncovered interest rate parity and calculate the profit from a carry trade

According to uncovered interest rate parity, high-yield currencies are expected to depreciate in value, while low-yield currencies are expected to appreciate in value. If uncovered interest rate parity held at all times, investors would not be able to profit from a strategy that undertook long positions in high-yield currencies and short positions in low-yield currencies. The change in spot rates over the tenor of the forward contracts would cancel out the interest rate differentials locked in at the inception of the position.

Uncovered interest rate parity is one of the most widely tested propositions in international finance. The evidence suggests that uncovered interest rate parity does *not* hold over short and medium time periods. Studies have generally found that *high-yield currencies, on average, have not depreciated and low-yield currencies have not appreciated to the levels predicted by interest rate differentials.*

These findings underscore the potential profitability of a trading strategy known as the **FX carry trade**, which involves taking long positions in high-yield currencies and short positions in low-yield currencies. The latter are often referred to as "funding currencies." As a simplified example of the carry trade, assume a trader can borrow

Canadian dollars at 1% and earn 9% on an investment in Brazilian reals for one year. To execute the trade to earn 8% from the interest rate differential, the trader will do the following:

1. Borrow Canadian dollars at $t = 0$.
2. Sell the dollars and buy Brazilian reals at the spot rate at $t = 0$.
3. Invest in a real-denominated investment at $t = 0$.
4. Liquidate the Brazilian investment at $t = 1$.
5. Sell the reals and buy dollars at the spot rate at $t = 1$.
6. Pay back the dollar loan.

If the real appreciates, the trader's profits will be greater than 8% because the stronger real will buy more dollars in one year. If the real depreciates, the trader's profits will be less than 8% because the weaker real will buy fewer dollars in the future. If the real falls in value by more than 8%, the trader will experience losses. The carry trader's return consists of the intermarket yield spread, the currency appreciation/depreciation, and the foreign investment appreciation/depreciation. Typically, a carry trade is executed using an investment in highly rated government debt so as to mitigate credit risk. In this simplified example, we use an additive approach to determine the trader's returns (i.e., we ignore the currency gain or loss on the 8% interest rate differential).

Historical evidence shows that carry trade strategies have generated positive returns over extended periods (see for example Dimson, Marsh, McGinnie, Staunton, and Wilmot 2012). One argument for the persistence of the carry trade is that the yields in higher interest rate countries reflect a risk premium due to a more unstable economy, while low-yield currencies represent less risky markets. Although small increases in financial market and/or FX volatility are unlikely to materially affect carry strategy profits, elevated levels of volatility and/or perceived risk in the financial markets can quickly turn these profits into substantial losses. That is, during turbulent periods, the returns on long high-yield currency positions will tend to decline dramatically, while the losses on short low-yield currency positions will tend to rise dramatically.

To understand why, we need to understand the nature of the risk and reward in the carry trade. The reward is the gradual accrual of the interest rate differential—income that is unrelated to exchange rate volatility. The risk arises from the potential for sudden adverse exchange rate movements that result in instantaneous capital losses. During periods of low turbulence, investors may feel relatively confident that exchange rate movements will not jeopardize the gradual accrual of the interest rate differential. Because low-volatility regimes have tended to be the norm and often last for extended periods, investors can become complacent, taking on larger carry trade positions in a search for yield but increasing their risk exposures. When volatility in the currency markets spikes, however, the risk of an adverse exchange rate movement rises sharply relative to the gradual flow of income. As the trade moves toward unprofitability, investors may rush to unwind the carry trade, selling high-yielding currencies and re-purchasing low-yielding currencies. These carry trades are often large-scale trades initiated by trading firms and other opportunistic investors, such as hedge funds. Traders often have stop-loss orders in place that are triggered when price declines reach a certain level. When they all attempt to unwind the trades at once, the selling pressure adds to the losses on the long position currency and the buying pressure on the short position currency drives that currency higher, exacerbating the loss. The "flight to quality" during turbulent times and the leverage inherent in the carry trade further compound the losses. The upshot is that *during periods of low volatility, carry trades tend to generate positive returns, but they are prone to significant crash risk in turbulent times*.

The tendency for carry trades to experience periodic crashes results in a non-normal distribution of returns for both developed and emerging market (EM) carry trades. Relative to a normal distribution, the distributions tend to be more peaked, with fatter tails and negative skewness. The more peaked distribution around the mean implies that carry trades have typically generated a larger number of trades with small gains/losses than would occur with the normal distribution. Although carry trades have generated positive returns on average in the past, the negative skew and fat tails indicate that carry trades have tended to have more frequent and larger losses than would have been experienced had the return distribution been normal.

EXAMPLE 7

Carry Trade Strategies

A currency fund manager is considering allocating a portion of her FX portfolio to carry trade strategies. The fund's investment committee asks the manager a number of questions about why she has chosen to become involved in FX carry trades and how she will manage the risk of potentially large downside moves associated with the unwinding of carry trades. Which of the following would be her *best* responses to the investment committee's questions?

1. Carry trades can be profitable when:

   A. covered interest rate parity does not hold.

   B. uncovered interest rate parity does not hold.

   C. the international Fisher effect does not hold.

   Solution

   B is correct. The carry trade is based on the supposition that uncovered interest rate parity does not hold.

2. Over time, the return distribution of the fund's FX carry trades is *most* likely to resemble a:

   A. normal distribution with fat tails.

   B. distribution with fat tails and a negative skew.

   C. distribution with thin tails and a positive skew.

   Solution

   B is correct. The "crash risk" of carry trades implies a fat-tailed distribution skewed toward a higher probability of large losses (compared with a normal distribution).

3. The volatility of the fund's returns relative to its equity base is *best* explained by:

   A. leverage.

   B. low deposit rates in the funding currency.

   C. the yield spread between the high- and low-yielding currencies.

   Solution

   A is correct. Carry trades are leveraged trades (borrow in the funding currency, invest in the high-yield currency), and leverage increases the volatility in the investor's return on equity.

4. A Tokyo-based asset manager enters into a carry trade position based on borrowing in yen and investing in one-year Australian MRR.

Today's One-Year MRR		Currency Pair	Spot Rate Today	Spot Rate One Year Later
JPY	0.10%	JPY/USD	105.40	104.60
AUD	1.70%	USD/AUD	0.6810	0.6850

After one year, the all-in return to this trade, measured in JPY terms, would be *closest* to:

A. +0.03%.

B. +1.53%.

C. +1.63%.

Solution

B is correct. To calculate the all-in return for a Japanese investor in a one-year AUD MRR deposit, we must first calculate the current and one-year-later JPY/AUD cross rates. Because USD 1.0000 buys JPY 105.40 today and AUD 1.0000 buys USD 0.6810 today, today's JPY/AUD cross rate is the product of these two numbers: 105.40 × 0.6810 = 71.78 (rounded to two decimal places). Similarly, one year later, the observed cross rate is 104.60 × 0.6850 = 71.65 (rounded to two decimal places).
Accordingly, measured in yen, the investment return for the unhedged Australian MRR deposit is

$$(1/71.78)(1 + 1.70\%)71.65 - 1 = 0.0152.$$

Against this 1.52% *gross* return, however, the manager must charge the borrowing costs to fund the carry trade investment (one-year JPY MRR was 0.10%). Hence, the *net* return on the carry trade is 1.52% – 0.10% = 1.42%. We can also calculate the profit using a transactional approach. Assuming an initial position of, for example, 100 yen (JPY 100), the investor will obtain JPY 100 × 1/JPY 71.78 = AUD 1.3931. After one year, the investment will be worth AUD 1.3931 × 1.017 = AUD 1.4168. Converting back to yen in one year results in AUD 1.4168 × JPY 71.65/AUD = JPY 101.51. Paying off the yen loan results in a profit of JPY 101.51 – (JPY 100 × 1.001) = JPY 1.41. This is equivalent to the 1.42% profit calculated previously (slight difference arising due to rounding).

11 THE IMPACT OF BALANCE OF PAYMENTS FLOWS

☐ explain how flows in the balance of payment accounts affect currency exchange rates

As noted earlier, the parity conditions may be appropriate for assessing fair value for currencies over long horizons, but they are of little use as a real-time gauge of value. There have been many attempts to find a better framework for determining a currency's short- or long-run equilibrium value. In this section, we examine the influence of trade and capital flows.

A country's balance of payments consists of its current account as well as its capital and financial account. The official balance of payments accounts make a distinction between the "capital account" and the "financial account" based on the nature of the assets involved. For simplicity, we will use the term "capital account" here to reflect all investment/financing flows. Loosely speaking, the current account reflects flows in the real economy, which refers to that part of the economy engaged in the actual production of goods and services (as opposed to the financial sector). The capital account reflects financial flows. Decisions about trade flows (the current account) and investment/financing flows (the capital account) are typically made by different entities with different perspectives and motivations. Their decisions are brought into alignment by changes in market prices and/or quantities. One of the key prices—perhaps *the* key price—in this process is the exchange rate.

Countries that import more than they export will have a negative current account balance and are said to have current account deficits. Those with more exports than imports will have a current account surplus. A country's current account balance must be matched by an equal and opposite balance in the capital account. Thus, countries with current account deficits must attract funds from abroad in order to pay for the imports (i.e., they must have a capital account surplus).

When discussing the effect of the balance of payments components on a country's exchange rate, one must distinguish between short- and intermediate-term influences on the one hand and longer-term influences on the other. Over the long term, countries that run persistent current account deficits (net borrowers) often see their currencies depreciate because they finance their acquisition of imports through the continued use of debt. Similarly, countries that run persistent current account surpluses (net lenders) often see their currencies appreciate over time.

However, investment/financing decisions are usually the dominant factor in determining exchange rate movements, at least in the short to intermediate term. There are four main reasons for this:

- Prices of real goods and services tend to adjust much more slowly than exchange rates and other asset prices.
- Production of real goods and services takes time, and demand decisions are subject to substantial inertia. In contrast, liquid financial markets allow virtually instantaneous redirection of financial flows.
- Current spending/production decisions reflect only purchases/sales of current production, while investment/financing decisions reflect not only the financing of current expenditures but also the reallocation of existing portfolios.
- *Expected* exchange rate movements can induce very large short-term capital flows. This tends to make the *actual* exchange rate very sensitive to the currency views held by owners/managers of liquid assets.

In this section, we first examine the impact of current account imbalances on exchange rates. Then, we take a closer look at capital flows.

Current Account Imbalances and the Determination of Exchange Rates

Current account trends influence the path of exchange rates over time through several mechanisms:

- The flow supply/demand channel
- The portfolio balance channel
- The debt sustainability channel

We briefly discuss each of these mechanisms next.

The Flow Supply/Demand Channel

The flow supply/demand channel is based on a fairly simple model that focuses on the fact that purchases and sales of internationally traded goods and services require the exchange of domestic and foreign currencies in order to arrange payment for those goods and services. For example, if a country sold more goods and services than it purchased (i.e., the country was running a current account surplus), then the demand for its currency should rise, and vice versa. Such shifts in currency demand should exert upward pressure on the value of the surplus nation's currency and downward pressure on the value of the deficit nation's currency.

Hence, countries with persistent current account surpluses should see their currencies appreciate over time, and countries with persistent current account deficits should see their currencies depreciate over time. A logical question, then, would be whether such trends can go on indefinitely. At some point, domestic currency strength should contribute to deterioration in the trade competitiveness of the surplus nation, while domestic currency weakness should contribute to an improvement in the trade competitiveness of the deficit nation. Thus, the exchange rate responses to these surpluses and deficits should eventually help eliminate—in the medium to long run—the source of the initial imbalances.

The amount by which exchange rates must adjust to restore current accounts to balanced positions depends on a number of factors:

- The initial gap between imports and exports
- The response of import and export prices to changes in the exchange rate
- The response of import and export demand to changes in import and export prices

If a country imports significantly more than it exports, export growth would need to far outstrip import growth in percentage terms in order to narrow the current account deficit. A large initial deficit may require a substantial depreciation of the currency to bring about a meaningful correction of the trade imbalance.

A depreciation of a deficit country's currency should result in an increase in import prices in domestic currency terms and a decrease in export prices in foreign currency terms. However, empirical studies often find limited pass-through effects of exchange rate changes on traded goods prices. For example, many studies have found that for every 1% decline in a currency's value, import prices rise by only 0.5%—and in some cases by even less—because foreign producers tend to lower their profit margins in an effort to preserve market share. In light of the limited pass-through of exchange rate changes into traded goods prices, the exchange rate adjustment required to narrow a trade imbalance may be far larger than would otherwise be the case.

Many studies have found that the response of import and export demand to changes in traded goods prices is often quite sluggish, and as a result, relatively long lags, lasting several years, can occur between (1) the onset of exchange rate changes, (2) the ultimate adjustment in traded goods prices, and (3) the eventual impact of those price changes on import demand, export demand, and the underlying current account imbalance.

The Portfolio Balance Channel

The second mechanism through which current account trends influence exchange rates is the so-called portfolio balance channel. Current account imbalances shift financial wealth from deficit nations to surplus nations. Countries with trade deficits will finance their trade with increased borrowing. This behavior may lead to shifts in global asset preferences, which in turn could influence the path of exchange rates. For example,

nations running large current account surpluses versus the United States might find that their holdings of US dollar–denominated assets exceed the amount they desire to hold in a portfolio context. Actions they might take to reduce their dollar holdings to desired levels could then have a profound negative impact on the dollar's value.

The Debt Sustainability Channel

The third mechanism through which current account imbalances can affect exchange rates is the so-called debt sustainability channel. According to this mechanism, there should be some upper limit on the ability of countries to run persistently large current account deficits. If a country runs a large and persistent current account deficit over time, eventually it will experience an untenable rise in debt owed to foreign investors. If such investors believe that the deficit country's external debt is rising to unsustainable levels, they are likely to reason that a major depreciation of the deficit country's currency will be required at some point to ensure that the current account deficit narrows significantly and that the external debt stabilizes at a level deemed sustainable.

The existence of persistent current account imbalances will tend to alter the market's notion of what exchange rate level represents the true, long-run equilibrium value. For deficit nations, ever-rising net external debt levels as a percentage of GDP should give rise to steady (but not necessarily smooth) downward revisions in market expectations of the currency's long-run equilibrium value. For surplus countries, ever-rising net external asset levels as a percentage of GDP should give rise to steady upward revisions of the currency's long-run equilibrium value. Hence, one would expect currency values to move broadly in line with trends in debt and/or asset accumulation.

PERSISTENT CURRENT ACCOUNT DEFICITS: THE US CURRENT ACCOUNT AND THE US DOLLAR

The historical record indicates that the trend in the US current account has been an important determinant of the long-term swings in the US dollar's value but also that there can be rather long lags between the onset of a deterioration in the current account balance and an eventual decline in the dollar's value. For example, the US current account balance deteriorated sharply in the first half of the 1980s, yet the dollar soared over that period. The reason for the dollar's strength over that period was that high US real interest rates attracted large inflows of capital from abroad, which pushed the dollar higher despite the large US external imbalance. Eventually, however, concerns regarding the sustainability of the ever-widening US current account deficit triggered a major dollar decline in the second half of the 1980s.

History repeated itself in the second half of the 1990s, with the US current account balance once again deteriorating while the dollar soared over the same period. This time, the dollar's strength was driven by strong foreign direct investment, as well as both debt- and equity-related flows into the United States. Beginning in 2001, however, the ever-widening US current account deficit, coupled with a decline in US interest rates, made it more difficult for the United States to attract the foreign private capital needed to finance its current account deficit. The dollar eventually succumbed to the weight of ever-larger trade and current account deficits and began a multi-year slide, starting in 2002–2003. Interestingly, the US dollar has undergone three major downward cycles since the advent of floating exchange rates: 1977–1978, 1985–1987, and 2002–2008. In each of those downward cycles, the dollar's slide was driven in large part by concerns over outsized US current account deficits coupled with relatively low nominal and/or real short-term US interest rates, which made it difficult to attract sufficient foreign capital to the United States to finance those deficits.

EXCHANGE RATE ADJUSTMENT IN SURPLUS NATIONS: JAPAN AND CHINA

Japan and, for a number of years, China represent examples of countries with large current account surpluses and illustrate the pressure that those surpluses can bring to bear on currencies. In the case of Japan, its rising current account surplus has exerted persistent upward pressure on the yen's value versus the dollar over time. Part of this upward pressure simply reflected the increase in demand for yen to pay for Japan's merchandise exports. But some of the upward pressure on the yen might also have stemmed from rising commercial tensions between the United States and Japan.

Protectionist sentiment in the United States rose steadily with the rising bilateral trade deficit that the United States ran with Japan in the postwar period. US policymakers contended that the yen was undervalued and needed to appreciate. With the increasing trade imbalance between the two countries contributing to more heated protectionist rhetoric, Japan felt compelled to tolerate steady upward pressure on the yen. As a result, the yen's value versus the dollar has tended to move in sync with the trend in Japan's current account surplus.

12 CAPITAL FLOWS

☐ explain how flows in the balance of payment accounts affect currency exchange rates

Greater financial integration of the world's capital markets and greater freedom of capital to flow across national borders have increased the importance of global financial flows in determining exchange rates, interest rates, and broad asset price trends. One can cite many examples in which global financial flows either caused or contributed to extremes in exchange rates, interest rates, or asset prices.

In numerous cases, global capital flows have helped fuel boom-like conditions in emerging market economies for a while before, suddenly and often without adequate warning, those flows reversed. The reversals often caused a major economic downturn, sovereign default, a serious banking crisis, and/or significant currency depreciation. Excessive emerging market capital inflows often plant the seeds of a crisis by contributing to:

1. an unwarranted appreciation of the emerging market currency,
2. a huge buildup in external indebtedness,
3. an asset bubble,
4. a consumption binge that contributes to explosive growth in domestic credit and/or the current account deficit, or
5. an overinvestment in risky projects and questionable activities.

Governments in emerging markets often resist currency appreciation from excessive capital inflows by using capital controls or selling their currency in the FX market. An example of capital controls is the Brazilian government 2016 tax on foreign exchange transactions to control capital flows and raise government revenue. In general, government control of the exchange rate will not be completely effective because even if

a government prohibits investment capital flows, some capital flows will be needed for international trade. In addition, the existence or emergence of black markets for the country's currency will inhibit the ability of the government to fully control the exchange rates for its own currency.

Sometimes, capital flows due to interest rate spreads have little impact on the trend in exchange rates. Consider the case of the Turkish lira. The lira attracted a lot of interest on the part of global fund managers over the 2002–10 period, in large part because of its attractive yields. Turkish–US short-term yield spreads averaged over 1,000 bps during much of this period. As capital flowed into Turkey, the Turkish authorities intervened in the foreign exchange market in an attempt to keep the lira from appreciating. The result was that international investors were not able to reap the anticipated currency gains over this period. While the return from the movement in the spot exchange rate was fairly small, a long Turkish lira/short US dollar carry trade position generated significant long-run returns, mostly from the accumulated yield spread.

One-sided capital flows can persist for long periods. Consider the case of a high-yield, inflation-prone emerging market country that wants to promote price stability and long-term sustainable growth. To achieve price stability, policymakers in the high-yield economy will initiate a tightening in monetary policy by gradually raising the level of domestic interest rates relative to yield levels in the rest of the world. If the tightening in domestic monetary policy is sustained, inflation expectations for the high-yield economy relative to other economies should gradually decline. The combination of sustained wide nominal yield spreads and a steady narrowing in relative inflation expectations should exert upward pressure on the high-yield currency's value, resulting in carry trade profits over long periods.

Policymakers in high-yield markets can also pursue policies which attract foreign investment; such policies might include tighter fiscal policies, liberalization of financial markets, fewer capital flow restrictions, privatization, and/or a better business environment. Such policies should encourage investors to gradually require a lower risk premium to hold the high-yield currency's assets and revise upward their assessment of the long-run equilibrium value of that country's currency.

The historical evidence suggests that the impact of nominal interest rate spreads on the exchange rate tends to be gradual. Monetary policymakers tend to adjust their official lending rates slowly over time—in part because of the uncertainty that policymakers face and in part because the authorities do not want to disrupt the financial markets. This very gradual change in rates implies a very gradual narrowing of the spread between high-yield and low-yield countries. Similarly, the downward trends in inflation expectations and risk premiums in the higher-yield market also tend to unfold gradually. It often takes several years to determine whether structural economic changes will take root and boost the long-run competitiveness of the higher-yield country. Because these fundamental drivers tend to reinforce each other over time, there may be persistence in capital flows and carry trade returns.

Equity Market Trends and Exchange Rates

Increasing equity prices can also attract foreign capital. Although exchange rates and equity market returns sometimes exhibit positive correlation, the relationship between equity market performance and exchange rates is not stable. The long-run correlation between the US equity market and the dollar, for example, is very close to zero, but over short to medium periods, correlations tend to swing from being highly positive to being highly negative, depending on market conditions. For instance, between 1990 and 1995, the US dollar fell while the US equity market was strong and the Japanese yen soared while Japanese stocks were weak. In contrast, between 1995 and early 2000, the US dollar soared in tandem with a rising US equity market while the yen

weakened in tandem with a decline in the Japanese equity market. *Such instability in the correlation between exchange rates and equity markets makes it difficult to form judgments on possible future currency moves based solely on expected equity market performance.*

Since the global financial crisis, there has been a decidedly negative correlation between the US dollar and the US equity market. Market observers attribute this behavior of the US dollar to its role as a safe haven asset. When investors' appetite for risk is high—that is, when the market is in "risk-on" mode—investor demand for risky assets, such as equities, tends to rise, which drives up their prices. At the same time, investor demand for safe haven assets, such as the dollar, tends to decline, which drives their values lower. The opposite has occurred when the market has been in "risk-off" mode.

EXAMPLE 8

Capital Flows and Exchange Rates

Monique Kwan, a currency strategist at a major foreign exchange dealer, is responsible for formulating trading strategies for the currencies of both developed market (DM) and emerging market (EM) countries. She examines two countries—one DM and one EM—and notes that the DM country has what is considered a low-yield safe haven currency while the EM country has a high-yield currency whose value is more exposed to fluctuations in the global economic growth rate. Kwan is trying to form an opinion about movements in the exchange rate for the EM currency.

1. All else equal, the exchange rate for the EM currency will *most likely* depreciate if the:

   A. long-run equilibrium value of the high-yield currency is revised upward.

   B. nominal yield spread between the EM and DM countries increases over time.

   C. expected inflation differential between the EM and DM countries is revised upward.

   Solution

   C is correct. All else equal, an increase in the expected inflation differential should lead to depreciation of the EM currency.

2. An increase in safe haven demand would *most likely*:

   A. increase the risk premium demanded by international investors to hold assets denominated in the EM currency.

   B. raise the return earned on carry trade strategies.

   C. exert upward pressure on the value of the EM currency.

   Solution

   A is correct. During times of intense risk aversion, investors will crowd into the safe haven currency. This tendency implies an increased risk premium demanded by investors to hold the EM currency.

3. Kwan notes that the DM country is running a persistent current account deficit with the EM country. To isolate the influence of this chronic imbalance on exchange rates, she focuses only on the bilateral relationship between the EM and DM countries and makes the simplifying assumption

that the external accounts of these two countries are otherwise balanced (i.e., there are no other current account deficits).

Over time and all else equal, the persistent current account deficit with the EM country would *most likely* lead to:

A. a large buildup of the EM country's assets held by the DM country.

B. an increase in the trade competitiveness of the EM country.

C. an upward revision in the long-run equilibrium EM currency value.

Solution

C is correct. Over time, the DM country will see its level of external debt rise as a result of the chronic current account imbalance. Eventually, this trend should lead to a downward revision of the DM currency's long-run equilibrium level (via the debt sustainability channel). This is equivalent to an *increase* in the EM currency's long-run exchange rate. A is incorrect because the DM country's current account deficit is likely to lead to a build-up in DM country assets held by the EM country. B is incorrect because, at some point, the currency strength should contribute to deterioration in the trade competitiveness of the country with the trade surplus (the EM country).

4. Kwan notes that because of the high yield on the EM country's bonds, international investors have recently been reallocating their portfolios more heavily toward this country's assets. As a result of these capital inflows, the EM country has been experiencing boom-like conditions.

Given the current boom-like conditions in the EM economy, in the *near term*, these capital inflows are *most likely* to lead to:

A. a decrease in inflation expectations in the EM.

B. an increase in the risk premium for the EM.

C. an increase in the EM currency value.

Solution

C is correct. Given the current investor enthusiasm for the EM country's assets and the boom-like conditions in the country, it is most likely that in the near term, the EM currency will appreciate. At the same time, expected inflation in the EM country is also likely increasing and—given the enthusiasm for EM assets—the risk premium is likely decreasing.

5. If these capital inflows led to an unwanted appreciation in the real value of its currency, the EM country's government would *most likely*:

A. impose capital controls.

B. decrease taxes on consumption and investment.

C. buy its currency in the foreign exchange market.

Solution

A is correct. To reduce unwanted appreciation of its currency, the EM country would be most likely to impose capital controls to counteract the surging capital inflows. Because these inflows are often associated with overinvestment and consumption, the EM government would not be likely to encourage these activities through lower taxes. Nor would the EM country be likely to encourage further currency appreciation by intervening in the market to *buy* its own currency.

6. If government actions were ineffective and the EM country's bubble eventually burst, this would *most likely* be reflected in an increase in:

   A. the risk premium for the EM.

   B. the EM currency value.

   C. the long-run equilibrium EM currency value.

   Solution

   A is correct. Episodes of surging capital flows into EM countries have often ended badly (with a rapid reversal of these inflows as the bubble bursts). This is most likely to be reflected in an increase in the EM risk premium. It is much less likely that a bursting bubble would be reflected in an increase in either the EM currency value or its long-term equilibrium value.

7. Finally, Kwan turns to examining the link between the value of the DM country's currency and movements in the DM country's main stock market index. One of her research associates tells her that, in general, the correlation between equity market returns and changes in exchange rates has been found to be highly positive over time.

   The statement made by the research associate is:

   A. correct.

   B. incorrect, because the correlation is highly negative over time.

   C. incorrect, because the correlation is not stable and tends to converge toward zero in the long run.

   Solution

   C is correct. Correlations between equity returns and exchange rates are unstable in the short term and tend toward zero in the long run.

13 MONETARY AND FISCAL POLICIES

☐ explain the potential effects of monetary and fiscal policy on exchange rates

As the foregoing discussion indicates, government policies can have a significant impact on exchange rate movements. We now examine the channels through which government monetary and fiscal policies are transmitted.

The Mundell–Fleming Model

The Mundell–Fleming model describes how changes in monetary and fiscal policy within a country affect interest rates and economic activity, which in turn leads to changes in capital flows and trade and ultimately to changes in the exchange rate. The model focuses only on aggregate demand and assumes there is sufficient slack in the economy to allow increases in output without price level increases.

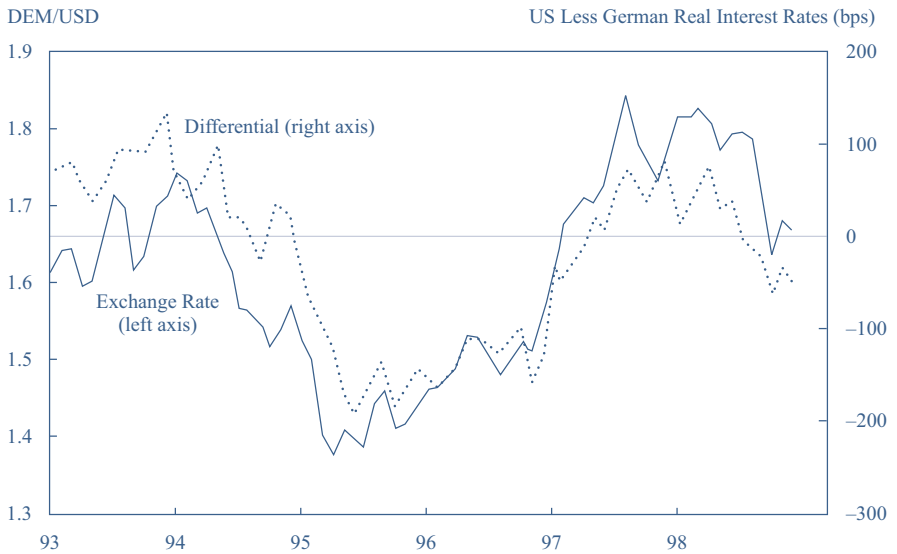
In this model, expansionary monetary policy affects growth, in part, by reducing interest rates and thereby increasing investment and consumption spending. Given flexible exchange rates and expansionary monetary policy, downward pressure on

domestic interest rates will induce capital to flow to higher-yielding markets, putting downward pressure on the domestic currency. The more responsive capital flows are to interest rate differentials, the greater the depreciation of the currency.

Expansionary fiscal policy—either directly through increased spending or indirectly via lower taxes—typically exerts upward pressure on interest rates because larger budget deficits must be financed. With flexible exchange rates and mobile capital, the rising domestic interest rates will attract capital from lower-yielding markets, putting upward pressure on the domestic currency. If capital flows are highly sensitive to interest rate differentials, then the domestic currency will tend to appreciate substantially. If, however, capital flows are immobile and very insensitive to interest rate differentials, the policy-induced increase in aggregate demand will increase imports and worsen the trade balance, creating downward pressure on the currency with no offsetting capital inflows to provide support for the currency.

The specific mix of monetary and fiscal policies in a country can have a profound effect on its exchange rate. Consider first the case of high capital mobility. With floating exchange rates and high capital mobility, a domestic currency will appreciate given a restrictive domestic monetary policy and/or an expansionary fiscal policy that results in higher real interest rates. Similarly, a domestic currency will depreciate given an expansionary domestic monetary policy and/or a restrictive fiscal policy that results in lower real interest rates. In Exhibit 4, we show that the combination of a restrictive monetary policy and an expansionary fiscal policy (higher real rates) is extremely bullish for a currency when capital mobility is high; likewise, the combination of an expansionary monetary policy and a restrictive fiscal policy (lower real rates) is bearish for a currency. The effect on the currency of monetary and fiscal policies that are both expansionary or both restrictive is indeterminate under conditions of high capital mobility.

Exhibit 4: Monetary–Fiscal Policy Mix and the Determination of Exchange Rates under Conditions of High Capital Mobility



Source: Rosenberg (1996, p. 132).

When capital mobility is low, the effects of monetary and fiscal policy on exchange rates will operate primarily through trade flows rather than capital flows. The combination of expansionary monetary *and* fiscal policy will be bearish for a currency.

Earlier we said that expansionary fiscal policy will increase imports and hence the trade deficit, creating downward pressure on the currency. Layering on an expansive monetary policy will further boost spending and imports, worsening the trade balance and exacerbating the downward pressure on the currency.

The combination of restrictive monetary *and* fiscal policy will be bullish for a currency. This policy mix will tend to reduce imports, leading to an improvement in the trade balance.

The impact of expansionary monetary and restrictive fiscal policies (or restrictive monetary and expansionary fiscal policies) on aggregate demand and the trade balance, and hence on the exchange rate, is indeterminate under conditions of low capital mobility. Exhibit 5 summarizes these results.

Exhibit 5: Monetary–Fiscal Policy Mix and the Determination of Exchange Rates under Conditions of Low Capital Mobility

	Expansionary Monetary Policy	Restrictive Monetary Policy
Expansionary Fiscal Policy	Domestic currency depreciates	Indeterminate
Restrictive Fiscal Policy	Indeterminate	Domestic currency appreciates

Source: Adapted from Rosenberg (1996, p. 133).

Exhibit 4 is more relevant for the G–10 countries because capital mobility tends to be high in developed economies. Exhibit 5 is more relevant for emerging market economies that restrict capital movement.

A classic case in which a dramatic shift in the policy mix caused dramatic changes in exchange rates was that of Germany in 1990–1992. During that period, the German government pursued a highly expansionary fiscal policy to help facilitate German unification. At the same time, the Bundesbank pursued an extraordinarily restrictive monetary policy to combat the inflationary pressures associated with unification. The expansive fiscal/restrictive monetary policy mix drove German interest rates sharply higher, eventually causing the German currency to appreciate.

Monetary Models of Exchange Rate Determination

In the Mundell–Fleming model, monetary policy is transmitted to the exchange rate through its impact on interest rates and output. Changes in the price level and/or the inflation rate play no role. Monetary models of exchange rate determination generally take the opposite perspective: Output is fixed and monetary policy affects exchange rates primarily through the price level and the rate of inflation. In this section, we briefly describe two variations of the monetary approach to exchange rate determination.

The monetary approach asserts that an X percent rise in the domestic money supply will produce an X percent rise in the domestic price level. Assuming that purchasing power parity holds—that is, that changes in exchange rates reflect changes in relative inflation rates—a money supply–induced increase (decrease) in domestic prices relative to foreign prices should lead to a proportional decrease (increase) in the domestic currency's value.

One of the major shortcomings of the pure monetary approach is the assumption that purchasing power parity holds in both the short and long runs. Because purchasing power parity rarely holds in either the short or medium run, the pure monetary model may not provide a realistic explanation of the impact of monetary forces on the exchange rate.

To rectify that problem, Dornbusch (1976) constructed a modified monetary model that assumes prices have limited flexibility in the short run but are fully flexible in the long run. The long-run flexibility of the price level ensures that any increase in the domestic money supply will give rise to a proportional increase in domestic prices and thus contribute to a depreciation of the domestic currency in the long run, which is consistent with the pure monetary model. If the domestic price level is assumed to be inflexible in the short run, however, the model implies that the exchange rate is likely to overshoot its long-run PPP path in the short run. With inflexible domestic prices in the short run, any increase in the nominal money supply results in a decline in the domestic interest rate. Assuming that capital is highly mobile, the decline in domestic interest rates will precipitate a capital outflow, which in the short run will cause the domestic currency to depreciate below its new long-run equilibrium level. In the long run, once domestic nominal interest rates rise, the currency will appreciate and move into line with the path predicted by the conventional monetary approach.

Monetary Policy and Exchange Rates: The Historical Evidence

Historically, changes in monetary policy have had a profound impact on exchange rates. In the case of the US dollar, the Federal Reserve's policy of quantitative easing after the global financial crisis resulted in dollar depreciation from mid-2009 to 2011. The subsequent ending of quantitative easing in 2014, along with the anticipation that the United States would raise interest rates before many other countries, played a key role in driving the dollar higher.

Beginning in 2013, Abenomics—fiscal stimulus, monetary easing, and structural reforms—and the use of quantitative easing in Japan led to a steady decline in interest rates and eventually to negative interest rates in 2016. From 2013 to 2015, the value of the yen changed from roughly JPY 90/USD to JPY 120/USD. Likewise, the use of quantitative easing by the European Central Bank in 2015 led to declines in the value of the euro.

Excessively expansionary monetary policies by central banks in emerging markets have often planted the seeds of speculative attacks on their currencies. In the early 1980s, exchange rate crises in Argentina, Brazil, Chile, and Mexico were all preceded by sharp accelerations in domestic credit expansions. In 2012, Venezuela began a period of triple-digit inflation, followed by a massive currency depreciation and an economic crisis.

EXAMPLE 9

Monetary Policy and Exchange Rates

Monique Kwan, the currency strategist at a major foreign exchange dealer, is preparing a report on the outlook for several currencies that she follows. She begins by considering the outlook for the currency of a developed market country with high capital mobility across its borders and a flexible exchange rate. This DM country also has low levels of public and private debt.

Given these conditions, Kwan tries to assess the impact of each of the following policy changes.

1. For the DM currency, increasing the degree of monetary easing (reducing interest rates and increasing money supply) will *most likely*:

   A. cause the currency to appreciate.

   B. cause the currency to depreciate.

   C. have an indeterminate effect on the currency.

   Solution

   B is correct. A decrease in the policy rate would most likely cause capital to re-allocate to higher-yielding markets. This would lead to currency depreciation.

2. The pursuit of an expansionary domestic fiscal policy by the DM country will, in the short run, *most likely*:

   A. cause the domestic currency's value to appreciate.

   B. cause the domestic currency's value to depreciate.

   C. have an indeterminate effect on the domestic currency's value.

   Solution

   A is correct. An expansionary fiscal policy will lead to higher levels of government debt and interest rates, which will attract international capital flows. (In the long run, however, an excessive buildup in debt may eventually cause downward pressure on the domestic currency.)

3. Next, Kwan turns her attention to an emerging market country that has low levels of public and private debt. Currently, the EM country has a fixed exchange rate but no controls over international capital mobility. However, the country is considering replacing its fixed exchange rate policy with a policy based on capital controls. These proposed controls are meant to reduce international capital mobility by limiting short-term investment flows ("hot money") in and out of its domestic capital markets.

   To maintain the exchange rate peg while increasing the degree of monetary easing, the EM country will *most likely* have to:

   A. tighten fiscal policy.

   B. decrease interest rates.

   C. buy its own currency in the FX market.

   Solution

   C is correct. The looser monetary policy will lead to exchange rate depreciation. To counter this effect and maintain the currency peg, the central bank will have to intervene in the FX market, buying the country's own currency.

A is incorrect because tighter fiscal policy is associated with lower interest rates and is therefore likely to increase rather than mitigate the downward pressure on the domestic currency. Similarly, B is incorrect because a move to lower interest rates would exacerbate the downward pressure on the currency and hence the pressure on the peg.

4. After the EM country replaces its currency peg with capital controls, would its exchange rate be unaffected by a tightening in monetary policy?

   A. Yes.

   B. No, the domestic currency would appreciate.

   C. No, the domestic currency would depreciate.

   Solution

   B is correct. In general, capital controls will not completely eliminate capital flows but will limit their magnitude and responsiveness to investment incentives such as interest rate differentials. At a minimum, flows directly related to financing international trade will typically be allowed. The exchange rate will still respond to monetary policy. With limited capital mobility, however, monetary policy's main influence is likely to come through the impact on aggregate demand and the trade balance. A tighter domestic monetary policy will most likely lead to higher interest rates and less domestic demand, including less demand for imported goods. With fewer imports and with exports held constant, there will be modest upward pressure on the currency.

5. After the EM country replaces its currency peg with capital controls, the simultaneous pursuit of a tight monetary policy and a highly expansionary fiscal policy by the EM country will *most likely*:

   A. cause the currency to appreciate.

   B. cause the currency to depreciate.

   C. have an indeterminate effect on the currency.

   Solution

   C is correct because (1) capital mobility is low, so the induced increase in interest rates is likely to exert only weak upward pressure on the currency; (2) the combined impact on aggregate demand is indeterminate; and (3) if aggregate demand increases, the downward pressure on the currency due to a worsening trade balance may or may not fully offset the upward pressure exerted by capital flows.

The Portfolio Balance Approach

In this section, we re-examine the role fiscal policy plays in determining exchange rates. The Mundell–Fleming model is essentially a short-run model of exchange rate determination. It makes no allowance for the long-term effects of budgetary imbalances that typically arise from sustained fiscal policy actions. The portfolio balance approach to exchange rate determination remedies this limitation. In our previous discussion of the portfolio balance channel, we stated that the currencies of countries with trade deficits will decline over time. We expand that discussion here to more closely examine how exchange rates change over the long term.

In the **portfolio balance approach**, global investors are assumed to hold a diversified portfolio of domestic and foreign assets, including bonds. The desired allocation is assumed to vary in response to changes in expected return and risk considerations.

In this framework, a growing government budget deficit leads to a steady increase in the supply of domestic bonds outstanding. These bonds will be willingly held only if investors are compensated in the form of a higher expected return. Such a return could come from (1) higher interest rates and/or a higher risk premium, (2) immediate *depreciation of the currency to a level sufficient to generate anticipation of gains from subsequent currency appreciation*, or (3) some combination of these two factors. The currency adjustments required in the second mechanism are the core of the portfolio balance approach.

One of the major insights one should draw from the portfolio balance model is that *in the long run, governments that run large budget deficits on a sustained basis could eventually see their currencies decline in value.*

The Mundell–Fleming and portfolio balance models can be combined into a single integrated framework in which expansionary fiscal policy under conditions of high capital mobility may be positive for a currency in the short run but negative in the long run. Exhibit 6 illustrates this concept. A domestic currency may rise in value when the expansionary fiscal policy is first put into place. As deficits mount over time and the government's debt obligations rise, however, market participants will begin to wonder how that debt will be financed. If the volume of debt rises to levels that are believed to be unsustainable, market participants may believe that the central bank will eventually be pressured to "monetize" the debt—that is, to buy the government's debt with newly created money. Such a scenario would clearly lead to a rapid reversal of the initial currency appreciation. Alternatively, the market may believe that the government will eventually have to shift toward significant restraint to implement a more restrictive, sustainable fiscal policy over the longer term.

Exhibit 6: The Short- and Long-Run Response of Exchange Rates to Changes in Fiscal Policy

	Expansionary Monetary Policy	Restrictive Monetary Policy
Expansionary Fiscal Policy	Domestic currency depreciates	Indeterminate
Restrictive Fiscal Policy	Indeterminate	Domestic currency appreciates

Source: Rosenberg (2003).

EXAMPLE 10

Fiscal Policy and Exchange Rates

Monique Kwan is continuing her analysis of the foreign exchange rate outlook for selected countries. She examines a DM country that has a high degree of capital mobility and a floating-rate currency regime. Kwan notices that although

the current outstanding volume of government debt is low, as a percentage of GDP, it is rising sharply as a result of expansionary fiscal policy. Moreover, projections for the government debt-to-GDP ratio point to further increases well into the future.

Kwan uses the Mundell–Fleming and portfolio balance models to form an opinion about both the short-run and long-run implications for the DM country's exchange rate.

1. Over the short run, Kwan is *most likely* to expect:

   A. appreciation of the DM's currency.

   B. an increase in the DM's asset prices.

   C. a decrease in the DM's risk premium.

   Solution

   A is correct. The DM country currently has a low debt load (as a percentage of GDP), and in the short run, its expansionary fiscal policy will lead to higher interest rates and higher real rates relative to other countries. This path should lead to currency appreciation. The higher domestic interest rates will (all else equal) depress local asset prices (so B is incorrect), and the rising debt load is likely to increase rather than decrease the risk premium (so C is incorrect).

2. Over the medium term, as the DM country's government debt becomes harder to finance, Kwan would be *most likely* to expect that:

   A. fiscal policy will turn more accommodative.

   B. the mark-to-market value of the debt will increase.

   C. monetary policy will become more accommodative.

   Solution

   C is correct. As government debt becomes harder to finance, the government will be tempted to monetize the debt through an accommodative monetary policy. A is incorrect because an inability to finance the debt will make it hard for fiscal policy to become more accommodative. B is incorrect because as investors demand a higher risk premium (a higher return) for holding the DM country's debt, the mark-to-market value of the debt will decline (i.e., bond prices will decrease and bond yields will increase).

3. Assuming that the DM country's government debt becomes harder to finance and there is no change in monetary policy, Kwan is *most likely* to expect that over the longer term, there will be a fiscal policy response that will lead to:

   A. currency appreciation as yields rise.

   B. currency depreciation as yields decline.

   C. an indeterminate impact on the currency, depending on which effect prevails.

   Solution

   B is correct. As the DM country's debt ratio deteriorates, foreign investors will demand a higher rate of return to compensate them for the increased risk. Assuming that the central bank will not accommodate (monetize) the rising government debt, the most likely fiscal response is an eventual move toward fiscal consolidation—reducing the public deficit and debt levels that were causing the debt metrics to deteriorate. This policy adjustment would

involve issuing fewer government bonds. All else equal, bond yields would decrease, leading to a weaker domestic currency over the longer term. A is incorrect because currency appreciation is not likely to accompany rising yields when the government is having difficulty financing its deficit. There would be a rising risk premium (a deteriorating investor appetite) for holding DM assets, and hence a currency appreciation would be unlikely despite high DM yields. To avoid paying these high yields on its debt, the DM government would eventually have to take measures to reduce its deficit spending. This approach would eventually help reduce investor risk aversion and DM yields. C is incorrect because given the deterioration in the DM's debt metrics, a depreciation of its exchange rate is likely to be an important part of the restoration of financial market equilibrium.

14 EXCHANGE RATE MANAGEMENT: INTERVENTION AND CONTROLS

☐ describe objectives of central bank or government intervention and capital controls and describe the effectiveness of intervention and capital controls

Capital flows can be both a blessing and a curse. Capital inflows can be a blessing when they increase domestic investment, thereby increasing a country's economic growth and asset values. Currency appreciation often follows, which increases returns to global investors. Capital inflows can be a curse, however, if they fuel boom-like conditions, asset price bubbles, and overvaluation of a country's currency. If capital inflows then reverse, the result may be a major economic downturn, a significant decline in asset prices, and a large depreciation of the currency. Capital inflows often are driven by a combination of "pull" and "push" factors. Pull factors represent a favorable set of developments that encourage foreign capital inflows. These factors may stem from both the public and private sectors. Examples of better economic management by a government include

- a decrease in inflation and inflation volatility,
- more-flexible exchange rate regimes,
- improved fiscal positions,
- privatization of state-owned entities,
- liberalization of financial markets, and
- lifting of foreign exchange regulations and controls.

Ideally, these changes will facilitate strong economic growth in the private sector, which will attract further foreign investment. A healthy export sector will generate improvement in the current account balance and an increase in FX reserves, which can be used by the government as a buffer against future speculative attacks. The returns from the currency and assets should increase, increasing the foreign investor's return.

Push factors driving foreign capital inflows are not determined by the domestic policies but arise from the primary sources of internationally mobile capital, notably the investor base in industrial countries. For example, the pursuit of low interest rate policies in industrial countries since the 2008 financial crisis has encouraged global investors to seek higher returns abroad.

Another important push factor is the long-run trend in asset allocation by industrial country investors. For example, many fund managers have traditionally had underweight exposures to emerging market assets, but with the weight of emerging market equities in broad global equity market indexes on the rise (as of 2019 the EM share of world GDP at current prices is over 40%, up from 17% in the 1960s, according to the IMF), capital flows to EM countries, in the form of increased allocations to EM equities, are likely to rise.

Private capital inflows to emerging markets go through significant changes over time. For example, they rose steadily between 2003 and 2007, posting nearly a six-fold increase over the period. Both push and pull factors contributed to that surge in capital flows. Net private capital flows to emerging markets tumbled in 2008 and 2009 as heightened risk aversion during the global financial crisis prompted investors to unwind some of their EM exposures in favor of US assets. In 2010, capital flows to emerging markets rose as many EM economies weathered the global financial crisis better than many industrial economies. In addition, the pursuit of ultra-low interest rate policies in the United States, the euro area, and Japan encouraged global investors to invest in higher-yielding EM assets.

However beneficial foreign capital is, policymakers must guard against excessive capital inflows that could quickly be reversed. Capital flow surges planted the seeds of three major currency crises in the 1990s—the European Exchange Rate Mechanism (ERM) crisis in 1992–1993, the Mexican peso crisis in late 1994, and the Asian currency and financial crisis in 1997–1998. Each crisis episode was preceded by a surge in capital inflows and a buildup of huge, highly leveraged speculative positions by local as well as international investors in currencies that eventually came under heavy speculative attack. In the run-up to the ERM crisis, investors—believing that European yield convergence would occur as European monetary union approached—took on highly leveraged long positions in the higher-yielding European currencies financed by short positions in the lower-yielding European currencies. Likewise, in the run-up to the Mexican peso crisis, investors and banks were highly leveraged and made extensive use of derivative products in taking on speculative long Mexican peso/short US dollar positions. And in the run-up to the Asian financial crisis, Asian companies and banks were highly leveraged as they took on a huge volume of short-term dollar- and yen-denominated debt to fund local activities. In each case, the sudden unwinding of those leveraged long speculative positions triggered the attacks on the currencies.

Governments resist excessive inflows and currency bubbles by using capital controls and direct intervention (selling their currency) in the foreign exchange market. Capital controls can take many forms. In the Asian financial crisis, many countries, such as Malaysia, prevented their banks from offering currency transactions in which their currency was sold. As mentioned earlier, Brazil has used a tax to limit currency transactions. In 2006, Thailand required a one-year, non-interest-bearing deposit of 30% of an investment's value to reduce new foreign inflows, which had been appreciating the Thai baht. Vietnam has limited the foreign ownership of local financial institutions. In 2015, Ukraine was removed from the MSCI Frontier Markets equity index after its central bank prevented foreign investors from repatriating funds from the sale of Ukrainian stocks. By 2016, Venezuela had instituted capital controls in the form of four different exchange rates, whereby the rate for selling Venezuelan bolivars for US dollars depended on what the dollars were used for. As a result, many Venezuelans used the black market to obtain dollars. Venezuela's capital controls were subsequently loosened in 2018 and 2019.

At one time, capital controls were frowned on as a policy tool for curbing undesired surges in capital inflows. It was generally felt that such controls tended to generate distortions in global trade and finance and that, in all likelihood, market participants would eventually find ways to circumvent the controls. Furthermore, many thought that capital controls imposed by one country could deflect capital flows to other

countries, which could complicate monetary and exchange rate policies in those economies. Despite such concerns, the IMF has said that the benefits associated with capital controls may exceed the associated costs. Given the painful lessons that EM policymakers have learned from previous episodes of capital flow surges, some believe that under certain circumstances, capital controls may be needed to prevent exchange rates from overshooting, asset bubbles from forming, and future financial conditions from deteriorating.

Although a case can be made for government intervention and capital controls to limit the potential damage associated with unrestricted inflows of overseas capital, the key issue for policymakers is whether intervention and capital controls will actually work in terms of (1) preventing currencies from appreciating too strongly, (2) reducing the aggregate volume of capital inflows, and (3) enabling monetary authorities to pursue independent monetary policies without having to worry about whether changes in policy rates might attract too much capital from overseas. As an example of the last issue, if a central bank increases interest rates to slow inflation, then capital controls might prevent foreign capital inflows from subsequently depressing interest rates.

Evidence on the effectiveness of direct government intervention suggests that, in the case of industrial countries, the volume of intervention is often quite small relative to the average daily turnover of G–10 currencies in the foreign exchange market. Hence, most studies have concluded that the effect of intervention in developed market economies is limited. For most developed market countries, the ratio of official FX reserves held by the respective central banks to the average daily turnover of foreign exchange trading in that currency is negligible. Most industrial countries hold insufficient reserves to significantly affect the supply of and demand for their currency. Note that if a central bank is intervening in an effort to weaken, rather than strengthen, its own currency, it could (at least in principle) create and sell an unlimited amount of its currency and accumulate a correspondingly large quantity of FX reserves. However, persistent intervention in the FX market can undermine the efficacy of domestic monetary policy.

The evidence on the effectiveness of government intervention in emerging market currencies is more mixed. Intervention appears to contribute to lower EM exchange rate volatility, but no statistically significant relationship has emerged between the level of EM exchange rates and intervention. Some studies have found, however, that EM policymakers might have greater success in controlling exchange rates than their industrial country counterparts because the ratio of EM central bank FX reserve holdings to average daily FX turnover in their domestic currencies is actually quite sizable. With considerably greater firepower in their reserve arsenals, emerging market central banks appear to be in a stronger position than their developed market counterparts to influence the level and path of their exchange rates. What's more, with emerging market central banks' FX reserve holdings expanding at a near-record clip in the past decade, the effectiveness of intervention may be greater now than in the past.

15 WARNING SIGNS OF A CURRENCY CRISIS

☐ describe warning signs of a currency crisis

If capital inflows come to a sudden stop, the result may be a financial crisis, in which the economy contracts, asset values plummet, and the currency sharply depreciates. History is filled with examples of currencies that have come under heavy selling pressure within short windows of time. For example, between August 2008 and February

2009, 23 currencies dropped by 25% or more against the US dollar. These included the developed market currencies of Australia, Sweden, and the United Kingdom, which dropped by 35% or more, and the emerging market currencies of Brazil, Russia, and South Korea, which fell by more than 50%.

Currency crises often occur suddenly, with many investors caught by surprise. Once a wave of selling begins, investors and borrowers must immediately reposition their portfolios to avoid excessive capital losses. For example, assume a carry trader had gone long the Brazilian real and borrowed US dollars. Upon an initial depreciation of the real, the trader would be inclined to exit the trade by selling reals and buying dollars. Or consider a Brazilian public or private borrower that had financed in US dollars. The borrower would also be selling reals to buy dollars in order to cover future repayment of the dollar debt. Either of these actions will intensify selling pressure on the depreciated currency. It is this massive liquidation of vulnerable positions, often reinforced by speculative offshore selling, that is largely responsible for the excessive exchange rate movements that occur during currency crises.

Because most crisis episodes have not been adequately anticipated, a great deal of effort has been spent developing early warning systems. One of the problems in developing an early warning system is that views on the underlying causes of currency crises differ greatly. One school of thought contends that currency crises tend to be precipitated by deteriorating economic fundamentals, while a second school contends that currency crises can occur out of the blue, with little evidence of deteriorating fundamentals preceding them.

If, according to the first school of thought, deteriorating economic fundamentals often precede crises and if those economic fundamentals tend to deteriorate steadily and predictably, then it should be possible to construct an early warning system to anticipate when a currency might be vulnerable.

The second school of thought argues that, although evidence of deteriorating economic fundamentals might explain a relatively large number of currency collapses, there might be cases in which economies with relatively sound fundamentals have their currencies come under attack. Clearly, these currency crises would be more difficult to predict. Events that are largely unrelated to domestic economic fundamentals include sudden adverse shifts in market sentiment that become self-fulfilling prophecies and contagion from crises in other markets. A crisis may spread to a country when, for example, the country devalues its currency to keep its exports competitive with those of another country that devalued.

Recognizing that no single model can correctly anticipate the onset of all crisis episodes, an early warning system might nevertheless be useful in assisting investors in structuring and/or hedging their global portfolios. An ideal early warning system would need to incorporate a number of important features. First, it should have a strong record of predicting actual crises but also should not issue false alarms. Second, it should include macroeconomic indicators whose data are available on a timely basis. If data arrive with a long lag, a crisis could be under way before the early warning system starts flashing red. Third, because currency crises tend to be triggered in countries with a number of economic problems, not just one, an ideal early warning system should be broad based, incorporating a wide range of symptoms that crisis-prone currencies might exhibit.

Many studies have been conducted to develop an early warning system for currency crises, typically by constructing a model in which a number of variables constitute the early warning system. Various definitions of currency crises have been used. Although the variables and methodologies differ from one study to the next, the following conditions were identified in one or more studies (Babecký, Havránek, Matějů, Rusnák, Šmídková, and Vašíček 2013 and 2014; Daniels and VanHoose 2018):

1. Prior to a currency crisis, the capital markets have been liberalized to allow the free flow of capital.

2. There are large inflows of foreign capital (relative to GDP) in the period leading up to a crisis, with short-term funding denominated in a foreign currency being particularly problematic.
3. Currency crises are often preceded by (and often coincide with) banking crises.
4. Countries with fixed or partially fixed exchange rates are more susceptible to currency crises than countries with floating exchange rates.
5. Foreign exchange reserves tend to decline precipitously as a crisis approaches.
6. In the period leading up to a crisis, the currency has risen substantially relative to its historical mean.
7. The ratio of exports to imports (known as "the terms of trade") often deteriorates before a crisis.
8. Broad money growth and the ratio of M2 (a measure of money supply) to bank reserves tend to rise prior to a crisis.
9. Inflation tends to be significantly higher in pre-crisis periods compared with tranquil periods.

These factors are usually interrelated and often feed off one another. For example, in the case of the first five factors, large inflows of foreign capital occur because the financial markets have been liberalized and domestic banks have borrowed abroad. If the borrowing is denominated in a foreign currency and the domestic currency initially depreciates, the bank may have trouble servicing its debt, especially when the debt is of shorter maturity. This scenario may cause foreign investors to withdraw capital and speculators to short the currency, with their actions causing further declines in the currency. If the government is trying to maintain the currency's value, it could increase interest rates to stem capital outflows or defend its currency using direct intervention. The former action may worsen the banking industry's condition and slow down the economy. In the latter approach, the government will have to spend down its foreign currency reserves to buy its own currency in the foreign exchange markets. If the government appears unwilling or unable to defend its currency, then capital outflows and speculative attacks will increase.

The fifth through seventh factors are related because an overvalued currency may make the country's exports less competitive. With fewer exports, the country is not able to earn as much foreign currency. Other interrelationships occur because these factors often coincide.

Models cannot predict every crisis, and they sometimes generate false alarms. Nevertheless, an early warning system can be useful in assessing and preparing for potential negative tail risks. As with any analytical tool, the implementation of an early warning system requires integration with other analysis and judgment that cannot be easily quantified or conceptualized.

ICELAND'S CURRENCY CRISIS OF 2008

Iceland, a country with a population of 320,000, had traditionally relied on the fishing, energy, and aluminum industries for economic growth. That began to change in 2001, when the banking industry was liberalized. Three banks dominated the Icelandic banking industry: Glitnir, Kaupthing, and Landsbanki. Given Iceland's small population, these banks sought growth by offering short-term, internet-based deposit accounts to foreign investors. These accounts offered attractive interest rates and were denominated in foreign currencies. In particular, many of the depositors were British, Dutch, and other European citizens who held deposit accounts denominated in pounds and euros.

With government guarantees on their deposit accounts, the banking industry grew rapidly. The largest bank, Kaupthing, experienced asset growth of 30 times between 2000 and 2008. The three banks increased lending rapidly, with many of their loans being long term, resulting in a maturity mismatch of assets and liabilities. The banks' assets were more than 14 times the country's GDP, while foreign debt was five times GDP. The three banks constituted more than 70% of the national stock market capitalization.

The economy expanded at a real growth rate above 20% annually between 2002 and 2005, and many Icelanders left traditional industries to work in the banks. Iceland earned the nickname "Nordic Tiger" as per capita GDP approached USD 70,000 in 2007. The Icelandic krona increased in value against the US dollar by 40% between 2001 and 2007. By 2007, the unemployment rate was less than 1%. Icelanders went on a shopping spree for consumer goods, in part by using loans tied to the value of foreign currencies, motivated by lower interest rates abroad. A 2002 trade surplus turned into a trade deficit in the years 2003–2007. Iceland's external debt in 2008 was more than 7 times its GDP and 14 times its export revenue. Broad-based monetary aggregates grew at a rate of 14%–35% annually from 2002 to 2007. By the fall of 2008, inflation had reached 14%.

As the global financial crisis unfolded in 2008, interbank lending declined and Icelandic banks were unable to roll over their short-term debt. Anxious foreign depositors began withdrawing their funds. In the first half of 2008, the krona depreciated by more than 40% against the euro. As the Icelandic currency declined in value, it became more difficult for the banks to meet depositors' liquidity demands, while at the same time the banks' depreciating krona-denominated assets could not be used for collateral financing.

The three banks collapsed in 2008. Unfortunately for foreign depositors, because of the relative size of the banks, the government guaranteed only domestic deposits. Iceland's central bank became technically insolvent, as its EUR 2 billion in assets was dwarfed by Iceland's debt to foreign banks of EUR 50 billion. Trading in the stock market was suspended in October 2008. When it reopened several days later, the Icelandic Stock Market Index fell by more than 77% as a result of the elimination of the three banks' equity value.

The government attempted to peg the krona to the euro in October 2008 but abandoned the peg one day later. When trading in the currency was resumed later that month, the currency value fell by more than 60% and trading was eventually suspended. Iceland increased interest rates to 18% to stem outflows of krona and imposed capital controls on the selling of krona for foreign currency. The Icelandic economy contracted, and per capita GDP fell 9.2% in 2009. By the spring of 2009, unemployment was 9%. The country subsequently required a bailout from the IMF and its neighbors of USD 4.6 billion.

Source: Federal Reserve Bank of St. Louis database; Bekaert and Hodrick 2018; Matsangou 2015; Daniels and VanHoose 2017.

EXAMPLE 11

Currency Crises

Monique Kwan now turns her attention to the likelihood of crises in various emerging market currencies. She discusses this matter with a research associate, who tells her that the historical record of currency crises shows that most of these episodes were not very well anticipated by investors (in terms of their

positioning), by the bond markets (in terms of yield spreads between countries), or by major credit rating agencies and economists (in terms of the sovereign credit ratings and forecasts, respectively).

1. The research associate is *most likely*:

   A. correct.

   B. incorrect, because most credit rating agencies and economists typically change their forecasts prior to a crisis.

   C. incorrect, because investor positioning and international yield differentials typically shift prior to a crisis.

   Solution

   A is correct. Currency crises often catch most market participants and analysts by surprise.

2. Kwan delves further into the historical record of currency crises. She concludes that even countries with relatively sound economic fundamentals can fall victim to these crisis episodes and that these attacks can occur when sentiment shifts for reasons unrelated to economic fundamentals.

   Kwan's conclusion is *most likely*:

   A. correct.

   B. incorrect, because there are few historical crises involving currencies of countries with sound economic fundamentals.

   C. incorrect, because there are few historical episodes in which a sudden adverse shift in market sentiment occurs that is unrelated to economic fundamentals.

   Solution

   A is correct. Even countries with sound economic fundamentals can be subject to a currency crisis, including instances when market sentiment shifts for non-economic reasons.

3. To better advise the firm's clients on the likelihood of currency crises, Kwan tries to formulate an early warning system for these episodes. She recognizes that a typical currency crisis tends to be triggered by a number of economic problems, not just one.

   Kwan's early warning system is *least likely* to indicate an impending crisis when there is:

   A. an expansionary monetary policy.

   B. an overly appreciated exchange rate.

   C. a rising level of foreign exchange reserves at the central bank.

   Solution

   C is correct. A high level of foreign exchange reserves held by a country typically decreases the likelihood of a currency crisis.

4. Kwan's early warning system would *most likely* be better if it:

   A. had a strong record of predicting actual crises, even if it generates a lot of false signals.

B. included a wide variety of economic indicators, including those for which data are available only with a significant lag.

C. started flashing well in advance of an actual currency crisis to give market participants time to adjust or hedge their portfolios before the crisis hits.

Solution

C is correct. Early warnings are a positive factor in judging the effectiveness of the system, whereas false signals and the use of lagged data would be considered negative factors.

SUMMARY

Exchange rates are among the most difficult financial market prices to understand and therefore to value. There is no simple, robust framework that investors can rely on in assessing the appropriate level and likely movements of exchange rates.

Most economists believe that there is an equilibrium level or a path to that equilibrium value that a currency will gravitate toward in the long run. Although short- and medium-term cyclical deviations from the long-run equilibrium path can be sizable and persistent, fundamental forces should eventually drive the currency back toward its long-run equilibrium path. Evidence suggests that misalignments tend to build up gradually over time. As these misalignments build, they are likely to generate serious economic imbalances that will eventually lead to correction of the underlying exchange rate misalignment.

We have described how changes in monetary policy, fiscal policy, current account trends, and capital flows affect exchange rate trends, as well as what role government intervention and capital controls can play in counteracting potentially undesirable exchange rate movements. We have made the following key points:

- Spot exchange rates apply to trades for the next settlement date (usually $T + 2$) for a given currency pair. Forward exchange rates apply to trades to be settled at any longer maturity.
- Market makers quote bid and offer prices (in terms of the *price currency*) at which they will buy or sell the *base currency.*
  - The offer price is always higher than the bid price.
  - The counterparty that asks for a two-sided price quote has the option (but not the obligation) to deal at either the bid or offer price quoted.
  - The bid–offer spread depends on (1) the currency pair involved, (2) the time of day, (3) market volatility, (4) the transaction size, and (5) the relationship between the dealer and the client. Spreads are tightest in highly liquid currency pairs, when the key market centers are open, and when market volatility is relatively low.
- Absence of arbitrage requires the following:
  - The bid (offer) shown by a dealer in the interbank market cannot be higher (lower) than the current interbank offer (bid) price.
  - The cross-rate bids (offers) posted by a dealer must be lower (higher) than the implied cross-rate offers (bids) available in the interbank market. If they are not, then a triangular arbitrage opportunity arises.

- Forward exchange rates are quoted in terms of points to be added to the spot exchange rate. If the points are positive (negative), the base currency is trading at a forward premium (discount). The points are proportional to the interest rate differential and approximately proportional to the time to maturity.
- International parity conditions show us how expected inflation, interest rate differentials, forward exchange rates, and expected future spot exchange rates are linked. In an ideal world,
  - relative expected inflation rates should determine relative nominal interest rates,
  - relative interest rates should determine forward exchange rates, and
  - forward exchange rates should correctly anticipate the path of the future spot exchange rate.
- International parity conditions tell us that countries with high (low) expected inflation rates should see their currencies depreciate (appreciate) over time, that high-yield currencies should depreciate relative to low-yield currencies over time, and that forward exchange rates should function as unbiased predictors of future spot exchange rates.
- With the exception of covered interest rate parity, which is enforced by arbitrage, the key international parity conditions rarely hold in either the short or medium term. However, the parity conditions tend to hold over relatively long horizons.
- According to the theory of covered interest rate parity, a foreign-currency-denominated money market investment that is completely hedged against exchange rate risk in the forward market should yield exactly the same return as an otherwise identical domestic money market investment.
- According to the theory of uncovered interest rate parity, the expected change in a domestic currency's value should be fully reflected in domestic–foreign interest rate spreads. Hence, an unhedged foreign-currency-denominated money market investment is expected to yield the same return as an otherwise identical domestic money market investment.
- According to the *ex ante* purchasing power parity condition, expected changes in exchange rates should equal the difference in expected national inflation rates.
- If both *ex ante* purchasing power parity and uncovered interest rate parity held, real interest rates across all markets would be the same. This result is real interest rate parity.
- The international Fisher effect says that the nominal interest rate differential between two currencies equals the difference between the expected inflation rates. The international Fisher effect assumes that risk premiums are the same throughout the world.
- If both covered and uncovered interest rate parity held, then forward rate parity would hold and the market would set the forward exchange rate equal to the expected spot exchange rate: The forward exchange rate would serve as an unbiased predictor of the future spot exchange rate.
- Most studies have found that high-yield currencies do not depreciate and low-yield currencies do not appreciate as much as yield spreads would suggest over short to medium periods, thus violating the theory of uncovered interest rate parity.

- Carry trades overweight high-yield currencies at the expense of low-yield currencies. Historically, carry trades have generated attractive returns in benign market conditions but tend to perform poorly (i.e., are subject to crash risk) when market conditions are highly volatile.
- According to a balance of payments approach, countries that run persistent current account deficits will generally see their currencies weaken over time. Similarly, countries that run persistent current account surpluses will tend to see their currencies appreciate over time.
- Large current account imbalances can persist for long periods of time before they trigger an adjustment in exchange rates.
- Greater financial integration of the world's capital markets and greater freedom of capital to flow across national borders have increased the importance of global capital flows in determining exchange rates.
- Countries that institute relatively tight monetary policies, introduce structural economic reforms, and lower budget deficits will often see their currencies strengthen over time as capital flows respond positively to relatively high nominal interest rates, lower inflation expectations, a lower risk premium, and an upward revision in the market's assessment of what exchange rate level constitutes long-run fair value.
- Monetary policy affects the exchange rate through a variety of channels. In the Mundell–Fleming model, it does so primarily through the interest rate sensitivity of capital flows, strengthening the currency when monetary policy is tightened and weakening it when monetary policy is eased. The more sensitive capital flows are to the change in interest rates, the greater the exchange rate's responsiveness to the change in monetary policy.
- In the monetary model of exchange rate determination, monetary policy is deemed to have a direct impact on the actual and expected path of inflation, which, via purchasing power parity, translates into a corresponding impact on the exchange rate.
- Countries that pursue overly easy monetary policies will see their currencies depreciate over time.
- In the Mundell–Fleming model, an expansionary fiscal policy typically results in a rise in domestic interest rates and an increase in economic activity. The rise in domestic interest rates should induce a capital inflow, which is positive for the domestic currency, but the rise in economic activity should contribute to a deterioration of the trade balance, which is negative for the domestic currency. The more mobile capital flows are, the greater the likelihood that the induced inflow of capital will dominate the deterioration in trade.
- Under conditions of high capital mobility, countries that simultaneously pursue expansionary fiscal policies and relatively tight monetary policies should see their currencies strengthen over time.
- The portfolio balance model of exchange rate determination asserts that increases in government debt resulting from a rising budget deficit will be willingly held by investors only if they are compensated in the form of a higher expected return. The higher expected return could come from (1) higher interest rates and/or a higher risk premium, (2) depreciation of the currency to a level sufficient to generate anticipation of gains from subsequent currency appreciation, or (3) some combination of the two.
- Surges in capital inflows can fuel boom-like conditions, asset price bubbles, and currency overvaluation.

- Many consider capital controls to be a legitimate part of a policymaker's toolkit. The IMF believes that capital controls may be needed to prevent exchange rates from overshooting, asset price bubbles from forming, and future financial conditions from deteriorating.
- The evidence indicates that government policies have had a significant impact on the course of exchange rates. Relative to developed countries, emerging markets may have greater success in managing their exchange rates because of their large foreign exchange reserve holdings, which appear sizable relative to the limited turnover of FX transactions in many emerging markets.
- Although each currency crisis is distinct in some respects, the following factors were identified in one or more studies:

1. Prior to a currency crisis, the capital markets have been liberalized to allow the free flow of capital.
2. There are large inflows of foreign capital (relative to GDP) in the period leading up to a crisis, with short-term funding denominated in a foreign currency being particularly problematic.
3. Currency crises are often preceded by (and often coincide with) banking crises.
4. Countries with fixed or partially fixed exchange rates are more susceptible to currency crises than countries with floating exchange rates.
5. Foreign exchange reserves tend to decline precipitously as a crisis approaches.
6. In the period leading up to a crisis, the currency has risen substantially relative to its historical mean.
7. The terms of trade (exports relative to imports) often deteriorate before a crisis.
8. Broad money growth and the ratio of M2 (a measure of money supply) to bank reserves tend to rise prior to a crisis.
9. Inflation tends to be significantly higher in pre-crisis periods compared with tranquil periods.

16 APPENDIX

Currency Codes Used

USD	US dollar
EUR	euro
GBP	UK pound
JPY	Japanese yen
MXN	Mexican peso
CHF	Swiss franc
CAD	Canadian dollar
SEK	Swedish krona
AUD	Australian dollar

KRW	Korean won
NZD	New Zealand dollar

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PRACTICE PROBLEMS

The following information relates to questions 1-5

Ed Smith is a new trainee in the foreign exchange (FX) services department of a major global bank. Smith's focus is to assist senior FX trader Feliz Mehmet, CFA. Mehmet mentions that an Indian corporate client exporting to the United Kingdom wants to estimate the potential hedging cost for a sale closing in one year. Smith is to determine the premium/discount for an annual (360-day) forward contract using the exchange rate data presented in Exhibit 1.

Exhibit 1: Select Currency Data for GBP and INR

Spot (INR/GBP)	79.5093
Annual (360-day) MRR (GBP)	5.43%
Annual (360-day) MRR (INR)	7.52%

Mehmet is also looking at two possible trades to determine their profit potential. The first trade involves a possible triangular arbitrage trade using the Swiss, US, and Brazilian currencies, to be executed based on a dealer's bid/offer rate quote of 0.2355/0.2358 in CHF/BRL and the interbank spot rate quotes presented in Exhibit 2.

Exhibit 2: Interbank Market Quotes

Currency Pair	Bid/Offer
CHF/USD	0.9799/0.9801
BRL/USD	4.1699/4.1701

Mehmet is also considering a carry trade involving the USD and the EUR. He anticipates it will generate a higher return than buying a one-year domestic note at the current market quote due to low US interest rates and his predictions of exchange rates in one year. To help Mehmet assess the carry trade, Smith provides Mehmet with selected current market data and his one-year forecasts in Exhibit 3.

Exhibit 3: Spot Rates and Interest Rates for Proposed Carry Trade

Today's One-Year MRR		Currency Pair (Price/Base)	Spot Rate Today	Projected Spot Rate in One Year
USD	0.80%	CAD/USD	1.3200	1.3151
CAD	1.71%	EUR/CAD	0.6506	0.6567
EUR	2.20%			

Finally, Mehmet asks Smith to assist with a trade involving a US multinational customer operating in Europe and Japan. The customer is a very cost-conscious industrial company with an AA credit rating and strives to execute its currency trades at the most favorable bid–offer spread. Because its Japanese subsidiary is about to close on a major European acquisition in three business days, the client wants to lock in a trade involving the Japanese yen and the euro as early as possible the next morning, preferably by 8:05 a.m. New York time.

At lunch, Smith and other FX trainees discuss how best to analyze currency market volatility from ongoing financial crises. The group agrees that a theoretical explanation of exchange rate movements, such as the framework of the international parity conditions, should be applicable across all trading environments. They note such analysis should enable traders to anticipate future spot exchange rates. But they disagree on which parity condition best predicts exchange rates, voicing several different assessments. Smith concludes the discussion on parity conditions by stating to the trainees,

I believe that in the current environment both covered and uncovered interest rate parity conditions are in effect.

1. Based on Exhibit 1, the forward premium (discount) for a 360-day INR/GBP forward contract is *closest* to:

   A. –1.546.

   B. 1.546.

   C. 1.576.

2. Based on Exhibit 2, the *most* appropriate recommendation regarding the triangular arbitrage trade is to:

   A. decline the trade, because no arbitrage profits are possible.

   B. execute the trade, buy BRL in the interbank market, and sell BRL to the dealer.

   C. execute the trade, buy BRL from the dealer, and sell BRL in the interbank market.

3. Based on Exhibit 3, the potential all-in USD return on the carry trade is *closest* to:

   A. 0.83%.

   B. 1.23%.

   C. 1.63%.

4. The factor *least likely* to lead to a narrow bid–offer spread for the industrial company's needed currency trade is the:

   A. timing of its trade.

   B. company's credit rating.

   C. pair of currencies involved.

5. If Smith's statement on parity conditions is correct, future spot exchange rates are *most likely* to be forecast by:

   A. current spot rates.

B. forward exchange rates.

C. inflation rate differentials.

The following information relates to questions 6-13

Anna Goldsworthy is the chief financial officer of a manufacturing firm headquartered in the United Kingdom. She is responsible for overseeing exposure to price risk in both the commodity and currency markets. Goldsworthy is settling her end-of-quarter transactions and creating reports. Her intern, Scott Underwood, assists her in this process.

The firm hedges input costs using forward contracts that are priced in US dollars (USD) and Mexican pesos (MXN). Processed goods are packaged for sale under licensing agreements with firms in foreign markets. Goldsworthy is expecting to receive a customer payment of JPY 225,000,000 (Japanese yen) that she wants to convert to pounds sterling (GBP). Underwood gathers the exchange rates from Dealer A in Exhibit 1.

Exhibit 1: Dealer A's Spot Exchange Rates

	Spot Exchange Rates		
Currency Pair (Price/Base)	**Bid**	**Offer**	**Midpoint**
JPY/GBP	129.65	129.69	129.67
MXN/USD	20.140	20.160	20.150
GBP/EUR	0.9467	0.9471	0.9469
USD/EUR	1.1648	1.1652	1.1650
USD/GBP	1.2301	1.2305	1.2303

The firm must also buy USD to pay a major supplier. Goldsworthy calls Dealer A with specific details of the transaction and asks to verify the USD/GBP quote. Dealer A calls her back later with a revised USD/GBP bid–offer quote of 1.2299/1.2307.

Goldsworthy must purchase MXN 27,000,000 to pay an invoice at the end of the quarter. In addition to the quotes from Dealer A, Underwood contacts Dealer B, who provides a bid–offer price of GBP/MXN 0.0403/0.0406. To check whether the dealer quotes are reflective of an efficient market, Underwood examines whether the prices allow for an arbitrage profit.

In three months, the firm will receive EUR 5,000,000 from another customer. Six months ago, the firm sold EUR 5,000,000 against the GBP using a nine-month forward contract at an all-in price of GBP/EUR 0.9526. To mark the position to market, Underwood collects the GBP/EUR forward rates in Exhibit 2.

Exhibit 2: GBP/EUR Forward Rates

Maturity	Forward Points
One month	4.40/4.55
Three months	14.0/15.0
Six months	29.0/30.0

Goldsworthy also asks for the current 90-day MRRs for the major currencies. Selected three-month MRRs (annualized) are shown in Exhibit 3. Goldsworthy studies Exhibit 3 and says, "We have the spot rate and the 90-day forward rate for GBP/EUR. As long as we have the GBP 90-day MRR, we will be able to calculate the implied EUR 90-day MRR."

Exhibit 3: 90-Day MRR

Currency	Annualized Rate
GBP	0.5800%
JPY	0.0893%
USD	0.3300%

After reading a draft report, Underwood notes, "We do not hedge the incoming Japanese yen cash flow. Your report asks for a forecast of the JPY/GBP exchange rate in 90 days. We know the JPY/GBP spot exchange rate." He asks, "Does the information we have collected tell us what the JPY/GBP exchange rate will be in 90 days?"

Goldsworthy replies, "The JPY/GBP exchange rate in 90 days would be a valuable piece of information to know. An international parity condition can be used to provide an estimate of the future spot rate."

6. Using the quotes in Exhibit 1, the amount received by Goldsworthy from converting JPY 225,000,000 will be *closest* to:

   A. GBP 1,734,906.

   B. GBP 1,735,174.

   C. GBP 1,735,442.

7. Using Exhibit 1, which of the following would be the *best* reason for the revised USD/GBP dealer quote of 1.2299/1.2307?

   A. A request for a much larger transaction

   B. A drop in volatility in the USD/GBP market

   C. A request to trade when both New York and London trading centers are open

8. Using the quotes from Dealer A and B, the triangular arbitrage profit on a transaction of MXN 27,000,000 would be *closest* to:

   A. GBP 0.

   B. GBP 5,400.

C. GBP 10,800.

9. Based on Exhibits 1, 2, and 3, the mark-to-market gain for Goldsworthy's forward position is *closest* to:

A. GBP 19,971.

B. GBP 20,500.

C. GBP 21,968.

10. Based on Exhibit 2, Underwood should conclude that three-month EUR MRR is:

A. below three-month GBP MRR.

B. equal to three-month GBP MRR.

C. above three-month GBP MRR.

11. Based on the exchange rate midpoint in Exhibit 1 and the rates in Exhibit 3, the 90-day forward premium (discount) for the USD/GBP would be *closest* to:

A. –0.0040.

B. –0.0010.

C. +0.0010.

12. Using Exhibits 1, 2, and 3, which international parity condition would Goldsworthy *most likely* use to calculate the EUR MRR?

A. Real interest rate parity

B. Covered interest rate parity

C. Uncovered interest rate parity

13. The international parity condition Goldsworthy will use to provide the estimate of the future JPY/GBP spot rate is *most likely*:

A. covered interest rate parity.

B. uncovered interest rate parity.

C. relative purchasing power parity.

The following information relates to questions 14-20

Connor Wagener, a student at the University of Canterbury in New Zealand, has been asked to prepare a presentation on foreign exchange rates for his international business course. Wagener has a basic understanding of exchange rates but would like a practitioner's perspective, and he has arranged an interview with currency trader Hannah McFadden. During the interview, Wagener asks McFadden,

Could you explain what drives exchange rates? I'm curious as to why our New

Zealand dollar was affected by the European debt crisis in 2011 and what other factors impact it.

In response, McFadden begins with a general discussion of exchange rates. She notes that international parity conditions illustrate how exchange rates are linked to expected inflation, interest rate differences, and forward exchange rates as well as current and expected future spot rates. McFadden makes the following statement:

Statement 1: "Fortunately, the international parity condition most relevant for FX carry trades does not always hold."

McFadden continues her discussion:

FX carry traders go long (i.e., buy) high-yield currencies and fund their position by shorting—that is, borrowing in—low-yield currencies. Unfortunately, crashes in currency values can occur which create financial crises as traders unwind their positions. For example, in 2008, the New Zealand dollar was negatively impacted when highly leveraged carry trades were unwound. In addition to investors, consumers and business owners can also affect currency exchange rates through their impact on their country's balance of payments. For example, if New Zealand consumers purchase more goods from China than New Zealand businesses sell to China, New Zealand will run a trade account deficit with China.

McFadden further explains,

Statement 2: "A trade surplus will tend to cause the currency of the country in surplus to appreciate, while a deficit will cause currency depreciation. Exchange rate changes will result in immediate adjustments in the prices of traded goods as well as in the demand for imports and exports. These changes will immediately correct the trade imbalance."

McFadden next addresses the influence of monetary and fiscal policy on exchange rates:

Countries also exert significant influence on exchange rates both through the initial mix of their fiscal and monetary policies and by subsequent adjustments to those policies. Various models have been developed to identify how these policies affect exchange rates. The Mundell–Fleming model addresses how changes in both fiscal and monetary policies affect interest rates and ultimately exchange rates in the short term.

McFadden describes monetary models by stating,

Statement 3: "Monetary models of exchange rate determination focus on the effects of inflation, price level changes, and risk premium adjustments."

McFadden continues her discussion:

So far, we've touched on balance of payments and monetary policy. The portfolio balance model addresses the impacts of sustained fiscal policy on exchange rates. I must take a client call but will return shortly. In the meantime, here is some relevant literature on the models I mentioned along with a couple of questions for you to consider:

Question 1: Assume an emerging market (EM) country has restrictive monetary and fiscal policies under low capital mobility conditions. Are these policies likely to lead to currency appreciation or currency depreciation or to have no impact?

Question 2: Assume a developed market (DM) country has an expansive fiscal policy under high capital mobility conditions. Why is its currency most likely to depreciate in the long run under an integrated Mundell–Fleming and portfolio balance approach?

Upon her return, Wagener and McFadden review the questions. McFadden notes that capital flows can have a significant impact on exchange rates and have contributed to currency crises in both EM and DM countries. She explains that central banks, such as the Reserve Bank of New Zealand, use FX market inter-

vention as a tool to manage exchange rates. McFadden states,

Statement 4: "Some studies have found that EM central banks tend to be more effective in using exchange rate intervention than DM central banks, primarily because of one important factor."

McFadden continues her discussion:

Statement 5: "I mentioned that capital inflows could cause a currency crisis, leaving fund managers with significant losses. In the period leading up to a currency crisis, I would predict that an affected country's:

Prediction 1: foreign exchange reserves will increase.

Prediction 2: broad money growth will increase.

Prediction 3: exchange rate will be substantially higher than its mean level during tranquil periods."

After the interview, McFadden agrees to meet the following week to discuss more recent events on the New Zealand dollar.

14. The international parity condition McFadden is referring to in Statement 1 is:

A. purchasing power parity.

B. covered interest rate parity.

C. uncovered interest rate parity.

15. In Statement 2, McFadden is *most likely* failing to consider the:

A. initial gap between the country's imports and exports.

B. effect of an initial trade deficit on a country's exchange rates.

C. lag in the response of import and export demand to price changes.

16. The *least* appropriate factor used to describe the type of models mentioned in Statement 3 is:

A. inflation.

B. price level changes.

C. risk premium adjustments.

17. The best response to Question 1 is that the policies will:

A. have no impact.

B. lead to currency appreciation.

C. lead to currency depreciation.

18. The most likely response to Question 2 is a(n):

A. increase in the price level.

B. decrease in risk premiums.

C. increase in government debt.

19. The factor that McFadden is *most likely* referring to in Statement 4 is:

A. FX reserve levels.

B. domestic demand.

C. the level of capital flows.

20. Which of McFadden's predictions in Statement 5 is *least likely to be correct*?

A. Prediction 1

B. Prediction 2

C. Prediction 3

SOLUTIONS

1. C is correct. The equation to calculate the forward premium (discount) is:

$$F_{f/d} - S_{f/d} = S_{f/d}\left(\frac{\left[\frac{Actual}{360}\right]}{1 + i_d\left[\frac{Actual}{360}\right]}\right)(i_f - i_d).$$

$S_{f/d}$ is the spot rate with GBP the base currency or d and INR the foreign currency or f. $S_{f/d}$ per Exhibit 1 is 79.5093, i_f is equal to 7.52%, and i_d is equal to 5.43%. With GBP as the base currency (i.e., the "domestic" currency) in the INR/GBP quote, substituting in the relevant base currency values from Exhibit 1 yields the following:

$$F_{f/d} - S_{f/d} = 79.5093\left(\frac{\left[\frac{360}{360}\right]}{1 + 0.0543\left[\frac{360}{360}\right]}\right)(0.0752 - 0.0543).$$

$$F_{f/d} - S_{f/d} = 79.5093\left(\frac{1}{1.0543}\right)(0.0752 - 0.0543).$$

$$F_{f/d} - S_{f/d} = 1.576.$$

2. B is correct. The dealer is posting a bid rate to buy BRL at a price that is too high. This overpricing is determined by calculating the interbank implied cross rate for the CHF/BRL using the intuitive equation-based approach:

CHF/BRL = CHF/USD × (BRL/USD)$^{-1}$, or

CHF/BRL = CHF/USD × USD/BRL.

Inverting the BRL/USD given the quotes in Exhibit 2 determines the USD/BRL bid–offer rates of 0.23980/0.23982. (The bid of 0.23980 is the inverse of the BRL/USD offer, calculated as 1/4.1702; the offer of 0.23982 is the inverse of the BRL/USD bid, calculated as 1/4.1698.) Multiplying the CHF/USD and USD/BRL bid–offer rates then leads to the interbank implied CHF/BRL cross rate:

Bid: 0.9799 × 0.23980 = 0.2349.

Offer: 0.9801 × 0.23982 = 0.23505.

Since the dealer is willing to buy BRL at 0.2355 but BRL can be purchased from the interbank market at 0.23505, there is an arbitrage opportunity to buy BRL in the interbank market and sell BRL to the dealer for a profit of 0.0045 CHF (0.2355 – 0.23505) per BRL transacted.

3. A is correct. The carry trade involves borrowing in a lower-yielding currency to invest in a higher-yielding one and netting any profit after allowing for borrowing costs and exchange rate movements. The relevant trade is to borrow USD and lend in EUR. To calculate the all-in USD return from a one-year EUR MRR deposit, first determine the current and one-year-later USD/EUR exchange rates. Because one USD buys CAD 1.3200 today and one CAD buys EUR 0.6506 today, today's EUR/USD rate is the product of these two numbers: 1.3200 × 0.6506 = 0.8588. The projected rate one year later is 1.3151 × 0.6567 = 0.8636. Accordingly, measured in dollars, the investment return for the unhedged EUR MRR deposit is equal to

$(1.3200 \times 0.6506) \times (1 + 0.022) \times [1/(1.3151 \times 0.6567)] - 1$
$= 0.8588 \times (1.022)(1/0.8636) - 1 = 1.01632 - 1$

$= 1.632\%$.

However, the borrowing costs must be charged against this *gross* return to fund the carry trade investment (one-year USD MRR was 0.80%). The *net* return on the carry trade is therefore 1.632% – 0.80% = 0.832%.

4. B is correct. While credit ratings can affect spreads, the trade involves spot settlement (i.e., two business days after the trade date), so the spread quoted to this highly rated (AA) firm is not likely to be much tighter than the spread that would be quoted to a somewhat lower-rated (but still high-quality) firm. The relationship between the bank and the client, the size of the trade, the time of day the trade is initiated, the currencies involved, and the level of market volatility are likely to be more significant factors in determining the spread for this trade.

5. B is correct. By rearranging the terms of the equation defining covered interest rate parity and assuming that uncovered interest rate parity is in effect, the forward exchange rate is equal to the expected future spot exchange rate—$F_{f/d} = S^e_{f/d}$—with the expected percentage change in the spot rate equal to the interest rate differential. Thus, the forward exchange rate is an unbiased forecast of the future spot exchange rate.

6. A is correct. Goldsworthy has been given a bid–offer spread. Because she is buying the base currency—in this case, GBP—she must pay the offer price of JPY 129.69 per GBP.

$$\frac{\text{JPY } 225{,}000{,}000}{129.69 \text{ JPY/GBP}} = \text{GBP } 1{,}734{,}906.$$

7. A is correct. Posted quotes are typically for transactions in 1 million units of the base currency. Larger transactions may be harder for the dealer to sell in the interbank market and would likely require the dealer to quote a wider spread (lower bid price and higher offer price).

8. A is correct. Using quotes from Dealer A, she can find

$$\frac{\text{MXN}}{\text{GBP}} = \frac{\text{MXN}}{\text{USD}} \times \frac{\text{USD}}{\text{GBP}}.$$

The bid from Dealer A for MXN/GBP is effectively

$$\left(\frac{\text{MXN}}{\text{GBP}}\right)_{bid} = \left(\frac{\text{MXN}}{\text{USD}}\right)_{bid} \times \left(\frac{\text{USD}}{\text{GBP}}\right)_{bid}$$
$$= 20.140 \times 1.2301 = 24.7742.$$

The offer from Dealer A is

$$\left(\frac{\text{MXN}}{\text{GBP}}\right)_{offer} = \left(\frac{\text{MXN}}{\text{USD}}\right)_{offer} \times \left(\frac{\text{USD}}{\text{GBP}}\right)_{offer}$$
$$= 20.160 \times 1.2305 = 24.8069.$$

To compare with Dealer B's quote, she must take the inverse of MXN/GBP, so she has an offer to sell MXN at a rate of 1/24.7742 = GBP 0.0404 and a bid to purchase MXN at a rate of 1/24.8069 = GBP 0.0403. Dealer A is effectively quoting GBP/MXN at 0.0403/0.0404. Although she can effectively buy MXN more cheaply from Dealer A (GBP 0.0404 from Dealer A, versus GBP 0.0406 from Dealer B), she cannot resell them to Dealer B for a higher price than GBP 0.0403. There is no profit from triangular arbitrage.

9. A is correct. Marking her nine-month contract to market six months later

requires buying GBP/EUR three months forward. The GBP/EUR spot rate is 0.9467/0.9471, and the three-month forward points are 14.0/15.0. The three-month forward rate to use is 0.9471 + (15/10000) = 0.9486. Goldsworthy sold EUR 5,000,000 at 0.9526 and bought at 0.9486. The net cash flow at the settlement date will equal EUR 5,000,000 × (0.9526 – 0.9486) GBP/EUR = GBP 20,000. This cash flow will occur in three months, so we discount at the three-month GBP MRR of 58 bps:

$$\frac{\text{GBP } 20{,}000}{1 + 0.0058\left(\frac{90}{360}\right)} = \text{GBP } 19{,}971.04.$$

10. A is correct. The positive forward points for the GBP/EUR pair shown in Exhibit 2 indicate that the EUR trades at a forward premium at all maturities, including three months. Covered interest rate parity,

$$F_{f/d} = S_{f/d}\left(\frac{1 + i_f\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right),$$

suggests a forward rate greater than the spot rate requires a non-domestic risk-free rate (in this case, the GBP MRR) greater than the domestic risk-free rate (EUR MRR). When covered interest rate parity is violated, traders can step in and conduct arbitrage.

11. B is correct. Using covered interest rate parity, the forward rate is

$$F_{f/d} = S_{f/d}\left(\frac{1 + i_f\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right)$$

$$= 1.2303\left(\frac{1 + 0.0033\left[\frac{90}{360}\right]}{1 + 0.0058\left[\frac{90}{360}\right]}\right) = 1.2295.$$

Because the domestic MRR is higher than the non-domestic MRR, the forward rate will be less than the spot rate, giving a forward discount of

$$F_{f/d} - S_{f/d} = 1.2295 - 1.2303 = -0.0008.$$

12. B is correct. The covered interest rate parity condition,

$$F_{f/d} = S_{f/d}\left(\frac{1 + i_f\left[\frac{\text{Actual}}{360}\right]}{1 + i_d\left[\frac{\text{Actual}}{360}\right]}\right), \text{ (Equation 1)}$$

specifies the forward exchange rate that must hold to prevent arbitrage given the spot exchange rate and the risk-free rates in both countries. If the forward and spot exchange rates, as well as one of the risk-free rates, are known, the other risk-free rate can be calculated.

13. B is correct. According to uncovered interest rate parity,

$$\%\Delta S^e_{f/d} = i_f - i_d, \text{ (Equation 2)}$$

the expected change in the spot exchange rate should reflect the interest rate spread between the two countries, which can be found in Exhibit 3. Given the spot exchange rate (from Exhibit 1) and the expected future change, she should be able to estimate the future spot exchange rate.

14. C is correct. The carry trade strategy is dependent on the fact that uncovered interest rate parity does not hold in the short or medium term. If uncovered interest rate parity held, it would mean that investors would receive identical returns

from either an unhedged foreign currency investment or a domestic currency investment because the appreciation/depreciation of the exchange rate would offset the yield differential. However, during periods of low volatility, evidence shows that high-yield currencies do not depreciate enough and low-yield currencies do not appreciate enough to offset the yield differential.

15. C is correct. McFadden states that exchange rates will *immediately* correct the trade imbalance. She is describing the flow supply/demand channel, which assumes that trade imbalances will be corrected as the deficit country's currency depreciates, causing its exports to become more competitive and its imports to become more expensive. Studies indicate that there can be long lags between exchange rate changes, changes in the prices of traded goods, and changes in the trade balance. In the short run, exchange rates tend to be more responsive to investment and financing decisions.

16. C is correct. Risk premiums are more closely associated with the portfolio balance approach. The portfolio balance approach addresses the impact of a country's net foreign asset/liability position. Under the portfolio balance approach, investors are assumed to hold a diversified portfolio of assets including foreign and domestic bonds. Investors will hold a country's bonds as long as they are compensated appropriately. Compensation may come in the form of higher interest rates and/or higher risk premiums.

17. B is correct. The currency is likely to appreciate. The emerging market country has both a restrictive monetary policy and a restrictive fiscal policy under conditions of low capital mobility. Low capital mobility indicates that interest rate changes induced by monetary and fiscal policy will not cause large changes in capital flows. Implementation of restrictive policies should result in an improvement in the trade balance, which will result in currency appreciation.

18. C is correct. Expansionary fiscal policies result in currency depreciation in the long run. Under a portfolio balance approach, the assumption is that investors hold a mix of domestic and foreign assets including bonds. Fiscal stimulus policies result in budget deficits, which are often financed by debt. As the debt level rises, investors become concerned as to how the ongoing deficit will be financed. The country's central bank may need to create more money in order to purchase the debt, which would cause the currency to depreciate. Or the government could adopt a more restrictive fiscal policy, which would also depreciate the currency.

19. A is correct. EM countries are better able to influence their exchange rates because their reserve levels as a ratio of average daily FX turnover are generally much greater than those of DM countries. This means that EM central banks are in a better position to affect currency supply and demand than DM countries, where the ratio is negligible. EM policymakers use their foreign exchange reserves as a kind of insurance to defend their currencies, as needed.

20. A is correct. Prediction 1 is least likely to be correct. Foreign exchange reserves tend to decline precipitously, not increase, as a currency crisis approaches. Broad money growth tends to rise in the period leading up to a currency crisis, and the exchange rate is substantially higher than its mean level during tranquil periods.