LM01 Currency Exchange Rates: Understanding Equilibrium Value

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1. Introduction

Exchange rates usually follow a random walk, i.e., fluctuations from one day to the next are unpredictable. Therefore, forecasting exchange rate movements can be a difficult task. This reading focuses on tools one can use to understand exchange rates and their long-term equilibrium value.

2. Foreign Exchange Market Concepts

An exchange rate is the price of the base currency expressed in terms of the price currency. For example, a USD/EUR rate of 1.3650 means the euro, the base currency, costs 1.3650 US dollars. Although different conventions can be used to express exchange rates, the curriculum (and exam questions) follows the Price Currency and Base Currency convention, "P/B".

Instructor's Note: Remember 'base' in the 'base'.

Currency quotes in the foreign exchange market are two sided; each quote has both a bid price and an offer price. The bid price represents the price at which the dealer is willing to buy the currency and the offer price represents the price at which the dealer is willing to sell the currency. Hence, a USD/EUR exchange rate of 1.3646/1.3651 means that the dealer is willing to buy one euro for USD 1.3646 and sell one euro for USD 1.3651. The offer price is also referred to as the "ask" price.

Instructor's Note: Remember 'b' for 'bid' and 'b' for 'buy'.

Most currencies are quoted to four decimal places, and one 'pip' is equal to 0.0001. The bid-offer spread in our example is 1.3651 – 1.3646 = 0.0005 = 5 pips. Some currencies are quoted to two decimal places, here one pip = 0.01 (for example, Japanese Yen).

The offer price is always higher than the bid price because the dealer seeks a compensation for providing foreign exchange to the market participants. The participant who receives the quote has the option (but not the obligation) to either sell the currency at the dealer's bid price or buy the currency at the dealer's offer price.

Factors that Affect Bid-Offer Spread

The size of the bid-offer spread that the dealer quotes to clients can vary depending on different factors. These factors are discussed below.

Primary Factors

1. *The currency pair involved*: Liquidity in major currency pairs such as USD/EUR, JPY/USD, and USD/GBP is generally higher than that in less popular pairs. Therefore, major currency pairs have lower spreads.

2. *The time of the day*: The interbank market is most liquid when major trading centers are open. Hence, liquidity would be higher when London and New York, two of the largest trading centers, are open at the same time.
3. *Market volatility*: If market volatility is high, market participants will charge a higher price for taking on risk, leading to high bid-offer spreads.

Secondary Factors

1. *The size of the transaction*: The larger the transaction size, the wider the bid-offer spread. This is because the dealer is taking larger FX risk and seeks compensation in the form of wider spreads.
2. *The relationship between the dealer and the client*: Dealers often offer more than just foreign exchange related services to clients. In order to secure regular business from the client in foreign exchange as well as in other asset classes, the dealer may offer tight bid-offer spreads.
3. *Client's credit profile*: If the client has poor credit history, the dealer may offer a wider bid-offer spread.

3. Arbitrage Constraints on Spot Exchange Rate Quotes

There are two primary constraints on spot exchange rate quotes:

1. The dealer bid cannot be higher than the interbank offer: We shall call this scenario **DBi G IO** (dealer bid greater than interbank offer). If the dealer's bid quote is higher than the interbank offer quote, then market participants can buy in the interbank market and sell to the dealer to make a riskless profit.

   For example, if the JPY/USD quote by the dealer is 100.50/100.60 and in the interbank market the quote is 100.40/100.45, then the participant can buy the base currency (USD) at 100.45 in the interbank market and sell at 100.50 to the dealer to make an arbitrage profit of JPY 0.05 per USD.

2. The dealer offer cannot be lower than the interbank bid: We shall call this scenario **DO L IB** (dealer offer lower than interbank bid). If the dealer offer is less than the interbank bid, the market participant can buy from the dealer and sell in the interbank market.

   For example, if the JPY/USD quote by the dealer is 100.50/100.60 and in the interbank market the quote is 100.70/100.75, then the market participant can buy the base currency (USD) from the dealer at 100.60 and sell in the interbank market at 100.70 to make an arbitrage profit of JPY 0.10 per USD.

Understanding Cross Rates

Assume A, B and C are three different currencies. We are given a quote for A/B and B/C and we wish to obtain a quote for A/C. The implied A/C can be derived using the A/B and the B/C

rates. This is demonstrated by the simple expression that:

$$\frac{A}{C} = \frac{A}{B} \times \frac{B}{C}$$

In this expression, 'B' would cancel out in the denominator and the numerator leaving us with the desired quote.

In foreign exchange markets, however, we have a two-sided quote for each currency pair, i.e., a bid and an offer for each pair. To derive the cross rates using bids and offers, the following relations should be kept in mind:

$$\frac{A}{C_{bid}} = \frac{A}{B_{bid}} \times \frac{B}{C_{bid}}$$

And:

$$\frac{A}{C_{offer}} = \frac{A}{B_{offer}} x \frac{B}{C_{offer}}$$

These are relatively straightforward relationships. A slight complication arises when we are given a quote where one currency does not 'cancel out' in our cross-rate expression. For example, if we are given a quote on A/B and a quote on C/B and we need a quote on A/C, then using these quotes as they are to determine the cross rate would give:

$$\frac{A}{C} \neq \frac{A}{B} \times \frac{C}{B}$$

This expression does not cancel out 'B' from the numerator and denominator, hence we cannot use these quotes as is to determine the cross rate. We need to convert the C/B quote to a B/C quote, i.e., a reciprocal quote. When converting a quote to a reciprocal quote, note that:

- B/C bid is the reciprocal of C/B offer, and
- B/C offer is the reciprocal of C/B bid

So, if we are given a quote on USD/EUR as 1.3456/1.3460 and we need to convert this to a reciprocal quote of EUR/USD. We can find the EUR/USD bid as the reciprocal of USD/EUR offer: 1/1.3460 = 0.7429. Likewise, the EUR/USD offer would be the reciprocal of the USD/EUR bid: 1/1.3456 = 0.7432. This gives us an EUR/USD quote of 0.7429/0.7432. Note that the bid is lower than the offer, as it should be.

With cross rates, our earlier established arbitrage constraints should hold:

- The dealer cross-rate bid must be lower than the implied interbank cross-rate offer, and
- The dealer cross rate offer must be higher than the implied interbank cross-rate bid.

Triangular Arbitrage

A triangular arbitrage opportunity exists if either of the two conditions mentioned above are violated. For every possible instance of determining whether a triangular arbitrage opportunity exists, the following steps need to be followed:

1. Calculate the cross-rate implied by the interbank market.
2. Compare the interbank rate with the dealer rate.
   - If dealer bid > interbank offer (DBi G IO) → buy base currency in the interbank market and sell to the dealer
   - If dealer offer < interbank bid (DO L IB) → buy base currency from dealer and sell in the interbank market

If you are asked to calculate the arbitrage profit, the additional steps will depend on what currency you start with and the currency in which you need to report the profit.

Consider an interbank quote of 85.76/85.80 on the currency pair A/B. The dealer quotes on the same currency from three dealers are as follows:
Dealer 1 quote: 85.74/85.81
Dealer 2 quote: 85.73/85.75
Dealer 3 quote: 85.81/85.83

When assessing for triangular arbitrage, we suggest using a 'number line' format, where the interbank and dealer rates are represented along a number line:

Step 1: Write the interbank rate within two lines as follows:

| 85.76 85.80 |

Step 2: Write all dealer quotes with reference to the interbank quote within the two lines. So, a number less that 85.76 would appear to the left of the interbank quote whereas a number greater than 85.80 would appear to the right of the interbank quote. The three dealer quotes can be represented as follows:

Interbank quote		85.76 85.80	
Dealer 1 quote	85.74		85.81
Dealer 2 quote	85.73 85.75		
Dealer 3 quote			85.81 85.83
Arbitrage condition	**DO L IB**		**DBi G IO**

Step 3: If the dealer quote falls entirely to the left of the interbank quote, then the DO L IB condition exists and an arbitrage profit can be made by buying base currency from the dealer and selling it in the interbank market. On the other hand, if the dealer quote falls entirely to the right of the interbank quote, then the DBi G IO condition exists and an arbitrage profit can be made by buying the base currency in the interbank market and selling it to the dealer. Any other arrangement of the dealer quote will not result in an arbitrage

opportunity. Therefore, in our example, dealer 1's quote does not provide an arbitrage opportunity, whereas dealer 2's quote provides an arbitrage opportunity as it meets the DO L IB condition and dealer 3's quote provides an arbitrage opportunity as it meets the DBi G IO condition.

Example: Bid-Offer Rates

(*This is based on Example 1 from the curriculum.*)

The following are spot rate quotes in the interbank market:

USD/EUR	1.4559/1.4561
JPY/USD	81.87/81.89
CAD/USD	0.9544/0.9546
SEK/USD	6.8739/6.8741

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

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

3. If a dealer quoted a bid–offer rate of 85.73/85.75 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.

4. If a dealer quoted a bid–offer of 85.74/85.81 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.

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?

Solution to 1:

To calculate the SEK/EUR rate, we multiply the SEK/USD and USD/EUR rates

Bid: 10.0077 = 6.8739 × 1.4559

Offer: 10.0094 = 6.8741 × 1.4561

Solution to 2:

To calculate the JPY/CAD rate, we have to multiply the JPY/USD and USD/CAD rates.

But we are not given the USD/CAD rate directly, we have to invert the CAD/USD quotes to get this rate. Given the CAD/USD quotes of 0.9544/0.9546, we take the inverse of each and interchange bid and offer, so that the USD/CAD quotes are (1/0.9546)/(1/0.9544), or 1.04756/1.04778

Multiplying the JPY/USD and USD/CAD we get:

Bid: 85.76 = 81.87 × 1.04756

Offer: 85.80 = 81.89 × 1.04778

Solution to 3: C is correct.

The implied interbank cross rate for JPY/CAD is 85.76/85.80 (the answer to Question 2).

The dealer's quote is 85.73/85.75 which lies entirely to the left of the interbank rate, i.e., we have a 'DO L IB' situation. Hence, an arbitrage opportunity exists. We can buy CAD from the dealer at 85.75 and sell CAD in the interbank market at 85.76, for a profit of JPY 0.01 per CAD.

Solution to 4: A is correct.

The implied interbank cross rate for JPY/CAD is 85.76/85.80 (the answer to Question 2).

The dealer's quote is 85.74/85.81 which does not lie entirely to the left or the right of the interbank rate, i.e., we do not have a 'DO L IB' or 'DBi G IO' situation. Hence, no arbitrage opportunity exists.

Solution to 5: Transactions 3, 1, 2

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.

4. Forward Markets

Forward contracts are agreements to exchange one currency for another on a future date at an exchange rate agreed upon today. Any exchange transaction that has a settlement date later than T+2 is a forward contract.

The forward rate can be calculated as:

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

where:

$F_{P/B}$ = forward rate

$S_{P/B}$ = spot rate

i_P = interest rate in the price currency

i_B = interest rate in the base currency

Actual = number of days in the underlying forward contract

Instructor's Note: Remember 'base' in the 'base'.

Once we have calculated the forward rate, we can calculate the forward premium:

Forward premium = Forward rate – Spot rate

The expression for the forward rate implies that:

- If the base currency interest rate is less than the price currency interest rate, then the forward rate > spot rate and the forward premium is positive.
- If the base currency interest rate is greater than the price currency interest rate, then forward rate < spot rate and the forward premium is negative.

Example: Calculating the Forward Premium (Discount)
(*This is based on Example 2 from the curriculum.*)

The following information is provided:

Spot (CAD/AUD)	1.0145
270-day Libor (AUD)	4.87%
270-day Libor (CAD)	1.41%

What is the forward premium (discount) for a 270-day forward contract for CAD/AUD?

Solution:

$$F_{P/B} = S_{P/B}\left(\frac{\left(1 + i_P\left[\frac{\text{Actual}}{360}\right]\right)}{\left(1 + i_B\left[\frac{\text{Actual}}{360}\right]\right)}\right) = 1.0145\left(\frac{\left(1 + 0.0141\left[\frac{270}{360}\right]\right)}{\left(1 + 0.0487\left[\frac{270}{360}\right]\right)}\right) = 0.9894$$

Forward premium = Forward rate – Spot rate = 0.9894 – 1.0145 = -0.0251

Instructor's Note:

1. As expected, since the base currency interest rate (4.87%) is greater than the price currency interest rate (1.41%), the forward rate is less than the spot rate and the forward premium is negative.
2. The answer we get using this method is slightly different from the answer in the curriculum due to rounding error. On the exam, use this method and pick an answer option that is closest to the calculated number.

In professional FX markets, forward rates are quoted in terms of points, which represent the difference between the forward rate and the spot rate. Just like the spot rate is quoted in terms of a bid and offer, the forward rate is also quoted in terms of the points on the bid and points on the offer. This is shown in Exhibit 1 of the curriculum presented below:

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

Maturity	**Spot Rate**
Spot (USD/EUR)	1.3549/1.3651
	Forward Points
One month	–5.6/–5.1
Three months	–15.9/–15.3
Six months	–37.0/–36.3
Twelve months	–94.3/–91.8

- As the points are negative, the currency trades at a forward discount.
- In the table, the points correspond to the last decimal place in the quote. In our example, the rate is quoted to four decimal places. Therefore, to convert the points into the actual exchange rate difference, divide the points by 10,000. Hence, the forward discount on the one month forward bid rate is -5.6/10,000 = -0.00056 and on the one month forward offer rate is -5.1/10,000 = -0.00051. The one-month forward quote is actually 1.3549-0.00056/1.3651-0.00051 = 1.35434/1.36459.
- The number of points is a function of the term of the contract; the longer the term of the contract, the larger the number of points.

5. The Mark- to- Market Value of a Forward Contract

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. At contract initiation, the forward rate is set such that the market value of the forward contract is zero. As time passes, the spot rate and interest rates in countries change, causing a change in the value of the forward contract.

We shall explain the mark-to-market process through an example used in the curriculum.

Suppose that an individual buys 10 million GBP against AUD in a six-month forward contract with a forward rate of 1.6100 AUD/GBP. What is the value three months later if the spot rate = 1.6210/1.6215 and 3-month points = 130/140. Three-month AUD Libor = 4.8%

To calculate the mark-to-market value of a forward contract, the following process is used:

1. Create an offsetting forward position that is equal to the original forward position. Hence, the individual would **sell** 10 million GBP against AUD in a 3-month forward contract. The term of the contract is three months because three months have already passed and the remaining time to the maturity of the original contract is three months.
2. Determine the appropriate all-in forward rate for this new, offsetting forward position. As the individual has to sell the currency, the appropriate rate is the market bid rate, i.e., 1.6210 +130/10,000 = 1.6340.
3. Calculate the cash flow on the settlement day. For our individual, the buying rate is 1.6100 and the selling rate is 1.6340. This means the individual sells higher than he bought, resulting into a cash inflow of (1.6340 – 1.6100) × 10,000,000 = +AUD 240,000.
4. Calculate the present value of this cash flow at the future settlement date. As the cash flow is to occur at the contract maturity date (3-months in our example), the cash flow must be discounted to find its current value. The cash flow is in AUD, therefore, the relevant discount rate is the 3-month AUD LIBOR. The present value of the cash flow is therefore:
$$\frac{\text{AUD } 240{,}000}{1 + 0.048\left(\frac{90}{360}\right)} = \text{AUD } 237{,}154$$

This is the mark-to-market value of the forward contract.

Example: Forward Rates and the Mark-to-Market Value of Forward Positions
(*This is Example 3 from the curriculum.*)

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)	1.4939/1.4941
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. What is the current all-in bid rate for delivery of GBP against the CHF in three months?

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

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 Libors (annualized) are as follows:

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

3. What is the mark-to-market value for Laurier Bay's forward position?

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.

4. Using the above table, what is the mark-to-market value for Laurier Bay's short USD forward position?

Solution to 1:

The current all-in three-month bid rate for GBP (the base currency) is equal to 1.4939 + (–25.4/10,000) = 1.49136.

Solution to 2:

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 1.4941 + (–54.0/10,000) = 1.48870.

Solution to 3:

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 Libor for this purpose):

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

Solution to 4:

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

NZD 12,658,228 – NZD 12,799,345 = –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 Libor:

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

6. A Long- Term Framework for Exchange Rates

This section lays out a framework for establishing a view on long term currency exchange rates. Certain concepts that have to be considered are:

1. Long run vs. short run: Certain factors determine the direction of exchange rates over the long run but may be a poor guide over the short run.
2. Expected vs. unexpected changes: In efficient markets, expected changes in market factors are reflected in exchange rates. However, unexpected changes will have a discrete and immediate impact on exchange rates.
3. Relative movements: An exchange rate represents the relative price of one currency in terms of another. Hence, when analyzing equilibrium exchange rates, the difference between factors across countries is more important that their absolute values in one particular country.

There is no simple model or formula which allows us to precisely forecast exchange rates, rather the tools discussed here can allow market participants to establish a view on long-term equilibrium exchange rates.

6.1 International Parity Conditions

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 are related to one another in an ideal world.

7. Covered Interest Rate Parity, Uncovered Interest Rate Parity, & Forward Rate Parity

Covered interest rate parity was discussed earlier under forward exchange rates. It is expressed as:

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

Under this parity condition, an investment in a foreign money market instrument that is completely hedged against exchange rate risk should yield the exact same return as an otherwise identical domestic money market investment.

The forward exchange rate should be such that it results in the same return for these two alternate investment strategies:

- Invest in a domestic money market instrument.
- Invest in a fully currency-hedged foreign money market instrument.

Arbitrage ensures that covered interest rate parity holds.

7.1 Uncovered Interest Rate Parity

Under uncovered interest rate parity, the **expected** return on an un-hedged foreign currency investment should equal the return on a similar domestic currency investment. Uncovered interest rate parity states that the change in spot rate over the investment horizon should offset the interest rate differentials between the two countries.

The return on a foreign investment would be equal to the foreign interest rate and the change in spot rate over the investment period. This is shown in the expression below:

$$(1 + i_f)(1 - \%\Delta S_{f/d}) - 1$$

Uncovered interest rate parity states that this return should be equal to the return on a domestic money market instrument over the same time horizon. If the foreign interest rate is higher than the domestic interest rate, the foreign spot rate is expected to depreciate such that the net return is equal to the domestic interest rate. On the other hand, if the foreign interest rate is lower than the domestic interest rate, the foreign spot rate is expected to appreciate such that the net return is equal to the domestic interest rate. As an expression this can be shown as:

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

There is no arbitrage relationship which forces uncovered interest rate parity to hold.

7.2 Forward Rate Parity

Forward rate parity states that the forward exchange rate will be an unbiased predictor of the future spot exchange rate if both covered and uncovered interest rate parity hold. Therefore, we can state the following:

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

If uncovered interest rate parity holds, then forward rate parity holds. However, the uncovered interest rate parity relationship:

- is not enforced by arbitrage.
- assumes that investors are risk neutral, which is not the case.

As a result, uncovered interest rate parity is often violated and the forward rate is a poor predictor of expected spot rate.

Example: Covered and Uncovered Interest Rate Parity: Predictors of Future Spot Rates
(*This is Example 4 from the curriculum.*)

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)	79.25
One-year forward points (mid-market)	–301.9
One-year Australian deposit rate	5.00%
One-year Japanese deposit rate	1.00%

1. Based on uncovered interest rate parity, over the next year, what is the expected change in the JPY/AUD rate?

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.

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.

4. Forecasting that the JPY/AUD spot rate one year from now will equal 79.25 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.

5. If the asset manager completely hedged the currency risk associated with a one-year Japanese deposit using a forward rate contract, what is the one-year all-in holding return, in AUD?

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 Libor		**Currency Pair**	**Spot Rate Today**
JPY	0.10%	JPY/USD	81.30
USD	0.10%	USD/GBP	1.5950
GBP	3.00%	JPY/GBP	129.67

6. If covered interest rate parity holds, what is the all-in one-year investment return to a Japanese investor whose currency exposure to the GBP is fully hedged?

7. If uncovered interest rate parity holds, today's expected value for the JPY/GBP currency pair one year from now?

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

Solution to 1:
The expected decline in the JPY/AUD rate is equal to the interest rate differential between Australia and Japan: 5% – 1% = 4%.

Solution to 2:
C is correct.

Solution to 3:
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.

Solution to 4:
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.

Solution to 5:
According to covered interest rate parity, a fully hedged JPY investment would provide the same return as the AUD investment: 5%.

Solution to 6:
If covered interest rate parity holds then the all-in investment return to a Japanese investor in a one-year, fully hedged GBP Libor position would be identical to a one-year JPY Libor position: 0.10%.

Solution to 7:
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.

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

Solution to 8:

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 Libor and JPY Libor. So, the expected change in spot rate is 0%.

8. Purchasing Power Parity

Law of one price: Purchasing power parity (PPP) examines the relationship between exchange rates and inflation differentials. PPP is based on the law of one price, which states that identical goods should trade at the same price across countries when valued in terms of a common currency.

Absolute version of PPP: The absolute version of PPP states that the nominal exchange rate will be determined entirely by the ratio of the foreign and domestic broad price indexes:

$$S_{f/d} = \frac{P_f}{P_d}$$

The absolute version of PPP assumes that 1) all domestic and foreign goods are tradable and 2) domestic and foreign price indexes include the same bundle of goods and services with the same exact weights in each country. These assumptions rarely hold true in the real world.

Relative version of PPP: The relative version of PPP states that the percentage change in the spot exchange rate ($\%S_{f/d}$) will be completely determined by the difference between the foreign and domestic inflation rates ($\pi_f - \pi_d$):

$$\%\Delta S_{f/d} \cong \pi_f - \pi_d$$

For instance, if the foreign inflation rate is 10% and the domestic inflation rate is 2%, the $S_{f/d}$ exchange rate must appreciate by 8% to maintain the relative competitiveness of both regions.

Ex ante version of PPP: The relative version of PPP is based on the 'actual' exchange rate movements and 'actual' inflation differentials, however, the ex-ante version of PPP states that 'expected' changes in spot exchange rates are driven by 'expected' inflation differentials:

$$\%\Delta S^e_{f/d} = \pi^e_f - \pi^e_d$$

Over short time horizons, nominal exchange rate movements appear random. However, over longer time horizons, nominal exchange rates tend to gravitate toward their long-run PPP equilibrium values.

9. The Fisher Effect, Real Interest Rate Parity and Tying the International Parity Conditions Together

Real interest rate parity: If uncovered interest rate parity and ex ante PPP hold, the real interest rate in the domestic country should be equal to the real interest rate in the foreign currency, i.e., real interest rates should converge to the same level across different markets.

International Fisher effect: If real interest rate parity holds, the foreign-domestic nominal yield spread is determined solely by the foreign-domestic expected inflation differential.

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

However, the assumption made here is that the currency risk is the same throughout the world, which is not true in reality. Hence, the international Fisher effect does not always hold.

Example: PPP and the International Fisher Effect
(*This is Example 5 from the curriculum.*)

An Australia-based fixed-income investment manager is deciding how to allocate her portfolio between Australia and Japan. (AUD is the domestic currency.) Australia's one-year deposit rate is 5%, considerably higher than Japan's at 1%, 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 4%.
B. The Australian inflation rate decreases by 10%.
C. The JPY/AUD exchange rate declines by 10%.

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. 4%.
C. 10%.

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.

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 to 1:
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.

Solution to 2:
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 (5% – 1%).

Solution to 3:
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.

Solution to 4:
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.

9.1 International Parity Conditions: Tying All the Pieces Together

The summary of key international parity conditions is as follows:

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 in the spot exchange rate should, on average, be equal to the nominal interest rate spread.
3. If both covered and uncovered interest rate parity hold, then the forward exchange rate will be an unbiased predictor of the future spot exchange rate.
4. According to the ex-ante PPP the expected change in the spot exchange rate should equal the expected difference between domestic and foreign inflation rates.
5. According to the International Fisher effect, the nominal yield spread between domestic and foreign markets will equal the domestic-foreign expected inflation differential.

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
- the difference between expected national inflation rates

It would then be impossible for a global investor to earn consistent profits on currency movements.

Example: The Relationships among the International Parity Conditions
(*This is Example 6 from the curriculum.*)

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

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

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

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.

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 to 1:
B is correct. Covered interest rate parity is enforced by equating the investment return on two riskless investments (domestic and currency-hedged foreign).

Solution to 2:
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.

Solution to 3:
B is correct. The international Fisher effect is based on real interest rate parity and ex ante PPP (not absolute PPP).

Solution to 4:
B is correct. The forward premium/discount is determined by covered interest rate arbitrage.

Solution to 5:
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.

10. The Carry Trade

If the uncovered interest rate parity holds, then exchange rate movements would cancel out the extra return that a high yielding foreign currency would earn such that the net return would be equal to that of the lower yielding domestic currency. However, empirical evidence suggests that: high-yield currencies, on average, have not depreciated, and low-yield currencies have not appreciated to the levels predicted by interest rate differentials, making it possible to earn more by investing in a higher yielding currency. Such a trade is called the **FX carry trade**, which involves taking long positions in a high yielding currency and a short position in a low yielding currency.

For example, if the US interest rate is 2% and the Pakistani interest rate is 8%, the trader would seek to earn 6% in the interest rate differential by borrowing US dollars at 2% at t=0, convert them to Pakistani Rupees at the USD/PKR spot rate at t=0, invest at the Pakistani interest rate of 8% from t=0 to t=1, sell Pakistani rupees at the PKR/USD spot rate at t=1 and pay back the dollar loan. If the rupee depreciates against the dollar, the trader's profits would be less than 8% as the weaker rupee would buy fewer dollars at t=1.

Investing in the higher yielding currency entails a risk of investing in a relatively unstable economy. Also, carry trade strategies involve leverage which increases volatility of returns. Hence, during turbulent economic times, such carry trades can yield significant losses if the higher yielding currency depreciates substantially. Due to the potential of high losses, carry trade returns are more peaked, with fatter tails relative to normal distribution and negative skewness.

Example: Carry Trade Strategies
(*This is Example 7 from the curriculum.*)

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.

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.

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.

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

Today's One-Year Libor		**Currency Pair**	**Spot Rate Today**	**Spot Rate One Year Later**
JPY	0.10%	JPY/USD	81.30	80.00
AUD	4.50%	USD/AUD	1.0750	1.0803

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

A. +1.84%.
B. +3.23%.
C. +5.02%.

Solution to 1:

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

Solution to 2:

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).

Solution to 3:

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.

Solution to 4:

B is correct. Assuming an initial position of, for example, 100 yen (JPY 100), the investor will obtain JPY 100 × 1/JPY 87.40 = AUD 1.1442. After one year, the investment will be worth AUD 1.1442 × 1.045 = AUD 1.1957. Converting back to yen in one year results in AUD 1.1957 × JPY 86.42/AUD = JPY 103.33. Paying off the yen loan results in a profit of JPY 103.33 – (JPY 100 × 1.001) = JPY 3.23. In percentage terms, this is 3.23% since our investment was 100 JPY.

11. The Impact of Balance of Payments Flows: Current Account Imbalances and the Determination of Exchange Rates

A country's balance of payment consists of:

- Current account: which reflects flows related to the real economy (trade in goods and services)
- Capital account: which reflects financial/ investment flows.

A current account surplus (deficit) means that exports are greater than (less than) imports. The balance in a country's current account must be offset by an equal and opposite balance in the capital account. Countries running a current account deficit must have inflows from abroad in order to pay for the higher imports, i.e., a capital account surplus.

Over the long term, countries that run persistent current account deficits see their currencies depreciate as they have to finance those deficits with foreign debt. Similarly, countries that run persistent current account surpluses see their currencies appreciate.

Over the short run, investment/financing decisions are the dominant factor in determining exchange rate movements because:

- Prices of real goods and services tend to adjust slowly, whereas exchange rates and stocks/bonds adjust quickly.
- Production of real goods and services takes time, whereas financial flows are fast.
- 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.

11.1 Current Account Imbalances and the Determination of Exchange Rates

Current account trends influence the direction of exchange rates over time through various mechanisms:

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

The Flow Supply/Demand Channel

The purchase and sale of internationally traded goods require one currency to be bought and another to be sold in order to complete the transaction. A country needs to purchase foreign currency in order to pay for its imports whereas foreigners would purchase domestic currency in order to pay for the country's exports.

A current account surplus indicates high demand for the domestic currency which would cause the currency to appreciate, over time the currency would lose its competitiveness resulting in a decline in exports and rise in imports, making the surplus hard to maintain. The opposite would be true in the case of deficits. 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 Portfolio Balance Channel

Current account balances result in a shift of wealth from deficit running countries to surplus running countries. Surplus nation ends up with assets in deficit nation currency (Ex: Japan owning US assets in the 80s). As countries with significant surpluses realize that their level of foreign reserves is much higher than required, they may attempt to reduce their foreign currency reserves, putting downward pressure on the deficit country's currency.

The Debt Sustainability Channel

Countries that run persistent current account deficits will see their foreign debt levels rising gradually. However, there should be an upper limit to the amount of foreign debt a country can take. If the foreign debt levels of a country rise to unsustainable levels, a currency depreciation would be required to narrow the current account deficit and take the foreign debt to a more manageable level.

12. Capital Flows and the Determination of Exchange Rates and Equity Market Trends and Exchange Rates

With increasing globalization and freedom of capital flows, exchange rates have become quite sensitive to cross-border capital flows. Global capital flows have often resulted in boom-like conditions in economies and subsequently left to a sharp decline in the currency value when flows reverse.

Capital flows can result due to interest rate differentials. A country with high inflation that seeks to bring about price stability would tighten its monetary policy by increasing interest rates. High interest rates with low inflation expectations would bring about carry trade flows that can put upward pressure on the currency's value.

At times, policy makers take measures to attract foreign flows. These may include:

- Tighter fiscal policies
- Liberalization of financial markets
- Fewer capital flow restrictions
- Privatization
- Better business environment

Such measures would lower the risk premium that investors would require to invest in that particular country.

Equity Market Trends and Exchange Rates

Increasing equity prices can attract foreign capital. Investors seek equity investments to generate higher risk-adjusted returns, and hence attractive equity markets can attract foreign capital.

Example: Capital Flows and Exchange Rates

(*This is Example 8 from the curriculum.*)

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.

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.

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).

3. 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.

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.

4. 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.

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.

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.

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.

7. 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 to 1:

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

Solution to 2:

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.

Solution to 3:

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.

Solution to 4:

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.

Solution to 5:

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.

Solution to 6:

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.

Solution to 7:

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

This section discusses how the government's monetary and fiscal policies can impact exchange rates.

13.1 The Mundell–Fleming Model

The Mundell-Fleming model describes how changes in monetary and fiscal policy affect economic activity, which affects trade and capital flows, which ultimately affect exchange rates. We will discuss how each type of policy affects the exchange rate under the Mundell-Fleming model.

Expansionary monetary policy:

- Expansionary monetary policy reduces interest rates and increases spending.
- Lower interest rates would cause capital to flow to higher yielding markets.
- Exchange rate will depreciate.

Expansionary fiscal policy:

- Lower taxes and/or higher spending results in larger budget deficits.
- Interest rates tend to increase as larger deficits must be financed.
- Rising interest rates will attract capital flows.
- Exchange rate will appreciate.

Capital mobility affects how government policies affect the exchange rate. We shall first consider a scenario of high capital mobility:

- Under high capital mobility, the domestic currency will appreciate under a restrictive monetary policy and/or an expansionary fiscal policy.
- Under high capital mobility, the domestic currency will depreciate under an expansionary monetary policy and/or a restrictive fiscal policy.
- 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.

This is summarized in the table below:

High Capital Mobility

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

When capital mobility is low, trade flows will determine exchange rate movements rather than capital flows. As there would be no capital flows, we need to only focus on how the policies would affect the country's trade balance. All expansionary policies would cause aggregate demand and imports to increase, leading to a worsening trade balance that would cause the currency to depreciate. Similarly, all restrictive policies will cause imports to decline, which would improve the trade balance and cause the currency to appreciate. This is summarized in the table below:

Low Capital Mobility

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

13.2 Monetary Models of Exchange Rate Determination

In the Mundell-Fleming model, policies affect exchange rates through changes in output and interest rates; the price level and inflation have no impact. Monetary models assume that output is fixed, and policies affect exchange rates through changes in price level and inflation. Two variations of the monetary approach are the 1) basic monetary approach and 2) the Dornbusch model.

1. The basic monetary approach asserts that an X percent rise in the domestic money supply will cause an X percent rise in domestic prices. Assuming that purchasing power parity holds, the increase (decrease) in domestic prices will cause a proportional decrease (increase) in the domestic currency's value.
   A shortcoming of the monetary approach is that it assumes that PPP holds in the short and the long run. This is unrealistic because PPP rarely ever holds in the short run. Addressing this approach, Dornbusch constructed a modified monetary model.
2. The Dornbusch model assumes that domestic prices are inflexible in the short run but flexible in the long run. Therefore, an increase in the domestic money supply in the long run will cause domestic prices to increase, causing the domestic currency to depreciate. In the short run, however, domestic prices are inflexible and this will cause the short-term interest rate to overshoot its long-term path. As money supply increases in the short run, price levels will not increase, rather, the higher money supply will cause short-term interest rates to decline leading to a capital outflow which in turn will cause the domestic currency to depreciate below its long-term equilibrium value. In the long run, as domestic interest rates rise, the currency will appreciate, and the exchange rate will move in line with its long-term equilibrium value.

Example: Monetary Policy and Exchange Rates
(*This is Example 9 from the curriculum.*)

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.

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.

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.

3. 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.

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.

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 to 1:

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.

Solution to 2:
A is correct. An expansionary fiscal policy will lead to higher levels of government debt and interest rates, which will attract international capital flows.

Solution to 3:
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.

Solution to 4:
B is correct. With limited capital mobility, the 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.

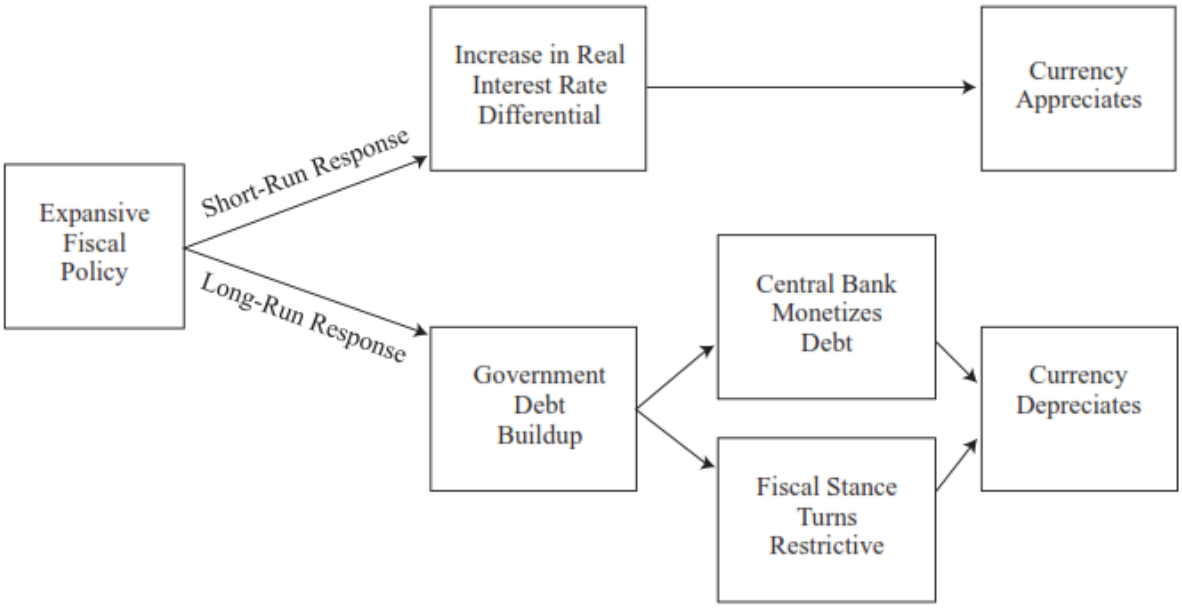
Solution to 5:
C is correct. In conditions of low capital mobility, a tight monetary policy and an expansionary fiscal policy has an indeterminate effect on exchange rates.

13.3 The Portfolio Balance Approach

Under the Mundell-Fleming model, we saw how changes in monetary and fiscal policies can induce changes in output and flows and affect exchange rates. However, no thought was given to how long-term budgetary imbalances from sustained policy actions affect currency value. The **portfolio balance approach** addresses this limitation.

This approach can be combined with the Mundell-Fleming model to determine that an expansionary fiscal policy can be positive for a currency in the short run but negative in the long run in the condition of high capital mobility. As budget deficit increases in the short run, interest rates increase bringing about capital flows and an appreciation of the domestic currency. In the long run, however, the growing budget deficit may imply that the central bank may need to print more money to lend to the government and the fiscal stance may turn restrictive, which would lead to a decline in the currency's value.

Exhibit 7 of the curriculum shows the short-and long-run response of exchange rates to changes in fiscal policy.



Example: Fiscal Policy and Exchange Rates

(*This is Example 10 from the curriculum.*)

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.

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.

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 to 1:
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.

Solution to 2:
C is correct. As government debt becomes harder to finance, the government will be tempted to monetize the debt through an accommodative monetary policy.

Solution to 3:
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.

14. Exchange Rate Management: Intervention and Controls

Capital flows carry both advantages and disadvantages. The advantages are an increase in domestic investment, increase in economic growth, increases in asset values, currency appreciation and better return to foreign investors. Capital flows can be disadvantageous if they fuel boom like conditions in an economy, create asset price bubbles and overvalue a currency. If flows subsequently reverse, the country can suffer from a currency crisis whereby its currency depreciates significantly.

Capital inflows are caused by "Pull" and "Push" factors. Pull factors represent favorable developments inside a country that attract foreign flows. These 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.

Push factors are not determined by domestic economic policies but by international capital mobility. These may include:

- search for higher interest rates by global investors.

- Increase in the weights of emerging markets in global equity indexes making fund managers invest more in these countries.

Even though capital flows carry their benefits, governments often seek to control them to avoid excessive flows that could quickly reverse. Governments restrict excessive capital flows by implementing capital controls and direct intervention by way of selling their currency in the FX markets.

The key issue for policy makers is whether intervention and capital controls would actually work in terms of 1) preventing currencies from appreciating too strongly, 2) reducing the aggregate volume of capital inflows and 3) enabling authorities to pursue independent monetary policies.

The effectiveness of government intervention depends on the ratio of central bank FX reserves and FX turnover. If the ratio is low (developed market) then government intervention will have low impact.

15. Warning Signs of a Currency Crisis

When capital inflows abruptly turn to capital outflows, the result is often a currency crisis where the currency value drops sharply, asset values decrease, and the economy contracts. Currency crises occur suddenly, and it can be difficult to stop the rapid selling once it starts. Leveraged positions such as carry trades can worsen the crisis as traders would sell the domestic currency not only to stop their losses but to also cover the short position in the lending currency.

Because a currency crisis can be hard to revert, it is important to have an early warning system which can signal a looming currency crisis. A good early warning system should:

1. have string record of predicting actual crises and avoids frequent issuance of false signals.
2. be based on macroeconomic indicators whose data are available on a timely basis and
3. incorporate a wide range of symptoms that crisis-prone currencies might exhibit.

It has been difficult to establish such a system due to varying schools of thought on the causes of currency crises. However, studies have been done to identify common traits in countries where currency crises have occurred. Certain conditions have been identified in countries that have suffered currency crises. These have been mentioned in the curriculum as follows:

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.

Example: Currency Crises

(*This is Example 11 from the curriculum.*)

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.

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.

2. 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.

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.

3. 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.

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 to 1:
A is correct. Currency crises often catch most market participants and analysts by surprise.

Solution to 2:
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.

Solution to 3:
C is correct. A high level of foreign exchange reserves held by a country typically decreases the likelihood of a currency crisis.

Solution to 4:
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

LO: Calculate and interpret the bid–offer spread on a spot or forward currency quotation and describe the factors that affect the bid– offer spread.

Currency quotes in the foreign exchange market are two sided; each quote has both a bid price and an offer price. The bid price represents the price at which the dealer is willing to buy the currency and the offer price represents the price at which the dealer is willing to sell the currency. The size of the bid-offer spread the dealer quotes to clients can vary depending on:

- The bid–offer spread in the interbank foreign exchange market
- The size of the transaction
- The relationship between the dealer and the client

LO: Identify a triangular arbitrage opportunity and calculate its profit, given the bid–offer quotations for three currencies.

A triangular arbitrage opportunity exists when:

- Dealer bid is greater than interbank offer (DBi G IO)
- Dealer offer is less than interbank bid (DO L IB)

LO: Explain spot and forward rates and calculate the forward premium/discount for a given currency.

Spot rate is the rate at which the currency trades in the market today. The forward rate is an agreed-upon rate to buy or sell a currency at a future date. The forward premium/discount is calculated as:

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

LO: Calculate the mark- to- market value of a forward contract.

A forward contract is marked-to-market through the following steps:

1. Create an offsetting forward position that is equal to the original forward position.
2. Determine the appropriate all-in forward rate for this new, offsetting forward position.
3. Calculate the cash flow on the settlement day.
4. Calculate the present value of this cash flow at the future settlement date.

LO: Explain international parity conditions (covered and uncovered interest rate parity, forward rate parity, purchasing power parity, and the international Fisher effect).

LO: Describe relations among the international parity conditions.

LO: Evaluate the use of the current spot rate, the forward rate, purchasing power parity, and uncovered interest parity to forecast future spot exchange rates.

LO: Explain approaches to assessing the long- run fair value of an exchange rate.

Covered interest rate parity asserts that 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.

Uncovered interest rate parity asserts that the **expected** return on an un-hedged foreign currency position should equal the return on a similar domestic currency investment.

Forward rate parity states that the forward exchange rate will be an unbiased predictor of the future spot exchange rate if covered interest rate parity and uncovered interest rate parity hold.

PPP is based on the law of one price, which states that identical goods should trade at the same price across countries when valued in terms of a common currency.

The international Fisher effect states that if real interest rates are equal across markets, then it also follows that the foreign–domestic nominal yield spread equal to the foreign–domestic expected inflation differential.

LO: Describe the carry trade and its relation to uncovered interest rate parity and calculate the profit from a carry trade.

An FX carry trade involves taking long positions in a high yielding currency and a short position in a low yielding currency.

If the uncovered interest rate parity holds, then exchange rate movements would cancel out the extra return that a high yielding foreign currency would earn such that the net return would be equal to that of the lower yielding domestic currency. However, empirical evidence suggests that: high-yield currencies, on average, have not depreciated, and low-yield currencies have not appreciated, to the levels predicted by interest rate differentials, making it possible to earn more by investing in a higher yielding currency.

LO: Explain how flows in the balance of payment accounts affect currency exchange rates.

Over the long term, countries that run persistent current account deficits see their currencies depreciate as they have to finance those deficits with foreign debt. Similarly, countries that run persistent current account surpluses see their currencies appreciate.

Flows in the balance of payment accounts affect exchange rates through the following mechanisms:

- The flow supply/demand channel

- The portfolio balance channel
- The debt sustainability channel

LO: Explain the potential effects of monetary and fiscal policy on exchange rates.

Effects of monetary and fiscal policy on exchange rates are explained through the following models:

- The Mundell-Fleming model: The Mundell-Fleming model describes how changes in monetary and fiscal policy affect economic activity, which affects trade and capital flows, which ultimately affect exchange rates.

  High Capital Mobility

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

  Low Capital Mobility

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

- Monetary models of exchange rate determination: Monetary policy has 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
- The Portfolio Balance approach: This approach can be combined with the Mundell-Fleming model to determine that an expansionary fiscal policy can be positive for a currency in the short run but negative in the long run in the condition of high capital mobility. As budget deficit increases in the short run, interest rates increase bringing about capital flows and an appreciation of the domestic currency. In the long run, however, the growing budget deficit may imply that the central bank may need to print more money to lend to the government and the fiscal stance may turn restrictive, which would lead to a decline in the currency's value.

LO: Describe objectives of central bank or government intervention and capital controls and describe the effectiveness of intervention and capital controls.

Governments often seek to control capital flows to avoid excessive flows that could quickly reverse. Governments restrict excessive capital flows by implementing capital controls and direct intervention by way of selling their currency in the FX markets. The key issue for policy makers is whether intervention and capital controls would actually work in terms of 1) preventing currencies from appreciating too strongly, 2) reducing the aggregate volume of capital inflows, and 3) enabling authorities to pursue independent monetary policies.

LO: Describe warning signs of a currency crisis.

Certain characteristics have been observed in countries that have suffered a currency crisis:

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.
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9. Inflation tends to be significantly higher in pre-crisis periods compared with tranquil periods.

