CHAPTER 3
MARKET STRUCTURE AND INSTITUTIONS

Chapter Overview

This chapter reviews the institutional and structural arrangements within the foreign exchange market. It begins with an examination of the importance of the foreign exchange market as measured by the volume of trading activity and the profitability of currency trading. The basic foreign exchange market products, including spot contracts and interbank swap contracts, are discussed next, together with a demonstration of how they can be transformed into innovative synthetic versions of spot, forward, and interest rate contracts. This is followed by a review of the foreign exchange market setting, including the structure of the market, the role of brokers, and competitive threats to the market. A discussion of policy matters and how they affect private enterprises and public policy-makers concludes the chapter.

Chapter Outline

Importance of Foreign Exchange Market Trading
  Origins of the Market
  Volume of Foreign Exchange Trading
  Foreign Exchange Trading Profits
  Explaining the Profitability of Foreign Exchange Trading
Foreign Exchange Market Products and Activities
  Spot and Forward Contracts
  Foreign Exchange Swaps
  Types of Trading Activities: Speculation and Arbitrage
  The Relationship between Spot and Forward Contracts
The Foreign Exchange Market Setting
  Comparing the Foreign Exchange Market with Other Markets
  Tracking Foreign Exchange Transactions
  Counterparties and Concentration in the Foreign Exchange Market
Policy Matter - Private Enterprises
  A Close-Up View on Foreign Exchange Trading
  Controls over Foreign Exchange Trading
  Valuing Foreign Exchange Trading Profits
Policy Matter - Public Policy-makers
Summary
**Supplementary Notes**

**The roles of money**

A background knowledge of the roles of money is important in understanding the functions and characteristics of exchange rates.

**Unit of account** (what currency to use in invoicing, pricing)
**Store of value** (saving, portfolio, inflation, exchange rate change)
    And also **store of liquidity**: You can readily exchange it for goods or other assets, thereby facilitating economic transactions.

**The value of money** depends on its purchasing power. The lower the expected inflation, the more money people will demand. Exchange rate reflects the relative demands for two moneys. (Shapiro, p.88)

**Medium of exchange** (effect payment for exchange)

**Exchange rate**

**Definition** The price of one currency measured in units of another currency.

**Convertibility**

**Current account convertibility** -- conversion between domestic currency and foreign currency is allowed for current account transactions.

**Capital account convertibility** -- conversion between domestic currency and foreign currency is allowed for capital account transactions (so that there is free capital mobility in and out of the country)

**Flexibility** fixed rate, floating rate

Add a table of foreign exchange trading volumes: BIS
    By country: London, New York, and Japan
    spot, forward, and swaps

**Foreign exchange market products**

A **spot** contract represents a binding commitment for an exchange of funds, with normal settlement and delivery of bank balances following in two business days or one day in the case of North American currencies.

A **forward** contract is an agreement made today for an obligatory exchange of funds at some specified time in the future. This is also referred as **outright forward**. Forward contracts represent a small fraction of the foreign exchange market and are mainly used by corporate customers in managing exchange rate risks.
A foreign exchange **swap** is the simultaneous sale of a currency for spot delivery and purchase of that currency for forward delivery. It can also be described as a simultaneous borrowing of one currency and lending of another currency. Commercial banks engage in swap transactions in order to manage the maturity structure of his or her currency positions.

**Exchange rate quotations**

Assuming the U.S. $ is the domestic currency (d.c.) and the British pound (£) is the foreign currency (f.c.), then:

<table>
<thead>
<tr>
<th></th>
<th>$'s per unit of f.c</th>
<th>£ per $</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>American terms</strong></td>
<td>$2.00/£</td>
<td></td>
</tr>
<tr>
<td><strong>European terms</strong></td>
<td>£0.50/$</td>
<td></td>
</tr>
<tr>
<td><strong>Direct quote</strong></td>
<td>units of f.c. per d.c.</td>
<td>$2.00/£</td>
</tr>
<tr>
<td><strong>Indirect quote</strong></td>
<td>units of d.c. per f.c.</td>
<td>£0.50/$</td>
</tr>
</tbody>
</table>

In currency futures and options markets, currency prices are quoted in American terms, that is, dollars per unit of another currency: $.6435/DM, $1.536/£. The Wall Street Journal and the Financial Times publishes exchange rates (both spot and forward) for the previous business day. The Wall Street Journal carries cross rates for major currencies in the foreign exchange section. Swap rates can be found on the Reuters screen (see Page 80 in the text).

**Bid/ask spread:**

**Bid price** -- the price at which a marketmaker is willing to buy a currency

**Ask price** -- the price at which a marketmaker is willing to sell a currency

The difference between the two prices is referred to as the bid/ask or bid/offer spread, which is often expressed in percentage terms:

\[
\text{Percent spread} = \left(\frac{\text{ask price} - \text{bid price}}{\text{ask price}}\right) \times 100
\]

Suppose: $1.7019-36

\[
\text{Percent spread} = \left(\frac{1.7036 - 1.7019}{1.7036}\right) = 0.1\%
\]

The spread for widely traded currencies, such as the British pound, DM, and the Japanese yen, is smaller than those that are traded less heavily.

**Cross rates and arbitrage**

An exchange rate between two currencies neither of which is the U.S. dollar. A cross rate is usually constructed from the individual exchange rates of the currencies with respect to the U.S. dollar.

British pound (in U.S. dollars) 1.5561 ==> $1.5561/£
Canadian dollar (in U.S. dollars) 0.7293 ==> $0.7293/C$
Swiss franc (per U.S. dollar) 1.2445 ==> SF1.2445/$
Japanese yen (per U.S. dollar) 110.36 ==> ¥110.36/$
German mark (per U.S. dollar) 1.5142 ==> DM1.5142/$

What is the exchange rate between the British pound and the Canadian dollar?

Canadian dollars per British pound:

\[
\frac{\$1.5561}{\£} \div \frac{\$0.7293}{C\$} = \frac{\$1.5561}{\£} \times \frac{C\$}{0.7293} = \frac{C\$2.1136}{\£}
\]

What's the exchange rate between the British pound and the Japanese yen?

Japanese yen per British pound:

\[
\frac{\$1.5561}{\£} \times \frac{¥110.3}{\$} = \frac{¥(110.36 \times 1.5561)}{\£}
\]

Arbitrage

If the cross rate is inconsistent with exchange rates between the two currencies and the dollar, an arbitrage opportunity exists.

Given:
(1) New York: $1.9809 / £
(2) Frankfurt: $0.6251 / DM
(3) London: DM3.1650 / £

Is there an arbitrage opportunity?

Key: calculate the exchange rate between DM and £ using the two direct quotes

Objective: Find out how much DM you have to pay for one £
Customer start with DM:

1. Sell DM for $ in Frankfurt: $0.6251 per DM
2. Sell $ for £ in New York: $1.9809 per £

How much DM have you spent on buying one £?

\[
\frac{1.9809}{0.6251} = 3.168932971 \text{ per £}
\]

Compare with the price for £ in London: DM3.1650 per £

===> price of £ in London is lower than the rate implied in the other two markets.

===> Customer should buy £ with DM in London and sell it elsewhere.

Cross rates with bid/ask spread:

Rule: the trader would choose the most advantageous price with each transaction (so you, as a customer, will take the unfavorable of the two prices in each transaction)

Two transactions involved.

Example:

Given: $1.7019-36 per £, $0.6250-67 per DM

What is the direct quote for £ in Frankfurt?

In Frankfurt, DM is the home currency. Direct quote: Number of DM per pound

The bid rate: trader's buying price of pound (customer sells £ for DM)

1. A customer sells £ for $ (or the trader buys £ with $) at the buying price $1.7019 per £ (the bid price for £)

2. Then the customer sells $ for DM (or the trader sell DM for $) at $0.6267/DM (the ask price for DM)

===> \[ \frac{1.7019/£}{0.6267/DM} = 2.7157/£ \]
The ask rate: trader's selling price of BP (Customer buy BP with DM)

1. Customer starts with DM, sells DM for $ (trader buy DM) at
   $0.6250 per DM  (the bid price for DM)
2. The customer sells $ for BP (trader sells BP) at
   $1.7036 per BP  (the ask price for BP)

=>  \[ \frac{[$1.7036/£]}{[$0.6250/DM]} = DM2.7258/£ \]

So the bid/ask price for £ in terms of DM is: DM2.7157-7258/£.

Forward market

Quoted in two ways:

Outright rate: Actual price  (see Wall Street Journal quotations), for commercial customers

Swap rate:  forward discount or forward premium points

Examples:

Spot yen sold at $0.006879
90-day forward at $0.006902
The swap rate for the 90-day forward yen is quoted at a 23-point premium (yen in unit of 100)

Spot BP sold at $1.7015
90-day forward at $1.6745
Swap rate:  270 point-discount

Explanation: The swap rate is calculated as the difference between the forward rate and the spot rate:

\[ F(t,T) - S(t) = $1.6745 - $1.7015 \]
\[ = -$0.0270  \implies 270 point-discount \]

The underlying currency is the British pound which is priced in $.  When the difference is positive, the underlying currency is at a forward premium; when it is negative, the currency is at a forward discount.  In the example above, the forward rate ($1.6745) is smaller than the spot rate ($1.7015), so the difference is negative (-
$0.0270). There £ is at a forward discount, and swap is represented as 270 point-discount.

**Swap rates with bid/ask spread**

| Spot rate: | DM2.4273/90 | spread: 0.0017 |
| Swap rate: | 30/20        | large/small ==> subtract |
| forward:   | DM2.4243/70  | spread: 0.0027 |

Rule: bid/ask spread will always widen as we go forward.

| Spot rate: | DM2.5005/10 | spread: 0.0005 |
| Swap rate: | 100/95      | large/small ==> subtract |
| forward:   | DM2.4905/15 | spread: 0.0010 |

| Spot rate: | DM2.5005/10 | spread: 0.0005 |
| Swap rate: | 95/100      | small/large ==> add |
| forward:   | DM2.5100/110 | spread: 0.0010 |

**The relationship between spot and forward rates: some basics**

**Forward premium (Discount)**

For direct quotes (domestic currency(dc)/foreign currency(fc), say $/£):

\[
FP_{\text{BP}} = \frac{F_{\text{BP},t} - S_{\text{BP},t}}{S_{\text{BP},t}} \times 100 \tag{1}
\]

Example:


- **German mark spot**: $.6604/DM
  - 30-day forward: .6618
  - 90-day forward: .6645
  - 180-day forward: .6690

The 180-day forward premium for DM:

\[
(0.6690 - 0.6604)/0.6604 \times 100 = 1.3022 \%
\]
What does this mean?

Suppose you need DM in 180 days (to pay for imports, to repay DM debt, or to make DM investment). Should you buy DM in the spot market (pay now) or buy DM in the forward market (sign contract now but pay 180 days later)? [Of course, there is another choice: Do nothing today and buy DM in the spot market 180 days later. God knows how much you are going to pay then? You may pay $.50 per DM or $.75 per DM -- the key point is that you face uncertainty -- foreign exchange rate risk!]

If you buy DM in the forward market (That's hedging with forward), you will have to pay 1.3022% more than you do now in the spot market. Should you buy DM in the spot market then?

If you buy DM in the spot market, you tie up your $ funds ==> opportunity cost: give up U.S. dollar interest rate income. But if you put the DM you just bought in DM deposit for 180 days (you will not need the DM until 180 days later anyway), you will earn DM interest (The combined action of buying DM spot and earn interest in DM before the DM is used is called money market hedging).

So To decide whether to buy foreign exchange in the spot market or in the forward market, one should not only consider forward premium, but also the interest rates involved.

Suppose: $i_s = 12\%$ (annualized ==> $i_s$ for 180 days = 6%) 
$i_{DM} = 8\%$ (annualized ==> $i_{DM}$ for 180 days = 4%)

Comparing costs in 180 days (future values) of buying ONE DM in the spot and forward markets:

Cost of buying forward: $F_{S/DM} = $.6690$

Cost of buying spot: $S_{S/DM} \frac{(1 + i_s)}{(1 + i_{DM})}$

$= $.6604 \frac{(1 + .06)}{(1 + .04)} = $.6731$

==> It actually cost you more to buy DM in the spot market.

If the costs of buying foreign exchange in the spot and the forward markets after adjusting for the relevant interest rates are the same ==> equilibrium.
Annualized forward premium (discount)

In our previous example, the forward premium is for 180 days. The annual interest rates are cut in half to be consistent with forward premium. Very often the practice is the other way round: we annualize the forward premium to match interest rates as interest rates are almost always quoted on an annual basis.

\[
FP_{BP} = \frac{F_{S/BP,T} - S_{S/BP,t}}{S_{S/BP,t}} \times \frac{360}{N} \times 100
\]  

(2)

To revisit our previous example, the annualized forward premium for the DM is 1.3022% x 2 = 2.6044%. The (annualized) cost of buying DM spot is 12% while the (annualized) cost of buying DM forward is only 10.6044% (8% + 2.6044%).

Example: On June 10, 1996, the spot and one-month forward rates between the U.S. dollar and the Japanese yen are 109.085 yen/$ and 108.64 yen/$, what is the annualized forward premium for the yen against the dollar?

Answer: 4.9% (annualized)

Example:

Spot yen sold at $0.006879
90-day forward at $0.006902

The swap rate for the 90-day forward yen is quoted at a 23-point premium (yen in unit of 100)

Forward premium or discount

\[
= \frac{\text{(forward rate} - \text{spot rate}) / \text{spot rate}} \times \frac{360}{n} \times 100
\]

n: forward contract length in days

= 1.34%

Synthetic forward and arbitrage

Interest parity involves four variables: F(t, T), S(t), i(T/360), i²(T/360) (ignore bid/ask for the moment).

Given: BP interest rate 12%
$ interest rate 7%
spot rate $1.75/BP
1 year forward rate $1.68/BP

3-9
Synthetic forward

= $1.75 [(1 + .07) / (1 + .12)] = $1.6719 < $1.68 = F(0, 1 year)

==> The actual forward rate is higher than the synthetic forward rate: BP overvalued

==> Arbitrage opportunity: generate pound using spot and money market, sell BP forward

Borrow $1 in New York at 7% for a year.

Convert $1 into £ at spot $1.75/£, get £0.5714.

Invest £ at 12% for a year. You are sure to get £.64 at end of the year.

Sell £0.64 forward at $1.68/£, lock in $ amount: $1.0752.

Repay $1 with 7% interest, left with $.0052 as profit.

The relationship between spot and forward exchange rates: applications

The relationship represents virtually the covered interest rate parity to be discussed in Chapter 5. It involves four variables: the spot and the forward rates, the domestic and foreign interest rates. It may be presented in three different forms by rearranging terms, each having its own specific interpretation and applications.

**Synthetic forwards:**

\[
F_{t,n} = S_t \left( \frac{(1 + i_{s,n}/(12/n))}{(1 + i_{DM,n}/(12/n))} \right)
\]

\(n\) is the number of months for the forward contract and the respective annualized interest rates. The key point for the relationship is financial innovation. When a forward contract for a particular currency does not exist, one can create the contract through the spot exchange rate and the two interests.

**Synthetic dollar securities:**

\[
(1 + i_{s,n}/(12/n)) = \frac{F_{t,n}(1 + i_{DM,n}/(12/n))}{S_t}
\]
The relationship suggests that a dollar-denominated security could be constructed by combining a foreign currency denominated security with a forward contract of similar maturity and a spot contract.

**Synthetic DM securities:**

\[ (1 + i_{DM,n}/(12/n)) = \frac{S_t(1 + i_{S,n}(12/n))}{F_{t,n}} \]  \hspace{1cm} (5)

The relationship suggests that a DM-denominated security could be constructed by combining a dollar-denominated security with a forward contract of similar maturity and a spot contract.
Answers to end-of-chapter questions

1. Explain how the nature of a currency as a domestic medium of exchange creates the need for foreign exchange markets. Provide an example.

In most cases, domestic money is the customary method of payment for transactions in the domestic economy. Transactions in Germany are typically priced in DM and paid for with DM. Individuals therefore tend to hold money balances primarily in their own domestic currency, especially as their transactions are concentrated in the domestic economy. International trade in goods, services or financial instruments creates a need for a foreign exchange market.

2. Sometimes a currency, like the US$, can be used to conduct international transactions without the need for a foreign exchange market. For example, in 1995 the US$ could be used for transactions in Panama and Russia. Explain why these transactions occur without a foreign exchange market.

In Panama, the US$ is considered legal tender. The government of Panama has fixed the exchange rate at one Panama dollar (P$) per US$ and converts US$ for P$ freely at the central bank. Therefore, Panamanian merchants willingly accept US$ in place of Panama dollars. In Russia in 1995, fear of inflation, currency depreciation and capital controls have led some people to prefer to hold US$ rather than domestic rubles. Small merchants may willingly accept US$ as payment for merchandise. They hold these US$ rather than convert them to Russian rubles.

3. Explain why commercial banks appear to make consistent profits in trading foreign exchange. How can you reconcile these data on profitability with the idea that foreign exchange trading is a zero-sum game?

Commercial banks may appear to make profits consistently in foreign exchange trading for several reasons. First, there is a positive spread between bid and ask prices in foreign exchange. Banks earn this spread from their retail foreign exchange business. Second, banks have very timely access to market information. They may earn a profit from having invested to obtain this desirable market position. Finally, banks profits are often reported on a gross basis rather than net of administrative expenses and other costs.

4. Explain the difference between a spot foreign exchange contract and a forward foreign exchange contract.

A spot foreign exchange contract is a contract made today for settlement and delivery of currencies "immediately" which generally means two business days (one day in the case of the US$ and the C$). A forward foreign exchange contract is a contract made today for settlement and delivery of currencies at a specified date in the future.
5. Contrast speculative trading with arbitrage trading.

Speculative trading implies trading that exposes the trader to a risk, and generally this implies a price risk. Buying spot DM and holding them for three minutes or three hours is an example of a speculative trade. Arbitrage trading implies establishing a position and, at the exact same time, establishing an offsetting position with the intent of a price gain. Buying DM 1,000,000 at a low price from one dealer and selling DM 1,000,000 at a higher price to another dealer reflects an arbitrage. Covered interest arbitrage is another example. Every transaction involves some counterparty risk (that is, risk of default at settlement), and transactions with foreign entities involve a country risk (that is, risk of an exchange control or capital market restriction).

6. What is the difference between spatial arbitrage and covered-interest arbitrage?

**Spatial arbitrage** implies an arbitrage of the same financial instrument between two different geographic places, such as arbitrage between two different banks, between two different cities, or between two different markets that trade the same instrument. **Covered interest arbitrage** implies an arbitrage between an interest bearing security in one currency (say DM) and an interest bearing security in another currency (say £). These positions can be compared because the arbitrage is covered against exchange rate risk by combining the £ position with a forward contract (sale of £) that effectively converts it into a DM position.

7. How would you explain the price dispersion across traders in the foreign exchange market?

Because the foreign exchange market is geographically dispersed, it is costly to search through dealer prices to obtain quotes. There is no consolidated record of transactions as they occur at each moment around the world. In addition, some quotations are for indications only; they are not firm trading prices. These factors permit some **price dispersion** from different dealers in the foreign exchange market.

8. What is the difference between a cross-rate and a direct rate in the foreign exchange market? How is a cross-rate derived from direct rates?

Under the Bretton Woods system, all exchange rates were defined in terms of gold and the US$ price of gold was fixed. Therefore, all exchange rates were pegged in terms of the US$. A **direct rate** shows the rate of exchange between a foreign currency (FC) and the US$. A **cross-rate** shows an exchange rate between two non-US$ currencies. An indicative cross-rate price can be calculated using **triangular parity**. For example, the DM/£ price should be roughly equal to the product: $DM/$ x $/£.

9. The US$ is used overwhelmingly as a vehicle currency in foreign exchange trading among non-US currencies. Why? What are the advantages of using the US$ instead of available cross-rates?

The role of the US$ as a vehicle currency was derived from the central role of the US$ under Bretton Woods and the leading position of the US economy at the end of World War II. The
US$ remained a convertible currency and so transactions in and out of the US$ were unrestricted. Exchange markets for each foreign currency were usually the deepest and most liquid with respect to the US$. Thus, making a transaction between Swedish Krona (SK) and Mexican Pesos (MP) would usually be faster, cheaper and less risky by making two transactions through the US$ (SK for US$, and US$ for MP), than by trying to execute only one transaction of SK for MP.

10. What is the relationship linking the spot rate, the forward rate, and interest rates in the domestic and the foreign currencies?

The equilibrium relationship between spot rates, forward rates and interest rates is given by the interest rate parity condition: \((F-S)/S = (i-i^*)/(1+i^*)\), where the forward rate has the same maturity as the domestic interest rate \((i)\) and foreign interest rate \((i^*)\).

11. Why is a forward foreign exchange contract called a redundant financial product?

The forward foreign exchange contract can be considered redundant because the cash flows of a forward position can be duplicated using a spot contract combined with borrowing and lending in the domestic and foreign securities market.

12. How do you create a synthetic forward contract? What are the advantages to a firm of using a forward as opposed to using a synthetic forward?

To create a synthetic forward contract, in £ for example, it depends whether we are buying or selling £. Buying forward £ is equivalent to: Borrowing US$, buying £ spot, and lending £. Selling forward £ is equivalent to: Borrowing £, selling £ spot, and lending US$. A firm may prefer a forward contract over a synthetic because it is easier to carry out. The firm may save money as well as time with a forward since the synthetic could involve the issuance of securities and a reduction in scarce borrowing capacity.

13. What difficulties might you encounter when creating a synthetic forward for "exotic" currencies?

Creation of a synthetic forward requires access to borrowing and lending in the foreign currency. An exotic currency may lack well-developed capital markets, or be subject to restrictions on borrowing and lending that may make it too costly or impossible to create the synthetic.

14. Define counterparty risk in the foreign exchange market.

Counterparty risk in the foreign exchange market is the risk of default by a counterparty, meaning the risk that the original terms for delivery and settlement will not be met. Default prior to the date of settlement produces rate risk. Default on the date of settlement could produce delivery risk, now called "Herstatt risk."
15. Define the "right-of-offset" in the foreign exchange market. What is its significance for a foreign exchange trader at a large bank?

The right-of-offset in foreign exchange pertains to the "two legs" of a foreign exchange transaction -- that is, the delivery of one currency (from A to B) and the expected receipt of the second (from B to A). The right-of-offset implies that if the first leg of the transaction is breached, the surviving counterparty is freed from his obligation to deliver the second leg of the transaction. The right-of-offset substantially reduces the risks faced by bank traders. With the right-of-offset, the bank's counterparty risk is only rate risk. Without the right-of-offset, the bank's counterparty risk includes delivery risk, which exposes them to the risk of a complete loss.

16. Many countries have restrictions on the securities sold by corporations. For example, Germany did not allow a commercial paper market to develop until 1991. How could a German firm create a synthetic commercial paper program using other financial instruments?

To create a synthetic DM commercial paper, the firm would enter into a US$ commercial paper program, sell the US$ proceeds in the spot market for DM, and buy US$ forward (sell DM forward) in an amount sufficient to extinguish the US$ commercial paper.

17. What are the main structural differences between the foreign exchange market and a major stock market such as the New York Stock Exchange?

The foreign exchange market is a geographically dispersed, broker-dealer market. The NYSE is a centralized, specialist-auction market. The NYSE is heavily regulated, policed against insider trading, and subject to trading halts when controversial information is pending or announced. The FX market is largely unregulated. An unscheduled halt to FX trading is a rare event. The NYSE produces a consolidated tape of all trading activities throughout the day. There is no consolidated public record of bank FX trading activity.

18. Contrast the clearing and settlement system in the foreign exchange market with that of centralized exchanges such as the Chicago Mercantile Exchange or Chicago Board of Trade.

Clearing and settlement in the foreign exchange market is on a bilateral basis. That is, if banks A and B enter into a transaction, A and B have each other as counterparties and assume each other's counterparty risk. Some new systems for centralized clearing and settlement have been developed, but these act only to speed settlement and reduce costs -- so the bilateral counterparty risks remain. On the CME and CBOT, each private agent (A and B) transacts with the exchange Clearinghouse. All contracts embody the same counterparty risk -- namely that of the Clearinghouse.

19. What are the main risks faced by the players in the foreign exchange market?

Traders in the foreign exchange market face a variety of risks: price risk, interest rate risk (gap risk), credit risk (including rate risk and delivery or Herstatt risk), and country risk.
Answers to end-of-chapter exercises

CROSS RATES

1. Suppose the Canadian dollar is currently traded at C$ 1.40/$. The Deutsche mark is traded at DM 1.39/$. Ignoring transaction costs:
   a. Determine the C$/DM exchange rate consistent with these direct quotations.
   b. Suppose the C$/DM cross rate in the market was at C$ 1.05/DM. Is there any arbitrage opportunity?
   c. How would you take advantage of any arbitrage situation?
   d. What is your profit?

   SOLUTIONS:

2. Suppose the Mexican Peso is currently traded at 7 MP/$. The yen is traded at Yen 90/$.
   a. Determine the MP/Yen cross rate.
   b. Suppose the MP/Yen cross rate in the market was at MP 0.1/Yen. Is there any arbitrage opportunity?
   c. How would you take advantage of any arbitrage situation?
   d. What is your profit?

   SOLUTIONS:

3. Suppose the French Franc is currently traded in a French bank at FF 3.55/DM. The DM is traded in a German bank at DM 1.39/$.
   a. Determine the FF/$ direct rate that you expect to see.
   b. Suppose the FF/$ was at FF 5.00/$. Is there any arbitrage opportunity?
   c. How would you take advantage of any arbitrage situation?
   d. What is your profit?
SOLUTIONS:

a. The direct spot rate is FF 4.9345/$ = (FF 3.55/DM * DM1.39/$)
b. Arbitrage opportunity: FF cheaper using the market's cross rate than direct rates.
c. Buy FF with $, buy DM with FF, sell DM for $.
d. Gain is $0.0133 [(FF5/$) / (FF3.55/DM) / (DM1.39/$) = $1.0133; 1.0133 - 1 = 0.0133]

4. Suppose the Japanese Yen is currently traded at Yen 90/$. The Canadian Dollar is traded at C$ 1.40/$.
   a. Determine the Yen/C$ cross rate.
   b. Suppose the Yen/C$ was at Yen 60/C$. Is there any arbitrage opportunity?
   c. How would you take advantage of any arbitrage situation?
   d. What is your profit?

SOLUTIONS:

a. Spot rate is Yen 64.2857/C$ = (Yen 90/$ / C$ 1.40/$)
b. Arbitrage opportunity: in terms of Yen, the C$ is cheaper using the direct rates than using the cross rates.
c. Buy C$ with Yen, Buy $ with C$, sell $ for Yen.
d. Gain is Yen 0.0714. [(Yen 1/(Yen60/C$)) / (C$1.40/$)* / (Yen 90/$) = Yen1.0714; 1.0714 - 1 = 0.0714]

5. Suppose the FFr/DM cross rate is currently at FFr 3.55/DM, while the DM trades at 1.40/$.
   a. What is the FFr/$ direct rate?
   b. Suppose the FFr suddenly depreciates to FF 3.65 against the DM, the DM/$ rate stays constant, and the FFr/$ direct rate depreciates to FFr 5.05/$. What would you do to take advantage of the arbitrage opportunity?

SOLUTIONS:

a. The direct rate is FFr 4.97/$ = (FFr 3.55./DM * DM 1.40/$)
b. The new direct rate should be: FFr 5.11/$ = (FFr 3.65/DM * DM 1.40/$). The FFr is cheaper using the direct rates than using the cross. As a US investor, buy DM with $, buy FFr with DM, sell FFr for $. The $ is cheaper using the cross rate than using the direct rates. As a French investor, buy $ with FFr, sell $ for DM, buy FFr for DM.

COVERED INTEREST ARBITRAGE

6. Suppose the spot rate is $ 0.60/DM, i$_{S,6}$ is 6.5% per annum and i$_{DM,6}$ is 9% per annum.
   a. What is your estimate of today's six-month forward $/DM rate?
   b. Suppose the six-month forward is quoted at $ 0.60/DM. What would you do to take
advantage of the arbitrage opportunity? Where would you borrow and lend?

SOLUTIONS:

7. Suppose the spot rate is Yen 100/$, $i_{6\text{m}}$ is 6.5% per annum and $i_{\text{yen,6m}}$ is 2.5% per annum.
   a. What is your estimate of today’s six-month forward rate?
   b. Suppose the forward is currently quoted at Yen 95/$. What would you do to take
      advantage of the arbitrage opportunity? Where would you borrow and lend?

SOLUTIONS:

   Profit: \( \frac{1}{0.60/\text{DM}} \times (1 + 0.09/2) \times 0.60/\text{DM} - 1 \times (1 + 0.065/2) = 0.0125 \); or
   1.25% gain on transaction

8. Suppose the spot rate is Yen 90/$, the three-month forward rate Yen 88/$ and the three-
   month yen interest rate 2.5%.
   a. What is the implied three-month US$ interest rate?
   b. Suppose the actual three-month US$ interest rate is 10%. What would you do to
      profit from the arbitrage opportunity?

SOLUTIONS:

b. At 10%, the US$ interest rate is below its interest parity value. To profit, borrow $ at
   10%, buy Yen spot, invest in Yen securities, sell Yen forward.
   Profit: \( \frac{1 \times \text{Yen90/$}}{88/$} - \frac{1 \times (1 + 0.10/4)}{1 + 0.025/4} = 0.0041 \). Gain
   of 0.4% in three months.

9. Suppose the current spot rate is $ 1.60/£, the one-year forward rate $ 1.50/£ and the British
   one-year interest rate 12%.
   a. What is the implied US $ one-year rate?
   b. Suppose the actual one-year US$ interest rate is 6%. What would you do to profit
      from the arbitrage opportunity?
SOLUTIONS:

a. \( F_t = S_t \times \frac{(1 + i_S)}{(1 + i_C)} \); which implies that \( 1 + i_S = \frac{F_t}{S_t} \times (1 + i_C) \), or \( 1 + i_S = \frac{1.50}{1.60} \times (1 + .12) \); which implies that \( i_S = 5\% \).

b. At 6\%, the US$ interest rate is above its interest parity value. To profit, borrow £ at 12\%, buy $ spot, invest in $ securities, sell $ forward.

Profit: £ 1 * $1.60/£ * (1 + 0.06) / $1.50/£ - £ 1 * (1 + 0.12) = £0.01067. Gain is 1.067\% in one year.

SYNTHETIC SECURITIES

10. Suppose a German firm wishes to issue commercial paper in DM, but it is unable to do so in the German market.

a. What can the firm do to replicate commercial paper (CP) securities without using German securities? Describe the transactions.

b. Assume that the spot rate is $0.60/DM. The three-month forward rate is $0.58/DM. The three-month US$ CP rate is 8\%. At what rate can the German firm expect to issue synthetic DM three-month CP?

SOLUTIONS:

a. The German firm could borrow in the US$ CP market and swap its dollar obligation into DM, that is by buying US$ forward to match its future CP payments (principal plus interest) and selling DM forward.

b. The German firm can secure the following rate: \( 1 + i_{DM}/4 = \frac{St}{Ft} \times (1 + i_S/4) \); \( 1 + i_{DM}/4 = \frac{0.60}{0.58} \times (1 + .08/4) \); which implies that \( i_{DM} = 22.07\% \).

11. Suppose a Canadian bond portfolio manager wishes to enhance his yield on Canadian short-term bills. Current one-year Canadian T-Bills yield 13\%. The current spot rate is C$ 1.40/$. The one-year forward rate is C$ 1.50/$. The US one-year T-Bill rate is 6\%.

a. What yield could the portfolio manager obtain by creating synthetic Canadian T-Bills?

b. What incentive is there in this case in terms of yield enhancement by building a synthetic C$ security?

SOLUTIONS:

a. \( 1 + i_C = \frac{F_t}{S_t} \times (1 + i_S) \); \( 1 + i_C = 1.50/1.40 \times (1.06) \); which implies that \( i_C = 13.57\% \).

b. There is a 0.57\% yield pick-up before considering the additional transaction costs of the synthetic.