Chapter 4

The Foreign Exchange Market

The foreign exchange market (FX market) is the market on which different currencies are traded against one another. The rate at which this happens is called the exchange rate or FX rate. Various instruments are used on the FX market, including FX spot transactions, FX forwards, and FX swaps. Most FX instruments are traded over-the-counter.

4.1 FX spot rates

With most FX transactions, the currencies are traded at the current market exchange rate and settlement takes place on a standard delivery date, usually two business days after the transaction date. These transactions are called FX spot transactions. The current market exchange rate is called the FX spot rate.

For certain currency pairs, the settlement of spot transactions takes place after only one business day. This is the case, for instance, for FX transactions between US and Canadian dollars. Sometimes the value date for one currency is different from that of another currency. This may be the case, for instance, when a currency from an Islamic nation is traded for a currency in a Western country and the delivery date is near the weekend.

4.1.1 *Exchange rates*

The exchange rate between two currencies is given using an FX quotation. An exchange rate expresses the value ratio between two currencies as a number. The currency mentioned first in an FX quotation is the trade currency or base currency (the traded good) and the second currency is the price currency or quoted currency (the currency in which the price of the traded good is expressed).

In FX quotations, currencies are expressed by their ISO-codes. ISO stands for International Standardization Organization. Figure 4.1 shows a table with the ISO-codes of some of the most important currencies.

Figure 4.1   *ISO Currency codes*

CURRENCY	ISO-CODE
Euro	EUR
US-dollar	USD
Pound sterling	GBP
Japanese yen	JPY
Canadian dollar	CAD
Australian dollar	AUD
New-Zealand dollar	NZD
Hong Kong dollar	HKD
Singapore dollar	SGD
Koran won	KRW
Danish crown	DKK
Swedish crown	SEK
Norwegian crown	NOK
Swiss franc	CHF
South African rand	ZAR
Mexican peso	MXN
Israeli shekel	ILS

There are international conventions regarding which currency is the base currency and which is the price currency in an FX quotation. The euro is always quoted as the base currency against other currencies: EUR/USD, EUR/GBP, EUR/JPY, EUR/CHF etc.

The British pound and the other currencies of the Commonwealth are base currency in all exchange rate quotations except in those cases where the euro is the counter currency. The US dollar is the base currency in most exchange rate quotations with the exception of euro and the currencies of the Commonwealth:

USD/JPY; USD/CHF; USD/CNY, however,
EUR/USD; GBP/USD; AUD/USD.

Exchange rate quotations for which these rules are properly applied, are referred to as direct quoted FX rates. If these rules are not applied, for instance in the case of GBP/EUR, the quotation is called an indirect quoted FX rate.

4.1.2 *Bid rate, ask rate and two way prices*

In most exchange rate quotations, one unit of a currency is expressed in a number of units of another currency. For example, when the EUR/USD spot rate is 1.5000 then this means that 1 euro has the same value as 1.5000 US dollars.

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EXAMPLE

On 12 October 2009, the euro-dollar trader at ING Bank buys 10 million euro at spot from the euro-dollar trader at Deutsche Bank. The spot rate is 1.3425.

On 14 October 2009 (= spot value date), ING Bank must transfer an amount of USD 13,425,000 to Deutsche Bank. Deutsche Bank must, in turn, transfer an amount of EUR 10,000,000 to ING.

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Just as with all prices in the financial markets, there are bid and ask rates for the FX spot rate. These two prices together are called a two-way price. The difference between the bid and ask rate is called the spread.

For example, when a market maker quotes the following two-way prices for EUR/USD: 1.3530 - 1.3532, this means that he is prepared to buy 1 euro for 1.3530 US dollars and to sell 1 euro for 1.3532 US dollars. The table below contains the amounts that this market maker is willing to exchange for an amount of EUR 10,000,000 and for an amount of USD 10,000,000.

ACTION MARKET TAKER	BID/AS	SPOT RATE	ACTION MARKET MAKER EUR/USD
sell EUR 10 mio	bid	1.3530	sell USD 10 mio x 1.3530 = USD 13,530,000
buy EUR 10 mio	ask	1.3532	buy USD 10 mio x 1.3532 = USD 13,532,000
sell USD 10 mio	ask	1.3532	buy EUR 10 mio / 1.3532 = EUR 7,389,891
buy USD 10 mio	bid	1.3530	sell EUR 10 mio / 1.3530 = EUR 7,390,983

Figure 4.2 shows a Thomson Reuters page with the FX spot rates of the contributing banks.

Figure 4.2   *FX spot quotations*

4.1.3   Big figure and points/pips

FX traders know fairly precisely what the level of an exchange rate is. When they give prices to one another, they therefore normally do not give all the digits for an exchange rate. Generally, they limit themselves to the last two digits. These are called the points or pips of an exchange rate. The remaining digits are called the 'big figure'. For example, for a USD/CHF FX spot rate of 1.2389 - 1.2391, 1.23 (really only the '3') is the big figure and there are 89 pips for the bid rate and 91 pips for the ask rate. A market maker would then only quote: 89-91. If, later, the USD/CHF two-way FX rate is 1.2398 - 1.2400, he will then quote 98-00 and calls this 98 'to the figure'. For some currency pairs such as EUR/JPY or USD/JPY, the exchange rate is a high number. For a USD/JPY spot rate of 82.45, for instance, the big figure is 82 and the number of pips is 45.

A common way to express the risk in an FX position is the 'value of one point'. This indicates how much the value of an FX position changes if the FX spot rate changes by 1 pip/point.

4.1.4 Cross rates

Not every currency pair is traded as often as others. Mexican pesos, for example, are commonly traded against US dollars but much less frequently against euro. There is therefore an interbank market for USD/MXN but not for EUR/MXN. If a client wants to conclude an FX spot transaction with a bank in EUR/MXN, the bank will need to conclude two spot transactions on the interbank market in order to offset this transaction - one in EUR/USD and one in USD/MXN. The exchange rates for currency pairs that are not directly traded are called cross rates. They are calculated using the FX rates for standard currency pairs in which the bank concludes the transactions to offset the transaction.

In order to calculate cross rates, it is easiest to consider the rates as mathematical expressions. Thus, for instance, EUR/USD expresses 1 euro divided by 'x' US dollars. And USD/MXN expresses 1 US dollar divided by 'x' Mexican pesos.

The EUR/MXN cross rate can then be calculated as the following mathematical product: EUR/USD x USD/MXN. In this mathematical product, USD appears once above the line and once below the line and is thus cancelled out.

Suppose that the two-way FX spot rates for EUR/USD and USD/MXN are as follows:

	BID	ASK
EUR/USD	1.3550	1.3552
USD/MXN	13.15	13.17

To determine whether we must use the bid rate or the ask rate from the two relevant currency pairs, we apply some straightforward reasoning: the bid rate is low and the ask rate high. This practical idea can always be used as a rule of thumb to avoid complicated reasoning.

This straightforward reasoning leads to the following conclusion:

– The bid rate for EUR/MXN is calculated using the bid rate for EUR/USD and the bid rate for USD/MXN, therefore, bid rate EUR/MXN = 1.3550 x 13.15 = 17.82.
– The ask rate for EUR/MXN is calculated using the ask rate for EUR/USD and the ask rate for USD/MXN, therefore, ask rate EUR/MXN = 1.3552 x 13.17 = 17.85.

The question of whether the bid or ask rate must be used can also be reasoned out by considering the actions that the bank needs to take to offset its position. If a market user requests a EUR/MXN bid rate, this means that he wants to sell euro to the bank against Mexican pesos. The bank must first sell the euro that it receives from the client against US dollars. Since the bank now acts as a market user, it will get the EUR/USD bid rate. This is shown in the right bottom side of figure 4.3. After this, the bank must sell the US dollars against pesos. The bank acts once again as a market user and gets the USD/MXN bid rate. This is shown in the right upper side of figure 4.3.

Figure 4.3   *Offsetting a EUR/MXN FX transaction*
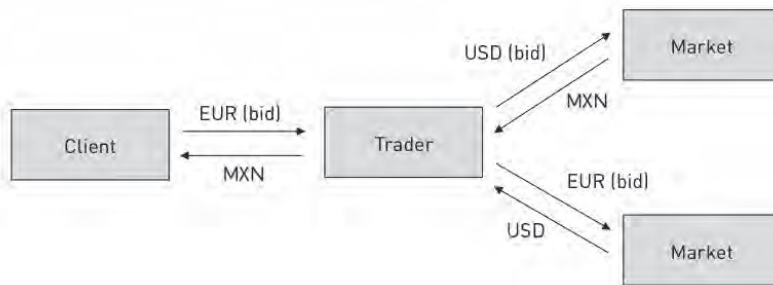
THE CROSS CURRENCY IS THE BASE CURRENCY IN BOTH FX QUOTATIONS

CHF/NOK is traded via EUR/CHF and EUR/NOK. Here,the base currency for both the currency pairs is the same. The cross rate CHF/NOK is calculated by dividing the EUR/NOK rate by the EUR/CHF rate:

$$CHF/NOK = \frac{EUR/NOK}{EUR/CHF}$$

In this equation, EUR, which is the 'cross currency' can be found once under the (horizontal) line and once above the (horizontal) line and is thus cancelled out. The NOK appears once under a (diagonal) line and remains there (as a denominator). The CHF appears twice under a line: once under the horizontal line and once under a diagonal line. Mathematically, this places CHF above the line (as a numerator).

Suppose that the two-way FX spot rates EUR/CHF and EUR/NOK are as follows:

	BID	ASK
EUR/NOK	8.8100	8.8150
EUR/CHF	1.5169	1.5171

To determine whether the bid or ask rates must be used, the rule of thumb is once again applied: the bid rate is low and the ask rate is high, thus

$$CHF/NOK_{bid} = \frac{EUR/NOK_{bid}}{EUR/CHF_{ask}} = \frac{8.8100}{1.5171} = 5.8071$$

and

$$CHF/NOK_{ask} = \frac{EUR/NOK_{ask}}{EUR/CHF_{bid}} = \frac{8.8150}{1.5169} = 5.8112$$

The question of whether the bid or ask rate must be used can again also be reasoned out by considering the actions that the bank needs to take to offset its position. If a client requests a CHF/NOK bid rate, this means he wants to sell Swiss francs to the bank against Norwegian crowns. The bank must now first sell the Swiss francs against euro; the bank must therefore buy euro. Because the bank is acting here as a market user, it gets the EUR/CHF ask rate and receives 1 / 1.5171 euro. This is shown in the left bottom side of figure 4.4. After this, the bank must sell the euro against Norwegian crowns. The bank is once again a market user and gets the EUR/NOK bid rate. For 1/1.5171 euro the bank receives 1/.5171 x 8.81 NOK. This is shown in the left upper side of figure 4.4. If the banks takes no margin, the client receives this amount of crownes for each Swiss franc that he sells to the bank.

Figure 4.4   *Offsetting a CHF/NOK FX transaction*
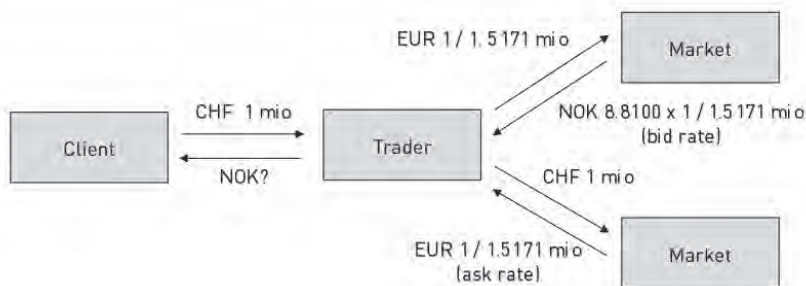
4.1.5   *Spot trading positions*

Traders with banks take positions in foreign exchange. They take a long position in one currency if they expect the FX rates will move in favour of this currency and take a short position if they have the opposite view. Normally, a trader's position is the result of a number of different transactions. In order to calculate the average price of an FX position, the following equation can be used[27]:

Average rate = Σ (p_i x r_i) / Σ p_i

Where
p_i = number of trade currency bought or sold in transaction 'i'
r_i = price of transaction 'i'

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EXAMPLE

A trader has concluded the following transactions:

Purchase of 5,000,000 euro against US-dollars: FX rate: 1.3500
Sale of 3,000,000 euro against US-dollars: FX rate 1.3520
Purchase of 4,000,000 euro against US-dollars: FX rate: 1.3485

The overall position of this trader is 6,000,000 long euro and the average rate of this position is

Average rate = (5,000,000 x 1.3500 - 3,000,000 x 1.3520 + 4,000,000 x 1.3485) / (5,000,000 - 3,000,000 + 4,000,000) = 1.3480

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27   The equation to calculate the average price of an FX position should be entered in a HP
        Financial Calculator as follows: AVRATE = (P1xR1+P2xR2+P3xR3) / (P1+P2+P3)

All trading positions are valued on a daily basis. For this purpose, valuation rates are used that are imported from the systems of data suppliers such as Thomson Reuters. The value of a position is calculated by comparing the average rate of the position with the valuation rate. The value of a spot position can be calculated by using the following equation:[28]

Position value = $(r_v - \Sigma (p_i \times r_i) / \Sigma p_i) \times \Sigma p_i$

In this equation, rv is the rate used for valuation.

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EXAMPLE

> The end of day FX spot rate used for valuation is 1.3524. The value of the above FX position can be calculated as[29]:
>
> Position value = (1.3524 - 1.3480) x (5,000,000 - 3,000,000 + 4,000,000) = USD 26,400

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4.2   FX forward

An FX forward contract, also known as an FX outright contract, is a contract in which two parties enter into a reciprocal obligation to exchange a certain amount of a currency at a certain time in the future for a predetermined amount in another currency. The rate used is called the FX forward rate. The FX forward rate is largely based on the FX spot rate.

Because the settlement of an FX forward takes place at a moment different from the spot date, the FX spot rate is adjusted. The level of the adjustment is based on the difference in the interest rates for the two currencies involved and is represented using swap points. One swap point for EUR/USD, for instance, is equal to 0.0001. Swap points are the translation of a difference in interest rates between two currencies into the difference between the FX spot rate and the FX forward rate.

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28   The equation to calculate the value of an FX position should be entered in a HP Financial Calculator as follows: POSVAL = (RVAL – (P1xR1+P2xR2+P3xR3) / (P1+P2+P3)) x (P1+P2+P3)

29   Use the POSVAL equation in your HP Financial Calculator to calculate the value of the position. RVAL = 1.3524, P1 = 5,000,000, R1 = 1.3500, P2 = -3,000,000, R2 = 1.3520, P3 = 4,000,000, R3 = 1.3485. Solve for POSVAL.

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EXAMPLE

> On 12 May 2011, the ING Bank euro-dollar trader concludes an FX forward with the Deutsche Bank euro-dollar trader in which he buys 10,000,000 euro for US dollars with delivery date 14 May 2012 (one year after the spot date). The EUR/USD cash rate is 1.3475 and the swap points amount to -130. The EUR/USD FX forward rate is thus 1.3345. .
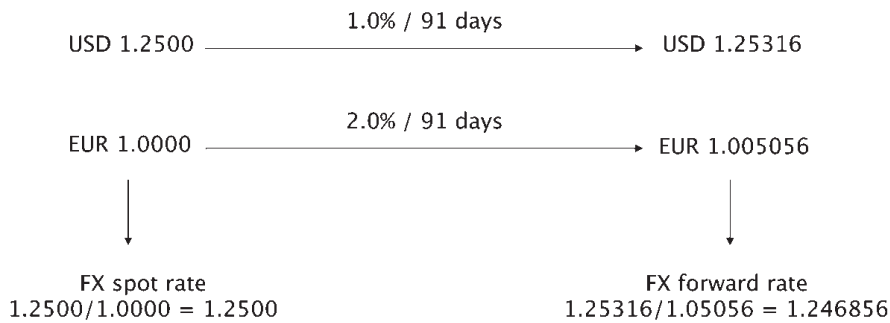
> On 14 May, 2012 ING Bank must transfer an amount of 13,345,000 US dollars to Deutsche Bank and Deutsche Bank must transfer an amount of 10,000,000 euros to ING Bank.

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4.2.1   Theoretical calculation of an FX forward rate

The FX forward rate can theoretically be calculated by calculating the future value of one unit of the trade currency and of the corresponding amount of units of the quoted currency, both on the forward delivery date. The future value in the quoted currency should then be divided by the future value in the trade currency.

In figure 4.5 the FX forward rate is theoretically calculated for a EUR/USD FX forward contract with a term of 91 days. The FX spot rate EUR/USD is 1.2500, the three months euro interest rate is 2% and the three month US dollar interest rate is 1%.

Figure 4.5   Theoretical calculation of the three month forward rate EUR/USD


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                         1.0% / 91 days
    USD 1.2500  ─────────────────────────────▶  USD 1.25316


                         2.0% / 91 days
    EUR 1.0000  ─────────────────────────────▶  EUR 1.005056

         │                                            │
         ▼                                            ▼
    FX spot rate                                 FX forward rate
1.2500/1.0000 = 1.2500                    1.25316/1.05056 = 1.246856
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The future value of 1.2500 USD (quoted currency) after three months is:

$$\text{Future value of USD } 1.2500 \ = \ 1.2500 \times \left(1 + \frac{91}{360} \times 0.01\right) \ = \ \text{USD } 1.25316$$

The future value of one euro (base currency) after three months is:

$$\text{Future value of EUR 1} \;=\; 1 \times \left(1 + \frac{91}{360} \times 0.02\right) \;=\; \text{EUR1.005056}$$

The theoretical FX forward rate is calculated by dividing the future value in the quoted currency by the future value in the trade currency:

$$\text{Forward FX rate} \;=\; \frac{1.25316}{1.005056} \;=\; 1.246856$$

The general equation to theoretically calculate an FX forward rate is[30]:

$$\text{Forward FX rate} \;=\; \frac{\text{Spot rate} \times (1 + \text{daycount fraction} \times r_q)}{1 + \text{daycount fraction} \times r_b}$$

In this equation r_q is the interest rate of the quoted currency and r_b is the interest rate of the base currency, both for the term of the FX forward contract.

In the above example, the FX forward rate is EUR/USD 1.2469 (rounded) where the FX spot rate is EUR/USD 1.2500. The difference between the FX forward rate and the FX spot rate is 0.0031, or 31 swap points.

4.2.2   *Swap points, premium and discount*

As we have seen, if the FX spot rate and the swap points are given, the FX forward rate can be calculated theoretically. The question is whether the swap points should be added to or subtracted from the FX spot rate, however. This depends on whether the interest rate for the base currency is higher or lower than that for the quoted currency.

Depending on the differences in interest rates between the currencies, there are three possibilities:

- the interest rate for the base currency is lower than that for the quoted currency: The forward rate is then higher than the spot rate. The base currency is said to trade at a premium
- the interest rate for the base currency is higher than that for the quoted currency. In this case, the forward rate is lower than the spot rate. The base currency is said to trade at a discount

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30   The equation to calculate an FX forward rate should be entered as follows in a HP Financial Calculator: FXFW = SPOT x (1+D/BQ x Y%Q) / (1+D/BB x Y%B)

– the interest rates of both relevant currencies are equal. The forward rate is the same as the spot rate and this is called parity.

If only the swap points are known and not the interest rates, the method of quotation can be used to determine whether there is a premium or discount. Just as with any other price, there are bid and ask rates for swap points. For example:

EUR/USD	BID	ASK
1 month	18	20
2 months	28	30
3 months	40	42
6 months	70	72
9 months	104	106
12 months	128	130

In the table above, the bid rates for the swap points are lower than the ask rates. In this case, there is a premium and the swap points must be added to the FX spot rate. For a forward bid rate, the bid rate for the swap points must be added to the bid rate for the FX spot rate. And for a forward ask rate, the ask rate for the swap points must be added to the ask rate for the FX spot rate.

If the two-way FX spot price is, for example, 1.2500 - 1.2502, the following FX forward rates apply.

EUR/USD	BID	ASK
1 month	1.2518	1.2522
	(1.2500 + 0.0018)	(1.2502 + 0.0020)
2 months	1.2528	1.2532
3 months	1.2540	1.2544
6 months	1.2570	1.2574
9 months	1.2604	1.2608
12 months	1.2628	1.2632

Figure 4.6 indicates that, in the case of a premium, the FX forward rate is higher for any value date that lies further in the future.

Figure 4.6   *FX forward rates when the base currency trades at a premium*
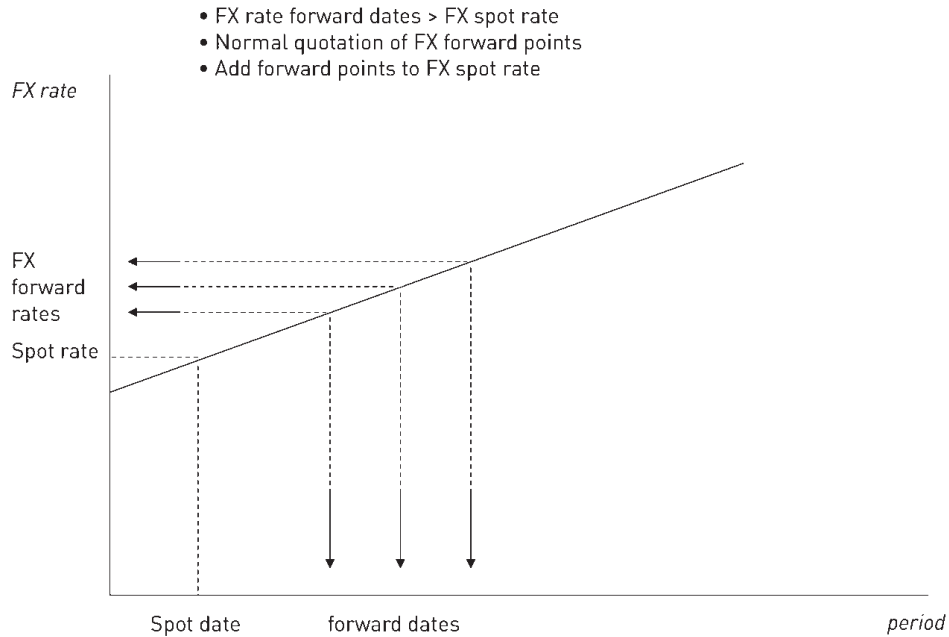
However, the bid rates of the swap points may also be higher than the ask rates. This is shown in the table below.

| EUR/JPY	BID	ASK
1 month	16	14
3 months	40	38
12 months	128	124

If this is the case, there is a discount and the swap points must be subtracted from the FX spot rate. Bid points must be subtracted from the FX spot bid rate and ask points must be subtracted from the FX spot ask rate.

If the two-way FX spot price is, for example, 140.50 - 140.52, the following FX forward rates apply.

EUR/JPY	BID	ASK
1 month	140.34	1.4038
	(140.50 - 0.16)	(140.52 - 0.14)
3 months	140.10	140.14
12 months	139.22	139.28

Figure 4.7 indicates that, in the case of a discount, the FX forward rate is lower for any value date that lies further in the future.

Figure 4.7   *FX forward rates when the base currency trades at a discount*
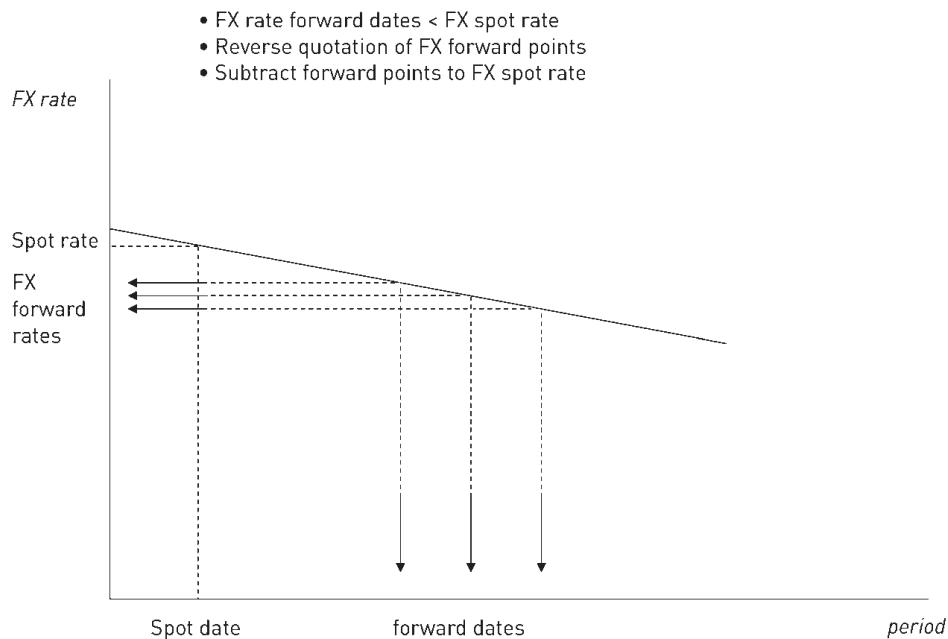
4.2.3   *Forward value dates and corresponding FX forward rates*

FX forwards are over-the-counter traded instruments. This means that they can be concluded for any amount and for any period. However, the FX swap points are normally only set for the standard periods: 1, 2, 3, 6 and 12 months. When determining the dates for these standard periods, the modified following convention is used. If the spot date is an ultimo date then the end-of-month convention is applicable for the standard periods.

As an example, the maturity dates for the regular periods based on the modified following convention for trading day 15/4/2009 are shown below.

PERIOD	DATE	DAY	REMARK
spot	17/4/2009	Fri	
1 month	18/5/2009	Mon	17/5 is Sunday
2 months	17/6/2009	Wed	
3 months	17/7/2009	Fri	
6 months	19/10/2009	Mon	17/10 is Saturday
12 months	19/4/2010	Mon	17/4 is Saturday

As another example: the EOM dates for trading day 28 April 2009 are shown in the following table.

PERIOD	VALUE DATE	DAY	REMARK
spot	30/4/2009	Thu	
1 month	29/5/2009	Fri	31/5 is Sunday
2 months	30/6/2009	Tue	
3 months	31/7/2009	Fri	31/7 is last business day
6 months	30/10/2009	Fri	31/10 is Saturday
12 months	30/4/2010	Fri	

In reality, it frequently happens that the value date for an FX forward contract does not fall exactly on a standard date. Such a date is called a broken date or cock date. To determine the number of FX swap points that belong to such a particular value date, interpolation is used. The following equation is used for this purpose:

$$fp_b = fp_s + \text{daycount fraction broken period} \times (fp_l - fp_s)$$

In this equation

fp_b = swap points for the broken period;

fp_s = swap points for the adjacent standard period that is shorter than the broken period;

fp_l = swap points for the adjacent standard period that is longer than the broken period.

The EUR/USD swap points for spot 15/1/2009 are given below:

PERIOD	VALUE DATE	# DAYS	FORWARD POINTS	
			BID	ASK
1 month	16-2-2009	32	5	8
2 months	16-3-2009	60	10	13
3 months	15-4-2009	90	17	20
6 months	15-7-2009	181	51	54
12 months	15-1-2010	365	125	130

If a market user wants to conclude an FX forward in which he sells US dollars against euro on 8 April 2009, the swap points are calculated as follows:

$$fp_b \ = \ 13 + 23/30 \times \langle 20 - 13 \rangle \ = \ 13 + 5.37 \ = \ 19$$

As a market user, he is buying the euro and, therefore, he gets the ask rate for the swap points from his counterparty. The value date, 8 April, lies between the regular periods of two months (16 March) and three months (15 April). As a starting point for the above calculation, the swap points for 8 April are taken: 13 swap points.

Next, the daycount fraction is calculated for the period from 16 March to 8 April. The number of interest days until 8 April is 23 and the number of days for the whole month is 30. The day count fraction is thus 23/30. This daycount fraction is then applied to the difference between the swap points for the regular three month period and the regular two month period (20 - 13 = 7). The outcome (23/30 x 7 = 5.37) is then added to the swap points for the adjacent shorter period: 13 + 5.37 = 18.37. Since the rate that is to be calculated is an ask rate and there is a premium, the market maker rounds this outcome upwards.

Figure 4.8 shows a Thomson Reuters screen with the regular forwards points for EUR/CHF. At the bottom of the screen, a tool for calculating forwards points for broken dates is added.

Figure 4.8   *Forward points for regular and broken dates*

4.2.4   *FX forward cross rates*

To calculate FX forward cross rates, the following steps must be undertaken:

1. Determine the way in which the FX spot cross rate would be calculated.
2. Apply this calculation method to the FX forward rates of the currency pairs that are used to offset the transaction in the market.

A trader is asked to give his FX forward bid rate for EUR/MXN when the following rates apply:

SPOT RATE	BID	ASK
EUR/USD	1.3550	1.3552
USD/MXN	13.15	13.17

and

1 MONTH SWAP RATE	BID	ASK
EUR/USD	0.0012	0.0010
USD/MXN	0.10	0.20

1. The FX spot bid rate for EUR/MXN is calculated by multiplying the spot bid rate EUR/USD by the spot bid rate USD/MXN.

2. The FX forward cross rate is calculated in the same way - thus by multiplying the FX forward bid rate EUR/USD by the FX forward bid rate USD/MXN.

   FX forward bid rate EUR/USD = 1.3538 (discount)
   FX forward bid rate USD/MXN = 13.25(premium)
   FX forward bid rate EUR/MXN = 1.3538 x 13.25 = 17.94

As a second example, we calculate an FX forward ask price for CHF/NOK when the following prices are known:

	BID	ASK
EUR/NOK	8.8100	8.8150
EUR/CHF	1.5169	1.5171

and

6 MONTH SWAP RATE	BID	ASK
EUR/NOK	0.44	0.45
EUR/CHF	0.0015	0.0013

1. The FX spot ask rate CHF/NOK is calculated by dividing the FX spot ask rate EUR/NOK by the FX spot bid rate EUR/CHF.

2. The forward cross rate is calculated in the same way – thus by dividing the FX forward ask rate EUR/NOK by the FX forward bid rate EUR/CHF.

FX forward ask rate EUR/NOK = 9.2650 (premium)
FX forward bid rate EUR/CHF = 1.5154 (discount)
FX forward ask rate CHF/NOK = 9.2650/ 1.5154 = 6.1139.

4.2.5   *Value tomorrow and value today FX rates*

Sometimes, the delivery for an FX transaction takes place on a date before the spot date; on the trading day itself (value today) or on the next trading day (value tomorrow). These dates are called ex ante dates. Settlement value tomorrow is always possible while settlement value today is only possible if the payment systems of the central banks of the relevant currencies are still operational.

A EUR/USD FX transaction concluded by a dealer in Europe can, in principle, be settled same day value. However, the transaction must be concluded before the TARGET2 cut-off time. TARGET2 is the euro inter-bank payment system. If the transaction must be settled via the CLS Bank, however, settlement same day value is no longer possible. This is because transactions that are settled value today via the CLS Bank, must be delivered to the CLS Bank before 6.30 am CET. A EUR/JPY FX transaction concluded between a German dealer and a US dealer can never be settled same day value. After all, the Japanese Central Bank closes at 07.00 CET.

A USD/MXN FX transaction can be settled same day value by a bank in the euro-zone or in the UK. After all, both the United States and Mexico are in a later time zone, which leaves plenty of time for sending settlement instructions. Settlement via the CSL Bank is still not possible, however, because, in that case, the transaction must once again be delivered before 6.30 am.

Just as for FX forward contracts, the FX rates for value today or value tomorrow FX transactions differ from the FX spot rates. Swap points are also used with these transactions and thus discount and premiums apply.

EX ANTE RATES IN THE CASE OF DISCOUNT

If a currency trades at a discount, this means that the FX rate is lower the further into the future a value date lies. This also applies for ex ante value dates. In the case of a discount, the FX rates for ex ante value dates are higher than the FX spot rate. After all, the spot date is further into the future than the ex ante date. This is shown in figure 4.9

Figure 4.9   *FX rates before the spot when the base currency is trading at a discount*
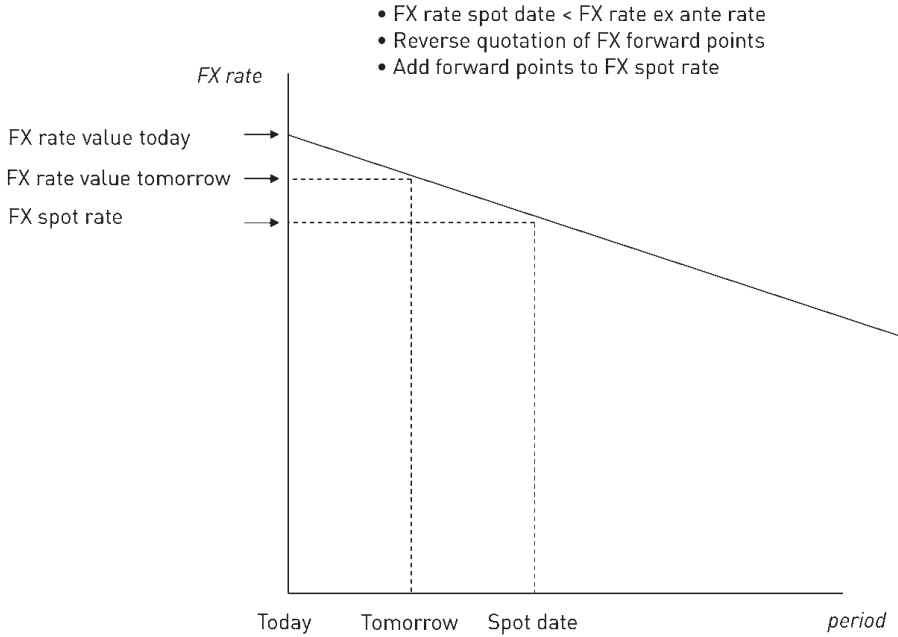
A discount can be recognised by an inverse quotation. This rule is applied consistently for ex ante dates. For a discount, a two-way price for value tomorrow (tom/next points) is, for example, 5 - 4. For an ex ante FX rate value tomorrow, these swap points must be added to the FX spot rate. Since a bid rate must be as low as possible, for the value tomorrow bid rate the lowest number of points (4) must be added to the FX spot bid rate. And since an ask rate must be as high as possible, for the value tomorrow ask rate the highest number of points (5) must be added to the FX spot ask rate.

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EXAMPLE

The two way spot rate GBP/USD is 1.2500 - 1.2502 and the two way price for tom/next points is 3 - 2.5.

The FX bid rate GBP/USD value tomorrow is 1.2500 + 2.5 = 1.25025.
The FX ask rate GBP/USD value tomorrow is 1.2502 + 3 = 1.2505.

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THE FOREIGN EXCHANGE MARKET

For an FX rate value today, a quotation is required for both the tom/next swap points and the overnight swap points. Such a quotation is given below:

	FORWARD POINTS	
	BID	**ASK**
tom/next swap	3	2.5
overnight swap	2	1.5
total	5	4

For a GBP/USD spot rate of 1.2500, the overnight bid rate GBP/USD is 1.2500 + 0.0004 = 1.2504 and the overnight ask rate is 1.2502 + 0.0005 = 1.2507.

EX ANTE RATES IN THE CASE OF PREMIUM

If a currency trades at a premium, this means that the FX rate is higher the further into the future a value date lies. This also applies to value dates for the spot; for a premium, the FX rates for value dates before the spot are lower than the FX spot. This is shown in figure 4.10 below.

Figure 4.10   *FX rates before the spot when the base currency is trading at a premium*

- FX rate spot date > FX rate ex ante rate
- Normal quotation of FX forward points
- Subtract forward points from FX spot rate
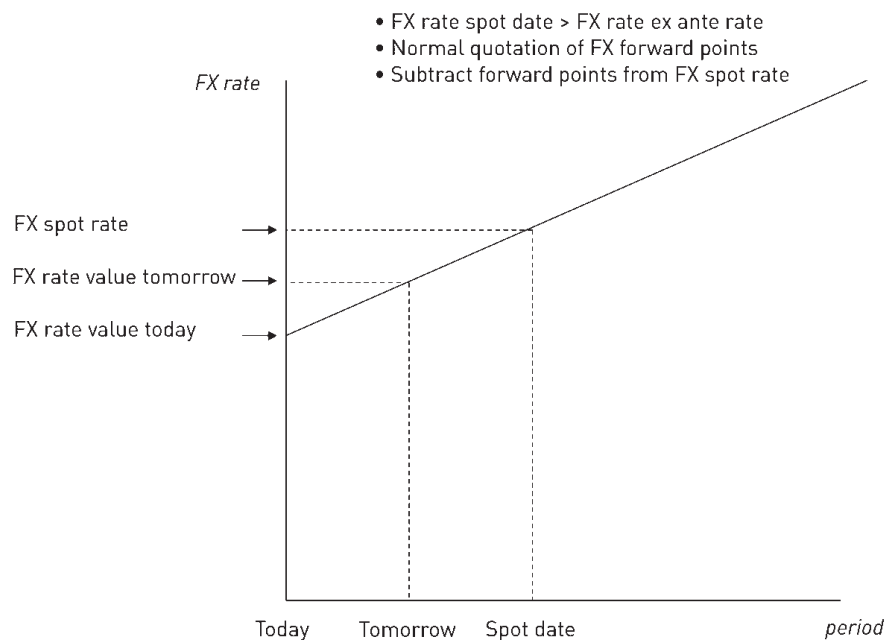
A premium can be recognised by a 'normal' quotation. This rule is applied consistently for ex ante dates. For a quote for the tom/next swap points of , for example, 0.5 - 1, the value tomorrow rates are thus lower than the FX spot rate. If the two way spot rate is 1.3500 - 1.3502 then the FX bid rate EUR/USD value tomorrow is 1.3500 - 1.0 = 1.3499 and the FX ask rate EUR/USD value tomorrow is 1.3502 - 0.5 = 1.35015.

For an FX rate value today, a quote is needed for both the FX swap points tom/next and for the overnight FX swap points:

	FORWARD POINTS	
	BID	ASK
overnight swap	0.75	1.25
tom/next swap	0.5	1
total	1.25	2.25

For a two way price for FX spot EUR/USD of 1.3500 - 1.3502, the overnight bid rate would be EUR/USD 1.3500 - 0.000225 = 1.349775 and the overnight ask rate 1.3502 - 0.000125 = 1.350075.

4.2.6   Time option forward contracts

A variant of the FX forward contract is a time option forward contract or delivery option contract. This is an FX forward contract where the customer may choose, within a specific period – the underlying period – when the settlement must take place. This period can come into effect on the spot date or at a specific moment in the future. The length of the underlying period is generally limited, e.g. up to three months. If, on the maturity date, the full amount of the contract still has not been settled, a close out takes place via a reverse spot transaction or the contract is rolled over by means of an FX swap.

The FX rate for a time option forward contract is the, for the customer, least favourable of the FX forward rates for the start date of the underlying period and the FX forward rate for the end date of the underlying period.

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A client concludes a time option forward contract in which, for the period between six and twelve months, he must purchase a total amount of EUR 50 million against a pre-determined rate.

At the moment when the contract is concluded, the following FX forward rates for EUR/USD apply:

Six month FX forward ask rate EUR/USD: 1.4590
Twelve month FX forward ask rate EUR/USD: 1.4520
The bank sets the contract rate at 1.4590.

If, after twelve months, the client has only used the time option forward contract to purchase 40 million euro, he must now either perform a close out FX spot transaction in which he sells 10 million euro per spot against the applicable spot rate or he must conclude an FX swap in which he sells 10 million euro per spot and repurchases these on a later date against the current FX forward rate.

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4.2.7   *Offsetting FX forwards*

Sometimes, an import or export transaction is cancelled. If a company has entered into an FX forward contract to fix the rate for the payment in foreign currency related to this transaction, this FX forward contract will be superfluous. The company will then probably want to undo the FX forward. This can be done by concluding a reverse FX forward for the same amount and with the same value date. This is called closing out the FX forward contract. In contrast to stock market transactions, where offsetting leads to the unwinding of the original contract, the two opposing FX forward contracts continue, in principle, to co-exist.

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EXAMPLE

A French company has concluded an import contract with an American supplier for a value of USD 2 million. The expected payment date is 10 October. The importer has concluded an FX forward contract with its bank in which it buys the US dollars against a EUR/USD forward rate of 1.5200. On 8 September, the importer hears that the supplier has gone bankrupt and that the delivery will therefore not take place. The payment of USD 2 million on 10 October will therefore also not take place.

Since the importer has already purchased the US dollars from the bank, he now has an unwanted long position in US dollars. To close this long position, the importer may conclude a reverse FX forward contract in which he sells USD 2 million value 10 October.

Suppose that on 8 September, the EUR/USD spot rate is 1.5385 and the one month premium is 0.0015. The one-month FX forward rate is therefore 1.5400.

With the settlement of the two FX forward contracts on 10 October, the following transfers are carried out in the bank accounts of the importer:

USD account: debit 2,000,000 and credit 2,000,000
Euro account: debit 1,315,789.47 (2,000,000 / 1.5200)
and credit 1,298,701.30 (2,000,000 / 1.5400)

On balance, the two transactions result in the debiting of the euro account of the importer with an amount of EUR 17,088.17.

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In front-office systems, an FX forward contract is valued first by calculating the individual present values of the two future cash flows using the current market interest rates, after which the present value for the foreign currency is converted at the FX spot valuation rate to a present value in the local currency. Finally, the balance of the two opposing present values is calculated.

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EXAMPLE

The cash flows on 10 October of the FX forward contract in the previous example are USD 2,000,000 and EUR 1,315,789.47. On 8 September, the one month EURIBOR is 2.00% and the one month USD LIBOR is 3.17%. The present values of the two cash flows are:

EUR 1,315,789.47 / (1 + 30/360 x 0.02) = EUR 1,313,600.14 negative
USD 2,000,000 / (1 + 30/360 x 0.0317) = USD 1,994,730.59 positive

Converted against the FX spot rate of 1.5385, the counter value of the US dollar cash flow in euro is USD 1,994,730.59 / 1.5385 = EUR 1,296,542.47.

The official value of the FX forward contract is thus
EUR 1,296,542.47 -/- EUR 1,313,600.14 = -/- EUR 17,057.67.

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4.2.8   *Theoretical hedge of an FX forward via FX spot and deposits*

In the inter-bank market, FX forward transactions are not commonly concluded. This means that a bank that has concluded an FX forward transaction with a client usually cannot offset it directly with another bank via a reverse FX forward transaction.

If, for instance, a British bank concludes an FX forward with a client in which, in 3 months, the bank will sell an amount of EUR 10 million against US dollars with an FX forward rate of EUR/USD 1.2469, this bank now has a short position in euro. To offset this short position, the bank buys an amount of EUR 10 million at spot against an FX spot rate of 1.2500. The FX position of the bank is now closed. The bank has purchased an amount of EUR 10 million and sold an amount of EUR 10 million and both the 'purchase price' and the 'selling price' for the euro are fixed.

However, a new issue arises. The bank now has a liquidity position in both currencies. It will receive an amount of 10 million euro per spot that does not need to be transferred to the client's account until after three months. Thus, it has temporary excess liquidity in euro. Furthermore, the bank has a temporary liquidity shortage in US dollars: on the spot date, it must deliver the US dollars to the market party from which it purchased the euro; however, it will only receive the US dollars from the client in three months' time.

The bank can theoretically close the liquidity positions in both currencies by investing the euro in the money market for three months and simultaneously taking a US dollar loan for three months. The costs and revenues associated with this will depend on the interest rate difference between euro and US dollars. In practice, however, the bank will not do this and it will offset the opposing liquidity positions using an FX swap.

4.3   FX swaps

An FX swap is an OTC currency derivative contract with a short term, in which two parties enter into a reciprocal obligation to exchange a certain amount of two currencies on the spot date at the FX spot rate and to reverse this exchange in the future at the FX forward rate. The exchange at the beginning of the maturity period is called the near leg (spot leg or first leg), the exchange at the end of the maturity period is called the far leg (forward leg or second leg).

If the first exchange of an FX swap takes place on the spot date, this exchange is also called the spot leg of the FX swap. The reverse exchange on the forward date is then called the forward leg.

If a bank sells euro against US dollars per spot and buys the euro back after three months, the bank is said to 'sell and buy euro against US dollars in three months'.

For the price for the near leg in an FX swap, the spot mid-rate is often taken. Within certain limits, however, a market maker can choose the level of the spot rate in agreement with the client. In the example below, the mid rate is used

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EXAMPLE

> A client wants to conclude an FX swap in which he sells 10 million euro per spot against US-dollars and then, 1 month later, he wants to buy them back. The spot rate is 1.2500 - 1.2504. The quote for the one month swap points is 18 - 20.
>
> The bank now 'buys and sells' the euro in one month against US-dollars and uses the following rates in this FX swap: 1.2502 and 1.2522.

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A special form of FX swaps are so-called IMM swaps. These are FX swaps where the maturity dates are the same as the maturity dates for IMM futures.

The 'price' of an FX swap where the first exchange takes place on the spot date are the FX swap points that correspond with the contract period of the transaction.

EUR/USD	BID	ASK
1 month	18	20
2 month	28	30
3 month	38	40
6 month	70	72
12 month	128	130

If a market maker buys the base currency in the forward leg (sells and buys the base currency), he will use the bid rates of his swap points quotation. A market maker uses his ask rate when he sells the base currency in the forward leg (when he buys and sells the base currency).

POINTS 'MY FAVOUR' AND POINTS 'AGAINST ME'

If the market maker who has provided the above prices concludes an FX swap in which he purchases the euro at spot and sells them for future delivery, for him the sale price is higher than the purchase price. This is because the euro is trading at a

premium. In jargon: the points are in his favour. This can also be explained by look-ing at what is actually happening in this FX swap: the market maker is in fact bor-rowing euro and lending US dollars for the term of the FX swap. Because the euro is trading at a premium, this means that the euro interest rate is lower than the US dollar interest rate. The market maker, therefore, borrows at the lower interest rate and lends at the higher interest rate. This means he is earning the interest rate dif-ferential. This is reflected in the swap points; here they are 'in his favour'.

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EXAMPLE

> As a market maker, an FX swap trader buys and sells euro against US-dollars in three months against the prices in the above table. The current EUR/USD spot rate is 1.2500. The position of the dealer is shown in figure 4.11 below.
>
> *Figure 4.11*
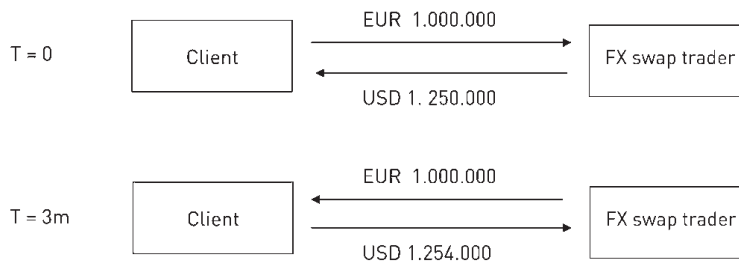
> In the picture it is clear that the points for the dealer are 'in his favour'. After all, at the maturity date he receives more US-dollars than he 'invested' at the start date; USD 1,254,000, corresponding with an FX forward rate of 1.2540 versus USD 1,254,00 corresponding with an FX spot rate of 1.2500.

....

For the client in the above example, the points are said to be against him. After all, he is borrowing US-dollars at a high interest rate and is lending euro at a low interest rate.

THEORETICAL CALCULATION OF SWAP POINTS

As we have already seen, swap points can be considered as an interest rate differen-tial expressed as a difference between the FX spot rate and the FX forward rate. This means that if we know the interest rates of the traded currencies, we should be able to calculate the swap points theoretically. To find this 'implied swap rate', we can use the following equation:[31]

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31   The equation to calculate the swap points should be entered in a HP financial calculator as follows: SWAP = SPOT x (1+D / BQ x Y%Q) / (1+D / BB x Y%B) – SPOT

$$\text{Swap points} = \frac{\text{Spot rate} \times (1 + \text{daycount fraction} \times r_q)}{1 + \text{daycount fraction} \times r_b} - \text{spot rate}$$

To calculate the ask price for the three month FX swap points we need the 3 month euro and 3 month US-dollar interest rates:

Euro:	2.00 - 2.05	(91 days)
US-dollar	3.22 - 3.27	(91 days)

We can determine whether we should take the bid or the ask side by again looking at what is actually happening in the swap. The market maker borrows euro and lends US-dollars. This means he will use his bid price for borrowing 3-month euro and his ask price for lending 3-month US-dollars in order to calculate the swap points[32]:

3 months swap points = 1.2500 (1 + 91/360 x 0.0327) / (1 + 91/30 x 0.020) – 1.2500
= 0.0040

4.3.1 Overnight swaps and tom/next swaps

Often, market parties may want to conclude FX swaps for periods that fall entirely before the spot date. An overnight swap (o/n swap) is an FX swap where the first leg falls on the current trading day and the second leg on the next trading day. The first leg of a tom/next swap (t/n swap) falls on the next trading day and the second leg on the spot date. It is easiest to take the FX spot mid rate for the first leg. The FX rate for the second leg can then be determined in the normal way: with a premium, the swap points are added to the first rate and, for a discount, they are subtracted.

……………………………

EXAMPLE

The following quotes are given:

	FORWARD POINTS	
	BID	ASK
overnight swap	0.75	1.25
tom/next swap	0.5	1
total	1.25	2.25

---

32 Use the SWAP equation in your HP Financial calculator to calculate the swap points:
    SPOT =1.2500, Y%Q = 0.0327, D = 91, BQ= 360, Y%B = 0.02, BB = 360. Solve for SWAP.

Here, the bid rates are lower than the ask rates. The trade currency therefore is trading at a premium. The FX rates for dates that lie further into the future are thus higher than those for earlier dates.

A market user who wants to conclude a tom/next swap in which he is buying euro value tomorrow and selling them per spot will be quoted 1.5000 and 1.50005 respectively if the spot rate is 1.5000.

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4.3.2   FX swaps out of today / out of tomorrow

FX swaps out of today and out of tomorrow are FX swaps where the first leg is before the spot date and the second leg is after the spot date. For these FX swaps, the swap points for the period before the spot date and for the forward period must be added. The following quotations for swap points are given:

overnight	0.5	1
tom/next	0.75	1.25
3 months	25	28
6 months	45	50

Based on these prices, the swap points for a 3 month FX swap out of tomorrow are:

TWO-WAY PRICE 3 MONTHS FX SWAP OUT OF TOMORROW		
tom/next	0.75	1.25
3 months	25	28
	25.75	29.25

And the swap points for a 6 month FX swap out of today are:

| TWO-WAY PRICE 6 MONTHS FX SWAP OUT OF TOMORROW		
overnight	0.5	1
tom/next	0.75	1.25
6 months	45	50
	46.25	52.25

4.3.3   *Hedging an FX forward via an FX spot and FX swap*

A bank that concludes an FX forward contract, always hedges its currency position via an opposing FX spot transaction. As we have seen, the bank can theoretically cancel out the liquidity positions that originate by concluding two opposing deposits. However, in practice, it will use an FX swap for this purpose.

When a bank, for instance, concludes a 3 month EUR/USD FX forward contract in which it sells 10 million euro to a client, it will immediately conclude an FX spot transaction in which the bank itself purchases 10 million euro. It also concludes an FX swap in which it sells and buys euro against US dollars for three months.

Suppose that the FX spot mid rate is 1.2502 and the quotation for the FX swap points is 38 - 40. For the FX swap that the bank concludes in the market, it acts as market user. Since the bank purchases euro in the far leg, the bank obtains the 3 month ask rate for the swap points: 40. If the bank would apply no credit spread (credit value adjustment – CVA), the bank would charge the client 1.2542 US dollars per euro. Figure 4.12 shows the FX forward transaction with the client, the reverse FX Spot deal and the FX swap that the bank has concluded to offset the FX forward contract.

Figure 4.12
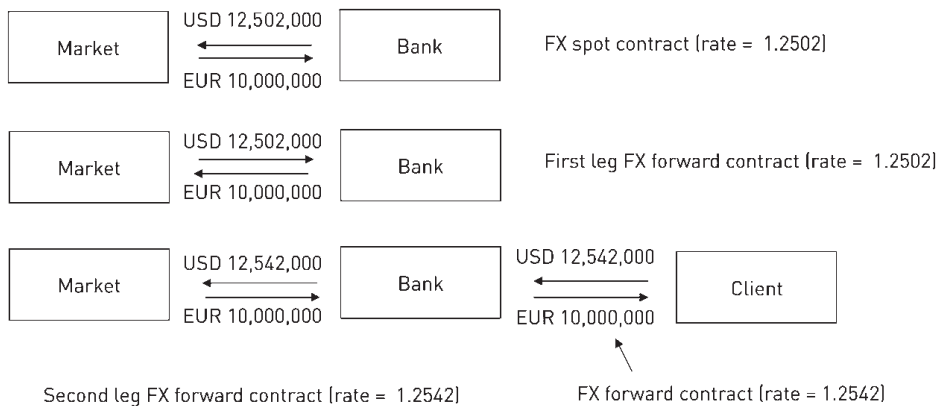
When a bank, for instance, concludes a value tomorrow EUR/USD FX forward contract in which it buys 10 million euro from a client, it will immediately conclude an FX spot transaction in which the bank itself sells 10 million euro. It also concludes an tom/next swap in which it sells euro value tomorrow and buys euro per spot.

Suppose that the FX spot mid rate is 1.2502 and the quotation for the tom/next swap points is 0.5 - 1. For the tom/next swap that the bank concludes in the market, it acts as market user. Since the bank purchases euro in the far leg, the bank obtains the

ask rate for the swap points: 1 point. This point is 'against the bank', however. If the bank would apply no credit spread (credit value adjustment – CVA), the bank would pay the client 1.4499 US dollars per euro. Figure 4.13 shows the FX forward transaction with the client, the reverse FX Spot deal and the tom/next swap that the bank has concluded to offset the client transaction.
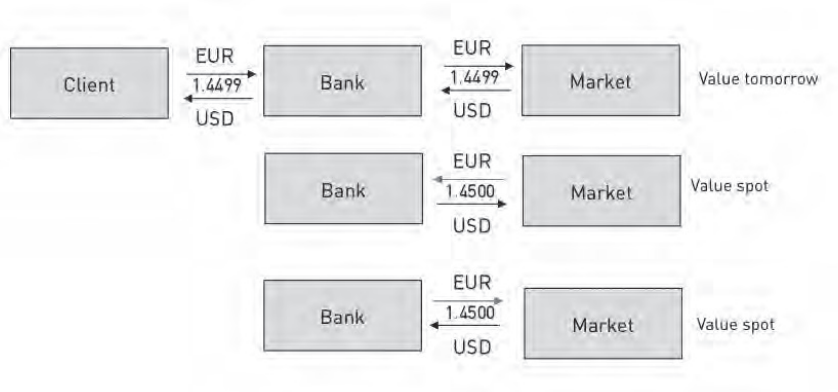
Figure 4.13

Note that if we would have use the 'rule of thumb' to calculate the FX rate for value tomorrow we would have taken the EUR/USD FX spot bid rate and would have subtracted 'as many points as possible': 1 point.

4.3.4 *Regulating cash positions using FX swaps*

Banks can also use FX swaps to regulate their cash positions. If a bank, for instance, has an overnight surplus in euro and, at the same time, a shortage in US dollars, it can invest the euro in an overnight euro deposit and draw on an overnight deposit in US dollars. However, it can also perform a tom/next swap in which it sells euro value today against US dollars and buys the euro back value tomorrow. Banks normally choose the latter alternative because the implied interest rate differential in the overnight FX swap is often more favourable than the difference between the interest rates of overnight deposits in the relevant currencies. Banks may also do this for longer periods. Companies that have two opposing liquidity positions in different currencies can also optimise their interest result by using FX swaps.

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In a particular month (31 days), a company has a liquidity surplus of GBP 20 million while, at the same time, it has a liquidity shortage of USD 25 million. After shopping around, the company receives the following rates:

1 month GBP deposit:	3%.
1 month USD money market loan:	5%.
1 month FX swap points:	17-19 (spot rate GBP/USD 1.2500)

If the company invests GBP 20 million and borrows USD 25 million for one month, the interest result is as follows:

Interest return GBP: GBP 20,000,000 x 0.03 x 31/365 = GBP 50,958.90
Interest costs USD: USD 25,000,000 x 0.05 x 31/360 =   USD 107,638.89
(converted against a GBP/USD forward rate of 1.2519 = GBP 85,980.42)
Net interest costs GBP 35,021.52.

As an alternative, the company can conclude an FX swap in which it sells and buys the GBP for one month against US-dollars. This results in the following cash flows:

Spot leg (spot rate 1.2500): Sale of GBP 20,000,000 against USD 25,000,000
Forward leg (FX forward rate 1.2519): Purchase of GBP 19,969,646.13 against USD 25,000,000
(Interest) costs: GBP 30,353.87.

Thus, the company can save an amount of : GBP 35,021.52 / GBP 30,353.87 = GBP 4,667.65 by using an FX swap.

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4.3.5   *Rolling over FX forward contracts using FX swaps*

Companies often use FX swaps to change the value date of an FX forward transaction. This is referred to as rolling over an FX forward transaction.

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A German company expects that its US customer will pay an invoice for USD 10 million on 15 October. With this in mind, the company has concluded an FX forward contract with value date 15 October in which it sells the USD 10 million to the bank against euro.

However, it appears that the customer is going to pay a month later. The company would now prefer to settle the FX forward on 15 November. To achieve this, it can conclude an FX swap of which the first leg falls on 15 October and the second leg on 15 November. In the first leg, the company buys USD 10 million against euro so that the transfers on its US-dollar account cancel each other out. On 15 November, in the second leg of the FX swap, the company sells the USD 10 million again to the bank, i.e. the amount that it hopes to receive from its customer by then. This is shown in figure 4.14.

Figure 4.14 Rolling over an FX forward contract
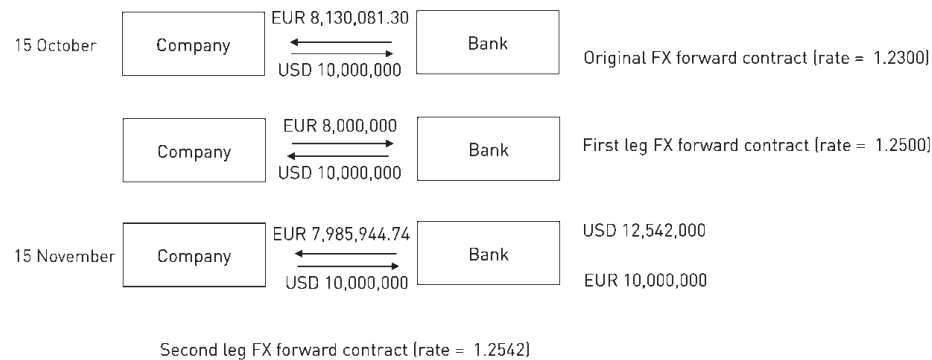
The figure shows that the US dollar transfers on value date 15 October cancel each other out and that, on value date 15 November, the US dollar account of the company is debited for USD 10 million. This is exactly what the company intended.

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In the example, the original FX forward rate of 1.2300 differed from the FX spot rate of 1.2500 used in the FX swap. The difference in these FX rates results, in this case, in a positive liquidity effect for the company; on 15 October it receives an amount of 8,130,081.30 euro, but only has to pay 8,000,000 euro. The company can invest the residue of 130,081,30 euro for one month and thus earn interest. If, however, the original FX forward rate had been higher than the current spot rate of 1.2500, the result would have been a negative liquidity effect and interest costs would have been incurred.

In order to avoid the potential negative liquidity effects, customers may ask their bank to use the original FX forward rate for the FX swap. However, if this rate differs significantly from the current rates, this is generally not allowed. This is because the use of so-called historical forward rates means that any losses on the original FX forward are not visible. Furthermore, the bank is, in fact, granting a credit to the customer for which a credit line must be available. In any case, this practice must be approved by a senior manager.

4.3.6   *Arbitrage between the FX swap market and the money markets*

When an organization has a funding requirement in its own currency, it can consider concluding a synthetic loan to lower its interest costs. This can be done.by concluding a loan in another currency and by using an FX swap to convert the cash flows from this loan into its own currency. In theory, this does not help the organization much; the interest rate differential between the loans in the two currencies is after all included in the FX forward rate used in the far leg of the FX swap. However, in practice, the implied interest differential in the FX swap points often differs slightly from the FX swap points that should theoretically apply based on the differences between the money market interest rates in the relevant currencies. This is because the money market works differently than the market for FX swaps. In such cases, arbitrage opportunities can arise. Making use of such opportunities is called covered interest arbitrage.

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EXAMPLE

A French organization wants to issue commercial paper with a maturity period of 30 days. The funding requirement is 8 million euro. The organization investigates whether it would be more favourable to arrange the financing by means of a synthetic commercial paper via US dollars instead of euro.

The one month interest rate for commercial paper in euro is 3.6%. The one-month US dollar interest rate for commercial paper is 5.6%, the EUR/USD FX spot rate is 1.2500 and the one month EUR/USD trades at a premium of 22 points.

The issue price of a commercial paper with a face value of USD 10 million can be calculated as follows:

$$\text{price} \ = \ \frac{\text{USD 10 mio}}{1 + 30/360 \times 0.056} \ = \ \text{USD } 9{,}953{,}550.10$$

Figure 4.15 shows the cash flows for the synthetic US dollar loan. The company sells the US dollar proceeds of the CP issue in the spot leg of the swap at the spot rate of 1.2500 and receives a euro amount of 9,953,550.120 / 1.2500 = 7,962,840.08 euro. In the far leg the company buys the face value of the CP issue from the bank at the forward rate of 1.2522 and pays 10,000,000 / 1.2522 = 7,985,944.74 euro.

Figure 4.15 Synthetic short term euro loan
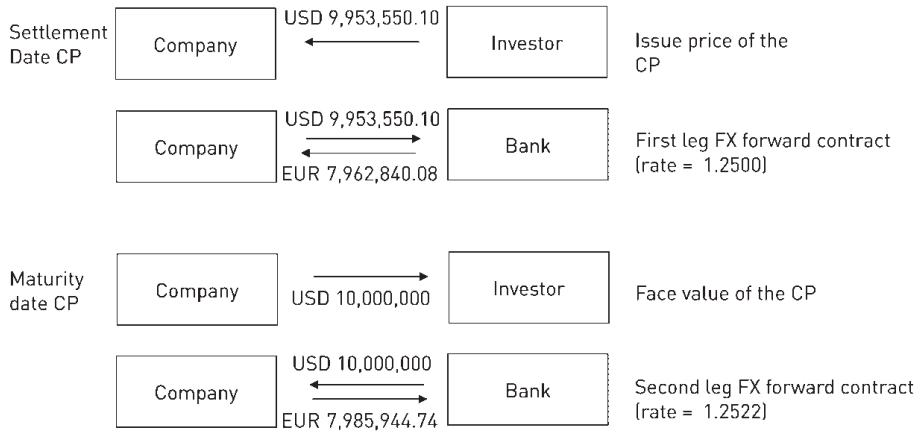
The interest rate that the organization pays in the above strategy can be calculated as follows:

Interest costs in euro = EUR 7,985,944.74 - EUR 7,962,840.08 = EUR 23,104.66.

The interest costs as a percentage of the principal amount can be calculated as follows:

EUR 23,104.66 / EUR 7,962,840.08 * 100% = 0.00290%

Interest rate on annual basis: 0.00290 * 360/30 = 3.48%

(Note that the term was 30 days).

If the organization had issued commercial paper in euro, the interest rate would have been 3.6%.

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The arbitrage opportunity for the organization in the above example arises because the FX swap points in the FX swap differ from the theoretical FX swap points that can be calculated based on the interest rate differential between the euro and the US-dollar. The following equation can be used to calculate the theoretical FX swap points that correspond with the interest rate differential between the US dollar commercial paper (5.60%) and the euro commercial paper (3.6%):

$$\text{Forward points} = \text{FX forward - FX spot} = \frac{1.2500 \times \left(1 + \frac{30}{360} \times 0.056\right)}{1 + \frac{30}{360} \times 0.036} - 1.2500 = 0.00208$$

The number of FX swap points according to the market is 22 while, theoretically, they should be only 20.8. This is the reason for the above arbitrage opportunity. If the FX swap points in the market had been lower than the theoretically calculated FX swap points, arbitrage would not have been possible. In that case, the organization should have issued the commercial paper in euro or should have investigated whether or not there was an arbitrage opportunity in another currency.

The following table shows when a covered arbitrage opportunity exists (the synthetic instrument then gives a more favourable interest rate than the original cash instrument).

	Interest rate in base currency < interest rate in quoted currency	Interest rate in base currency > interest rate in quoted currency
Interest differential in the FX swap market < interest differential on the cash market	Synthetic loan in base currency	Synthetic investment in base currency
Interest differential in the FX swap market > interest differential on the cash market	Synthetic investment in quoted currency	Synthetic loan in quoted currency

In the above situation, the company really had an underlying position; it was short in one currency. However, dealers at the banks can also try to take advantage of the above arbitrage opportunity without having an underlying position. This is in fact more a genuine example of arbitrage. For example, a dealer can borrow his own currency synthetically via another currency and then invest the money in a deposit in his own currency. If the interest paid by the bank in the synthetic taken deposit is lower than the bid rate on the money market in that currency, the trader realizes an arbitrage profit.

For the calculation of arbitrage opportunities, the following equations should be used:[33]

$$\text{Synth. quoted curr. } \% = \left[\left(\left(1 + r_b \times \text{daycount fraction}\right) \times \frac{\text{forw rate}}{\text{spot rate}}\right) - 1\right] \times \frac{1}{\text{daycount fraction}}$$

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33 These equations are both represented in your HP Financial calculator by the SWAP equation.

and

$$\text{Synth. base curr. \%} = \left[\left(\left(1 + r_q \times \text{daycount fraction}\right) \times \frac{\text{spot rate}}{\text{forw rate}}\right) - 1\right] \times \frac{1}{\text{daycount fraction}}$$

....

EXAMPLE

The following rates apply:

EUR/GBP Spot rate	0.9000
1 month EUR/GBP swap points	9 - 10
1 month EUR interest rate	1.00 - 1.01% (31 days)
1 month GBP interest rate	2.17 - 2.18% (31 days)

A trader thinks that there may be an arbitrage opportunity to take up a synthetic loan in euro via GBP and invest the money in the euro money market.

To find this out, he calculates the synthetic ask interest rate he can achieve for euro when borrowing GBP at 2.18% and buying and selling euro at 9 points[34]:

Euro ask rate = (((1 + 0.0218 x 31/365) x 0.9009/ 0.9000) - 1) x 360/31 = 0.99%

It turns out that there is indeed an arbitrage opportunity. The trader can borrow euro via a GBP loan and an FX swap contract and then lend the euro in the euro money market. He then pays 0.99% and receives 1.00%.

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The table below gives an overview of the different (relevant) interest arbitrage strategies in which cash money market instruments are combined with FX swaps. The table also shows whether a market party should use the bid or ask rate of the relevant instruments in order to investigate if an arbitrage opportunity exists.

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34   Use the SWAP equation in your HP financial calculator to calculate the synthetic interest euro interest rate: SWAP =0.0009, SPOT = 0.9000, Y%Q = 0.0218, D = 31, BQ = 365, BB = 360. Solve for Y%B.

Synthetic instrument	Composition of the synthetic instrument		Offsetting transaction with regular arbitrage
	Cash market	FX swap	
Synthetic loan in base currency (ask rate)	Loan in quoted currency (ask rate)	Buy and sell base currency (bid rate)	Investment in base currency (bid rate)
Synthetic loan in quoted currency (ask rate)	Loan in base currency (ask rate)	Sell and buy base currency (ask rate)	Investment in quoted currency (bid rate)
Synthetic investment in base currency (bid rate)	Investment in quoted currency (bid rate)	Sell and buy base currency (ask rate)	Loan in quoted currency (ask rate)
Synthetic investment in the quoted currency (bid rate)	Investment in base currency (bid rate)	Buy and sell base currency (bid rate)	Loan in base currency (ask rate)

4.3.7   *Rolling over trader FX positions using tom/next swaps*

A spot trader who wants to keep an open position must roll this over each day using an FX swap. The trader waits for the next trading day and then concludes a tom/next swap. The reason for this is that a spot trader often waits to make the decision on whether or not to take his position overnight until the end of the trading day. If he then still wishes to conclude a spot/next swap, he would most probably get a bad price. He therefore issues a stop loss order to one of his colleagues in a later time zone and waits until the following morning when he will conclude a tom/next swap.

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EXAMPLE

> At the end of a trading day, a London FX trader holds a long GBP/USD position against an average rate of 1.4490. He decides to roll over his position for a day. He issues a stop-loss order to his colleague in New York and goes home.
> At the beginning of the next day, it turns out that the stop-loss order was not executed. He therefore concludes a tom/next swap in which he sells the GBP per tomorrow and buys them back per spot.

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If the GBP/USD trades at a discount, he achieves an interest benefit from the FX swap After all, the GBP rate is then higher than the USD rate and the FX swap can be seen conceptually as an investment in an overnight GBP deposit and a drawn over-

night US dollar deposit. The points in the tom/next swap are therefore 'in his favour'. This is advantageous for his result.

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EXAMPLE

> The average purchase price for the GBP bought by a trader is 1.4490. He decides to roll over his position for a day. The quote for the tom/next swap points is 0.0002 - 0.000015.
> The trader sells and buys GBP (buys and sells euro). Therefore, he gets the bid rate of 0.00015 (in his favour!). As a consequence, the average cost decreases by the number of tom/next swap points.
>
> The average purchase price is now adjusted with the swap points:
> 1.4490 - 0.00015 = 1.448850.

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4.3.8   *Forward forward FX swap*

A forward forward FX swap is an FX swap where the first leg takes place on a date later than the spot date. Forward forward swaps are typically client transactions. Corporate clients may want to use a forward forward swap to extend an FX forward transaction with a value date that lies in the future. Banks hedge forward forward swaps by concluding two opposite FX swaps. For instance, a three month forward forward FX swap starting after six months is hedged by a six months FX swap and an opposite nine months FX swap.

An FX forward forward bid rate is calculated by subtracting the ask rate of the short term FX swap points from the bid rate for the longer term FX swap points. An FX forward forward ask rate is calculated by subtracting the bid rate for the short term FX swap points from the ask rate for the longer term FX swap points. Examples of two-way prices for various forward forward swaps are shown in the table below:

EUR/USD	BID	ASK
1 - 3 months	18	22
	(38-20)	(40-18)
3-6 months	30	34
	(70-40)	(72-38)
6-12 months	56	60
	(128-72)	(130-70)

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A client wants to conclude an FX swap in which he buys 10 million euro in one month against USD and sells them 2 months later. He therefore simultaneously sells and buys EUR/USD in one month and buys and sells EUR/USD in three months.

The spot rate is quoted 1.2500 - 1.2504.
The one month swap points are quoted: 18 - 20
The three month swap points are quoted: 38 - 40

The rates employed in the FX swap are
1 month ask rate EUR/USD 1.2522 (1.2502 + 0.0020)
3 month bid rate EUR/USD 1.2540 (1.2502 + 0.0038).

The price for the forward forward swap is 18 points in favour of the client.

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4.3.9   *Trading FX Swaps*

Swap traders with banks take positions in interest rate differentials between two currencies. If they expect that the interest rate differentials will increase and, as a consequence, the number of swap points will also increase, they take a long term position in 'points against them' and a short term position in 'points their favour'. If, on the other hand, they expect that the interest rate differential will fall, they take the opposite position. They use FX swaps for this purpose; buying and selling for a short period and selling and buying for a longer period or vice versa.

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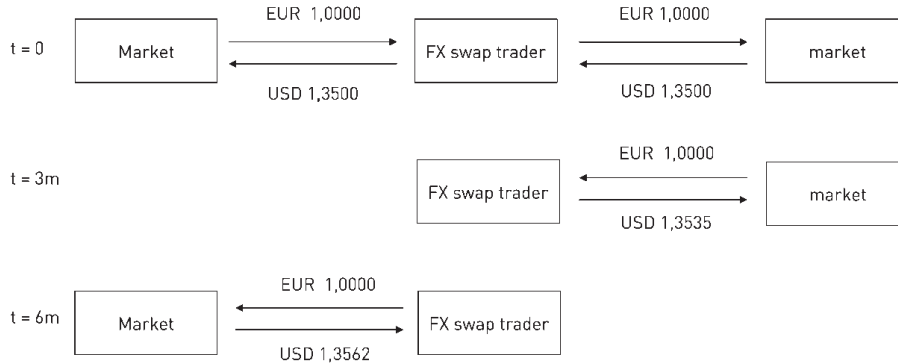
EXAMPLE

A swap trader expects that the euro-dollar interest rate differential will narrow. The current rates are:

EUR/USD spot rate: 1.3500
3 months swap points EUR/USD   30 - 35
6 months swap points EUR/USD   62 - 68

The swap trader expects that the 3 months swap points after three months could, for instance, be quoted 20-25. Since the euro is trading at a premium, the trader must take a position in which he 'pays' the 3-month swap points and 'receives' the 6-month swap points. Because the euro is trading at a premium, he therefore buys

and sells euro in six months and sells and buys euro in three months. This position is shown in figure 4.16.

Figure 4.16 3s v 6s FX swap position

If the trader proves to be right, he will be able to conclude another FX swap transaction after three months in which he pays, for example, only 25 points. He will now realize a profit of two points. This is shown in figure 4.17.

Figure 4.17 Closed FX swap position
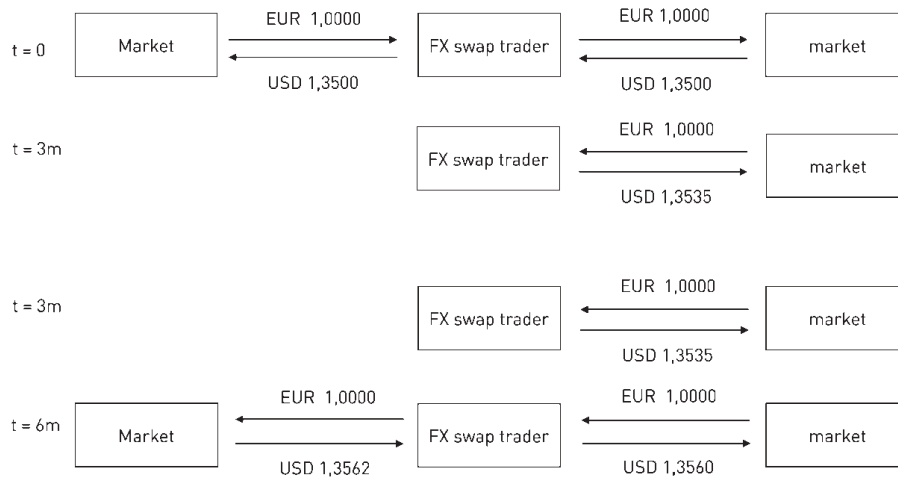
In this example, for didactical reasons, the FX rate in the first leg of the second swap on the right hand side of the diagram is equal to the FX rate in the second leg of the first swap on the right hand side. This, of course, would be a rare coincidence. We will focus on this issue in the next paragraph.