

Chapter 13

Foreign Exchange

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. FX instruments are mostly traded over-the-counter.

FX transactions are settled by two opposite money transfers in the traded currencies. In order to limit the settlement risk associated with these transactions, several international banks have jointly developed a system called the continuous linked settlement system (CLS system). The CLS system makes the opposite transfers in a FX transaction interdependent.

13.1 FX spot

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 also sometimes 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.

EXCHANGE RATES

The exchange rate between two currencies is given by using an FX quotation. An FX quotation expresses the value ratio between two currencies as a number. In the case of most FX quotations, one unit of a currency is expressed as a number of unit of another currency. An exception is the Japanese yen where 100 units are normally expressed as a number of another currency.

The currency mentioned first in an FX quotation is referred to as the base currency (the traded value) and the second currency is referred to as the 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. In Appendix I of this book a table with ISO codes is included.

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 Common Wealth are base currency in all FX quotations except in the cases that the euro is the counter currency. The US dollar is the base currency in most FX quotations with exception of euro, British pounds etcetera:

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

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

If the EUR/USD exchange rate is 1.5000, this means that one euro is worth just as much as 1.5000 US dollars. The euro is the trade currency and the dollar is the quoted currency. If a company wants to buy 1,000,000 euro, it pays $1,000,000 \times 1.5000 = 1,500,000$ US dollars.

It is a little more complex if a company wants to buy 1,000,000 US dollars for euro. The US dollar now looks like the traded good, but the exchange rate does not reflect this. In order to know how many euro the company must pay, the reciprocal of the exchange rate is used: $1,000,000 \times 1/1.5000 = \text{EUR } 666,666.67$.

EXAMPLE

On 11 September 2013, the UBS euro-dollar trader buys 10 million euro against US dollars from the Deutsche Bank euro-dollar trader at an FX spot rate of 1.3425.

As a result, on 13 September 2009, UBS must transfer an amount of $10,000,000 \times 1.34245 = 13,425,000$ US dollars to Deutsche Bank. Deutsche Bank, in turn, must transfer an amount of 10,000,000 euro to UBS.

EXAMPLE

On 16 September 2013, the USD/CHF trader of BNP Paribas buys 10 million Swiss francs against US dollars from the USD/CHF trader of Mitsubishi Bank at an FX spot rate of 0.9245.

As a result, on 20 September 2013, BNP Paribas must transfer an amount of $10,000,000 \times 1 / 0.9245$ US dollars = 10,816,657.65 US dollars to Mitsubishi Bank. Mitsubishi Bank, in turn, must transfer an amount of 10,000,000 Swiss francs to BNP Paribas.

If an FX spot dealer concludes a number of transactions, he needs to know what his position is and what his break-even rate is, i.e. the rate that he needs to be able to close his position without incurring a loss.

EXAMPLE

A trader has concluded the following transactions²:

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

² In the exam, some of the transactions may be stated in the quoted currency. In that case, the third transaction would be stated as follows: Sale of 5,394,000 US dollars; FX rate 1.3485. In this case, you have to convert the transaction to a purchase of 4,000,000 euro. The rate, however, stays the same!

The overall position of this trader is $+5,000,000 - 3,000,000 + 4,000,000 = 6,000,000$ long euro and the average rate of this position is:
 Average rate = $(5,000,000 \times 1.3500 - 3,000,000 \times 1.3520 + 4,000,000 \times 1.3485) / (5,000,000 - 3,000,000 + 4,000,000) = 1.3480$.

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13.2 FX forward

An FX forward is an FX instrument whereby 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 determined by the FX spot exchange rate.

Because settlement only takes place after some time in the case of an FX forward, the FX spot rate is corrected. The correction used is based on the difference in the interest rates for the two currencies involved and is represented by 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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EXAMPLE

The euro-dollar trader of a small bank concludes an FX forward with the Deutsche Bank euro-dollar trader on 27 August 2013 and buys 10,000,000 euro for US dollars with the delivery date being 29 August 2014 (one year after the spot date). The EUR/USD FX spot rate is 1.3475 and the swap points amount to $-/ - 0.0130$. The EUR/USD FX forward rate is thus 1.3345.

On 29 August 2014, the small 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 euro in return.

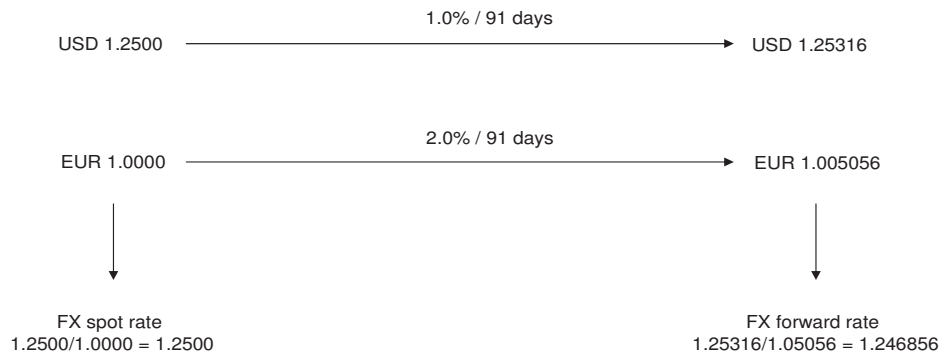
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THEORETICAL CALCULATION OF AN FX FORWARD RATE

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 according to the FX spot rate, both on the forward delivery date. The future value in the quoted currency must then be divided by the future value in the trade currency.

In figure 13.1 the FX forward rate is calculated for an FX forward contract in EUR/USD 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 months US dollar interest rate is 1%.

Figure 13.1 Three months FX forward rate EUR/USD



The future value of 1.2500 USD (quoted currency) after three months is:

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

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

$$\text{Future value of EUR 1} = 1 \times (1 + 91 / 360 \times 0.02) = \text{EUR 1.00505.}$$

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

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

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 forward points. Here, the FX forward rate is lower than the FX spot rate. The euro now trades at a 'discount' against the US dollar. If the euro interest rate would have been lower than the US dollar interest rate, the FX forward rate would have been higher than the FX spot rate. The euro would then be traded at a 'premium'.

VALUE TODAY AND VALUE TOMORROW FX OUTRIGHTS

In some cases market parties want the settlement of an FX transaction to take place before the spot date, on the trading day itself (value today), for instance, or on the first subsequent business day (value tomorrow). Settlement value tomorrow is always possible, settlement value today is only possible if the systems used for the settlement of FX transactions, the payment systems of the central banks for the currencies involved, are still in operation. As with FX forward contracts, the FX spot rate is adjusted for the interest rate differential between the traded currencies.

13.3 FX swap

FX spot transactions and FX forward transactions are also referred to as outright transactions. This means that there is only one exchange in principals involved. An FX swap, on the other hand, is an OTC currency derivative with a short maturity period, whereby 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 at the FX forward rate, in the future. In other words, with an FX swap, two opposite exchanges of principals take place. As a result, the FX position of both parties does not change by concluding an FX swap; each party ends up with the same FX position that he had before the transaction was concluded.

The exchange at the beginning of the maturity period is called the near leg or spot leg, the exchange at the end of the maturity period is called the far leg or the forward leg.

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EXAMPLE

A bank sells one million euro for 1,250,000 US dollars with delivery after two business days (EUR/USD FX spot rate is 1.2500) and at the same time agrees to buy the euro back after 91 days at an FX forward rate of 1.2469, therefore receiving 1,246,900 US dollars. This contract is called a 'EUR/USD FX swap' with a term of 91 days.

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The official terminology that traders use in case of the FX swap in the above example is the following: the bank sells and buys euro in three months. The first action ('sells') refers to what happens in respect to the base currency (EUR) in the spot leg, the second action ('buys') refers to what happens in the forward leg.

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.

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EXAMPLE

A tom next EUR/JPY FX Swap is traded on Thursday, 19 May, and there are no holidays in the relevant currencies during the week of May 23 – 30. The value date of the first leg is 20 May and the value date of the second leg is 23 May.

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13.4 Settlement of FX transactions

An FX transaction is processed by two separate interbank transfers in the currencies concerned. If, for instance, a Dutch bank buys dollars from a Japanese bank against euro, the Dutch bank sends a settlement instruction for the euro amount to the ECB on the settlement day chargeable to its euro account and payable to the Japanese bank's euro correspondent bank with the Japanese bank as final beneficiary. The Japanese bank in turn sends a settlement instruction to its US correspondent bank, chargeable to its US dollar account and payable to the Dutch bank's US correspondent bank, with the Dutch bank as final beneficiary.

Because the transfers in the two currencies do not take place within one and the same system, there is a risk that one party's transfer takes place without the other party's transfer taking place. This is called settlement risk. Because of the huge volume of FX transactions, banks have decided to limit this risk by founding a settlement institution for FX transactions: the CLS Bank.

13.4.1 The role of the CLS Bank

The CLS Bank is a settlement institution that carries out transfers in the most important currencies resulting from the FX transactions of about 70 of the world's largest banks. In order to effect an FX transaction through the CLS bank, both transaction parties need to be registered with the CLS bank and both currencies need to be included in the CLS bank's currency assortment: euro, US dollar, Japanese yen, Canadian dollar, Australian dollar, New Zealand dollar, Hong Kong dollar, Singa-

pore dollar, Korean won, Danish crown, Swedish crown, Norwegian crown, Swiss franc, South African rand, Mexican peso, Israeli shekel.

All participating banks hold an account at the CLS bank in each of the afore-mentioned currencies, in order to facilitate the processing of the FX transactions. The CLS bank in turn holds accounts at the central banks concerned. For instance, the CLS holds a US dollar account at the Federal Reserve Bank (FED), a Japanese yen account at The Bank of Japan and a euro account at the ECB. Banks can transfer amounts to the accounts they hold at the CLS bank using these accounts. These transfers are called 'pay-ins'.

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EXAMPLE

Barclays needs to deposit an amount in its CLS Bank US dollar account. In order to do this, it must instruct its correspondent bank JP Morgan Chase to transfer the US dollar amount to the CLS Bank's US dollar account at the FED in favour of Barclay's CLS Bank US dollar account.

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13.4.2 The settlement procedure of the CLS Bank

The CLS Bank processes transfers in three phases. First, the receipt of instructions and pay-ins through the central banks, second, the internal settlement within the CLS Bank and finally the external settlement through the central banks. The inter-bank payment systems (TARGET2, Fedwire, FXYCS etc.) of all currencies involved are operational throughout these three phases.

PHASE 1: THE DELIVERY OF INSTRUCTIONS AND PAY-INS

All member banks send SWIFT messages of the FX transactions they have concluded to the CLS Bank (MT304). Based on all the transactions delivered, CLS Bank creates a pay-in schedule every day. This is an overview of the payment obligations in all currencies of the banks involved on account of the FX transactions they have concluded and that need to be settled on that day. The cut-off time for the notification of transactions that have to be processed on that same value date is 06:30 CET (Central European Time).

PHASE 2: INTERNAL SETTLEMENT WITHIN THE CLS BANK

The settlement of transactions subsequently takes place between 07:00 CET and 09:00 CET. For the Far East, this is at the end of the afternoon and for the United States it is in the middle of the night. The CLS system processes the FX transactions on an

order-to-order basis. This means that the CLS Bank processes each transaction separately, on a first in first out basis. The payment-versus-payment principle (PVP) applies to each individual transaction. This means that the two cash flows resulting from a FX transaction take place simultaneously and that the CLS bank only debits a member's account if it is certain that another account belonging to the same member is simultaneously credited in another currency.

The CLS Bank, however, may also process an FX transaction under certain circumstances if a bank does not have sufficient funds in a currency to be delivered. In such cases, the bank must have sufficient collateral in the form of balances in other currencies. However, the CLS Bank does not take the entire balance in other currencies into account, but subtracts a safety margin: the haircut. This is how the CLS Bank allows for possible changes in exchange rates during the day. In the case of a 15% haircut, the collateral value of a balance in another currency is equal to 85% of that balance.

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EXAMPLE

Société Générale carries out an FX spot transaction with Deutsche Bank. It sells 100 million British pounds for 130 million US dollars. Settlement takes place at the CLS Bank.

However, the balance on Société Générale's British pound account at the CLS Bank is only GBP 75 million. The CLS Bank would therefore not carry out the transaction based on the GBP balance alone.

However, Société Générale has a credit balance of 100 million euro on its euro account. At a EUR/GBP exchange rate of 0.75, that is equivalent to GBP 75 million. The CLS Bank applies a 10% haircut. This means that the collateral value of the euro credit balance is equal to $90\% \times \text{GBP } 75 \text{ million} = \text{GBP } 67.5 \text{ million}$.

Because Société Générale has sufficient collateral, the CLS Bank will execute the GBP/USD FX transaction.

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If a bank has sufficient collateral, the CLS Bank therefore also executes transactions that result in a debit position on an account in a certain currency. The advantage of this is that a bank does not need to transfer money immediately to the CLS Bank to make up the debit balance. That would not be efficient, because it is very possible that a debit balance on this account would be supplemented through the settlement of another transaction that is processed later in the day.

This is why banks do not need to carry out pay-ins for each separate currency equal to the net amount to be transferred based on all the FX transactions they have de-

posited. Instead, they ensure that the account in their own currency has a surplus, in order to be able to provide the necessary collateral for possible interim debit positions in other currencies. Settlements through the CLS bank therefore have considerably less impact on the liquidities of the members' banks than the traditional method of settlement.

The CLS Bank imposes a limit on the size of the debit balance of an account. If this limit is reached, the member bank must cover the deficit of the currency account concerned before the CLS Bank continues to process the transactions chargeable to this account. This applies regardless whether the bank concerned has sufficient collateral.

A deficit can be covered in three ways: through an interim pay in to the CLS Bank, through an inside/outside swap (I/O swap) or through a today/tomorrow swap.

An I/O swap is an intraday FX swap whereby one leg is completed within and the other leg is completed outside the CLS system. In order to remove a debit balance in euro, a member can conclude an I/O swap with another member in which the member buys euro within the CLS system for US dollars and sells the euro outside the CLS system for US dollars at the same rate. The second leg of the swap is settled outside the CLS bank, through the central banks' RTGS systems. A disadvantage of an I/O swap is that part of the settlement risk is being reintroduced to the parties. After all, the second leg of the swap takes place outside the CLS bank.

A today/tomorrow swap is an FX swap that is settled entirely within the CLS bank. The settlement of the first leg takes place on the day the today/tomorrow swap is concluded. The settlement of the second leg takes place a day later. The advantage of a today/tomorrow swap over an I/O swap is that no settlement risk returns. The drawback of the today/tomorrow swap is that the liquidity position of both members in the two currencies is influenced for an entire day.

PHASE 3: EXTERNAL SETTLEMENT THROUGH THE CENTRAL BANKS

During the final phase of the settlement process, the CLS Bank pays out the balances that are on the member banks' accounts after the internal settlement of all transactions has been completed. In order to do this, the CLS Bank instructs the central banks to debit its account there and credit the account of the member banks. These transfers are called pay-outs.

The CLS bank only transfers amounts to a member after the member has covered any debit balances on its accounts. This is why the member banks still have the opportunity to make interim pay-ins during phase 3, too.

At the end of phase 3, all the accounts within the CLS bank have a zero balance. This also applies to all accounts that the CLS bank holds at the central banks. Phase 3 ends at 10:00 CET for the Asia and Pacific region and at 12:00 CET for the Europe region.

Chapter 14

Derivatives

Derivatives are instruments whereby the value is derived from the value of traditional instruments or the value of certain financial indicators. In every financial sub-market, derivatives are traded. In the money market, for instance, money market futures are traded. In the capital market fixed-income, amongst others, interest rate swaps are traded. And in the FX market, FX options are traded. Derivatives can be used to hedge interest or FX positions or to take open positions.

14.1 General features of derivatives

The instruments or indicators that the value of derivatives is derived from are called the underlying value or reference value. The following can be agreed within a financial derivatives contract:

- to buy/deliver a certain financial value (possibly after an opposite initial exchange) on a future date;
- to offset the difference between an interest rate or price that has been agreed upon in the contract and the actual interest rate or price at a certain time in the future, the fixing date;
- to exchange the yields of two different financial instruments during a future time period;
- to conclude a certain transaction at a predetermined price or fixed interest rate on a future date.

The following must be recorded when concluding a derivatives contract. First, the size of the contract, which is expressed in a number of shares in the case of shares derivatives, a nominal amount in the case of interest rate derivatives or an amount of a certain currency in the case of FX derivatives. Second, the reference value, the reference value is the closing price on an exchange in the case of shares derivatives,

an interest rate benchmark like EURIBOR in the case of interest rate derivatives or an agreed exchange rate on a certain screen at a certain point in time in the case of FX derivatives. Third, who the buyer and seller are. With the exception of options, no payment takes place when the derivatives contract is concluded. After all, derivatives refer to the entering into of future obligations. Even so, the terms buying and selling are used. A derivative buyer is generally the party that profits from an increase in the price/rate of the underlying value and a seller is the party that profits from a decrease.

A contract price or rate should also be included in a derivatives contract. This is the price or rate that is compared to the reference value on the fixing dates or the price at which a future transaction shall be concluded as a result of the derivatives contract.

Fixing dates and settlement dates must also be included in the contract. Fixing dates are the dates on which the contract price is compared to the reference value or the market price of the underlying value at that moment. Settlement dates are the dates on which the parties involved settle the calculated obligations.

14.2 FRA

A forward rate agreement (FRA) is an OTC interest rate derivative that is traded on the money market in which two parties enter into a reciprocal obligation to offset the difference between an interest rate agreed in the contract and the level of a reference interest rate – i.e. an overnight swap index – at a certain date in the future.

The buyer of an FRA is the party that receives an amount of money from the other party if the reference interest rate on the fixing date is higher than the contract interest rate. The seller receives an amount of money from the buyer if the reference interest rate is lower than the contract interest rate at maturity.

There are two kinds of terms for FRAs: the contract term and the underlying term. The contract term runs from the contract date to the settlement date. The underlying term runs from the settlement date to the last day of the underlying period. The contract term of a '6s vs. 9s' FRA, for instance, is six months and the underlying term is three months.

EXAMPLE

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The relevant dates of a '6s vs. 9s' FRA contract that is concluded on the 1st of March are:

- Contract date: March 1st;
 - Fixing date: September 1st;
 - Settlement date: September 3rd (= maturity date of the FRA contract);
 - Maturity date of the underlying period: December 3rd.
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THE SETTLEMENT OF AN FRA

The amounts involved in the settlement of an FRA are calculated on the fixing date. Settlement takes place on the corresponding spot date, which in most cases means two working days later (t+2). The calculation of the FRA settlement amount takes place in three steps:

- On the fixing date, the reference interest rate is compared with the contract interest rate; the back-office sends a SWIFT message to notify the counterparty of the fixing rate.
 - The difference in interest rates is calculated as an amount over the underlying term and over the contract amount.
 - Because the settlement date is two days after the fixing date, instead of at the maturity date of the underlying period of the FRA, the settlement amount is discounted against the money market reference rate that corresponds with the underlying period.
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EXAMPLE

Two parties have concluded a '4 vs. 7' FRA. The reference interest rate is the three-month EURIBOR and the contract interest rate is 3.75%. The contract principal is EUR 5,000,000.

On the fixing date, the three-month EURIBOR is fixed at 3.95%.

This FRA is settled as follows:

1. The difference between the contract interest rate and the reference interest rate = 0.20%.

2. The interest amount over the underlying term and over the principal amount of EUR 5,000,000 is calculated: $\text{EUR } 5,000,000 \times 91/360 \times 0.20\% = \text{EUR } 2,527.78$.
3. This amount is discounted using the three-month EURIBOR rate of 3.95%. The present value formula is used to achieve this:
Settlement amount / $(1 + \text{days} / 360 \times \text{interest rate})$.

In this case, the settlement amount is:
 $2,527.78 / (1 + 91/360 \times 0.0395) = \text{EUR } 2,502.79$.

The seller has to pay EUR 2,502.79 to the buyer on the settlement date.

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14.3 Financial future

A financial future is an exchange traded financial instrument whereby two parties enter into a reciprocal obligation to buy or deliver a certain financial value at a future date at a predetermined price (physical delivery) or to offset the difference between the price that is agreed upon in the futures contract and the actual price at the agreed future date (cash settlement).

In Europe, financial futures are mainly traded on Euronext.liffe and Eurex, the derivatives daughter markets of NYSE Euronext and Deutsche Bourse, respectively.

Bought futures contracts can be sold to the exchange and sold futures contracts can be bought back from the exchange at any time during their lifetime. This is referred to as closing the futures contract or offsetting it. If a party closes a futures contract, the original contract becomes void. The last date on which trading may take place is called the expiry date. Just before the expiry date of a future with physical settlement, the market parties usually close their futures contracts in order to avoid physical delivery.

Because financial futures are exclusively traded on an exchange, they have standardized conditions. In the case of most futures, only a limited number of series are traded. Contract sizes are also standardized. Parties that want to conclude a futures contract need only indicate how many contracts they would like to conclude.

Futures have a wide range of underlying values, varying from bonds to exotic fruits. The registration of futures is carried out by clearing institutions.

14.3.1 Bond future

A bond future is a forward contract that is listed on a derivatives exchange whereby Government bonds must be delivered at a predetermined price at maturity.

The most commonly traded bond futures in Europe are the Bund future, Bobl future and Schatz future. The underlying value for these futures are German Government bond with ten, five and two-year terms, respectively, and a 6% coupon. In addition to these bond futures, there is also the German Buxl future which has a notional bond as its underlying value with a 30-year term and a 4% coupon. The prices of these bond futures are used as the most important benchmark for the euro capital market interest rate.

14.3.2 Money market future

A money market future (MM future) is a future with a short-term forward rate as underlying value. A MM future is comparable to an FRA. Like FRAs, MM futures are cash settled. The price of a money market future is expressed as 100 +/- the forward yield over the underlying period of the MM future. The price will go up if the relevant forward rate decreases and will go down if the relevant forward rate increases. A party that wants to take profit from higher interest rates, therefore, has to sell MM futures. This is the opposite as with FRAs.

MM futures are standardized. The underlying period is often three months and the contract amounts are shown in figure 14.1.

Figure 14.1 Overview of money market futures

CONTRACT	CONTRACT VOLUME	TICK SIZE	VALUE OF ONE POINT
Short sterling	GBP 500,000	1	GBP 12,50
Eurodollar	USD 1,000,000	0,5	USD 25,00
Euribor	EUR 1,000,000	0,5	EUR 25,00
Euroyen	JPY 100,000,000	0,5	JPY 2,500

The tick size is the smallest increment (tick) by which the price of an exchange instrument moves.

The value of one point is the change in the contract value if the underlying interest rate changes with one basis point (0.01%) using the 30/360 daycount convention. The value of one point of a Short Sterling contract, for instance, can be calculated as follows:

$$\text{Value of one point} = \text{GBP } 500,000 \times 0.0001 \times 90/360 = \text{GBP } 12.50.$$

The changes in the value of futures contracts are settled with the exchange on a daily basis. This process is called margining.

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EXAMPLE

On Monday, a money market trader buys 25 month Eurodollar contracts at a price of 97.47. During the first week the closing prices of this future are:
 Mon: 97.54, Tue: 97.42, Wed: 97.48, Thu: 97.50, Fri: 97.58.

The daily margin payments are as follows:

TRADE DAY	PRICE MOVEMENT IN POINTS	MARGIN CALL	PAID BY
Monday	+7	7 x 25 x USD 25 = USD 4,375	Clearing house
Tuesday	-12	12 x 25 x USD 25 = USD 7,500	MM trader
Wednesday	+6	6 x 25 x USD 25 = USD 3,750	Clearing house
Thursday	+2	2 x 25 x USD 25 = USD 1,250	Clearing house
Friday	+8	8 x 25 x USD 25 = USD 5,000	Clearing house

If the MM trader is able to sell the MM futures on Monday at the opening of the exchange at a price of 97.58, his result will be USD 6,875. Since the exchange has already paid this amount to the trader during the term of the contract, no additional settlement will take place.

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During the lifetime of a money market future, the price is determined by the free play of demand and supply. The fixing rate on the expiry date, however, is set by the exchange. For money futures that are traded on NYSE Liffe, for instance, this rate is called 'exchange delivery settlement price' (EDSP). The EDSP is fixed at 11.00 a.m. on the last trading day and is calculated as 100 +/- the British Bankers' Association Interest Settlement Rate (BBAISR), which is a mean of the quotes of 16 banks for the three months money market interest rate.

14.4 Interest rate swap

An interest rate swap (IRS) is an OTC interest rate derivative whereby two parties enter into a reciprocal obligation to exchange interest coupon payments in the same currency during an agreed period of time without exchanging principals. Interest rate swaps are used to change the interest rate conditions of a financial instrument, usually from fixed to variable or vice versa.

For the party in an interest rate swap paying the fixed-interest rate coupon, the interest rate swap is referred to as a payer's swap. For the party in the interest rate swap receiving the fixed interest rate coupon, the same interest rate swap is referred to as a receiver's swap. Sometimes the terms buying and selling are used. The general rule regarding buying and selling on the financial markets applies here too: a buyer benefits from an increase in a market variable and a seller benefits from a decrease. The buyer of a swap is therefore the one that pays the fixed interest. After all, this party benefits from an increase in the interest rate.

The interest rate swap terms vary from one to fifty years. The principals differ greatly. The principal for most transactions is somewhere between 1 and 100 million euro. The reference rate for the variable interest rate obligation is usually the three or six-month EURIBOR or LIBOR rate.

The fixed IRS rate is determined by supply and demand on the IRS market and usually follows the market interest rate for Government bonds with a spread. The fixed-interest rate usually applies for the whole term of the interest rate swap. In some cases, both interest rates are floating. This is the case, for instance, for an interest rate swap in which a three-month EURIBOR is swapped for a one-year EURIBOR. A swap involving the exchange of two floating interest coupons is called a basis swap.

IRS SETTLEMENT

Both the fixed and floating interest coupons in an IRS are paid in arrears. The floating coupon is usually paid every quarter or semi-annually. The floating interest rate for the next coupon period is determined two business days before the expiration of the current floating coupon period. The fixed interest rate is usually paid at the end of each year. The amount of the fixed coupon is often offset with the floating coupon that is due on the day that the fixed coupon is paid. This is called payment netting. This is standard procedure for swaps that are concluded under an ISDA agreement.

EXAMPLE

The cash flows for a payer’s IRS with a principal of 10,000,000 euro and a term of three years, in which a three-year fixed-interest rate of 3.5% is swapped with a six-month EURIBOR rate are as follows. The first EURIBOR fixing is 2.1% and the first floating coupon period is 183 days.

PERIOD	INCOMING TRANSFERS	OUTGOING TRANSFERS
T=0		
6 months	EUR 10,000,000 x 183/360 x 0.021 = EUR 106,166.00	
1 year		EUR 350,000 - EUR 10,000,000 x # days/360 x 6m EURIBOR-2nd fixing
1.5 year	EUR 10,000 x # days/360 x 6m EURIBOR-3rd fixing	
2 years		EUR 350,000 - EUR 10,000,000 x # days/360 x 6m EURIBOR-4th fixing
2.5 years	EUR 10,000 x # days/360 x 6m EURIBOR-5th fixing	
3 years		EUR 350,000 - EUR 10,000,000 x # days/360 x 6m EURIBOR-6th fixing

14.5 Cross Currency Interest rate Swaps (CIRS)

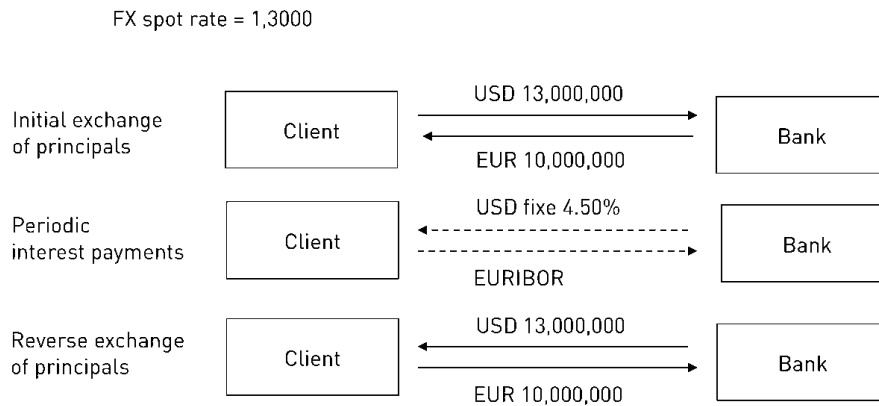
A cross-currency interest rate swap (CIRS) is an over-the-counter traded financial instrument in which two parties agree to exchange a certain amount of two currencies on the spot date at the FX spot rate and to reverse this exchange at an agreed moment in the future. For the latter exchange, also the FX spot rate at the moment of concluding the transaction is used. During the term of the contract the parties pay coupons to one another based on the amount that they have received at the start of the contract. These coupons can either be based on a fixed or a floating rate.

In fact, a cross currency swap is a combination of two opposite loans in two different currencies. The loan amounts have an equal value at the start date of the swap.

A cross currency swap can also be compared to an FX swap. In fact, it follows the same concept. There are only two differences. Firstly, an FX swap has a shorter term than an CIRS. Secondly, the FX rate that is used for the reverse exchange of princi-

pals is different. With an FX swap the FX rate that is used in the far leg is the FX forward rate at the moment of concluding the transaction. With an CIRS the FX rate in the second exchange is the FX spot rate at the moment of concluding the transaction. With both instruments, however, the interest rate differential between the two currency areas is taken into account. With an FX swap this is reflected in the difference between the FX spot rate and the FX forward rate, i.e. the swap points. With a CIRS, the interest differential is reflected in the fact that the coupons are based on the prevailing interest rates on the moment of concluding the transaction. Figure 14.2 shows an example of a EUR/USD CIRS.

14.2 Cross currency interest rate swap (CIRS)



14.6 Overnight index swap

An overnight index swap (OIS) is an OTC interest rate derivative whereby two parties enter into a reciprocal obligation to exchange interest coupon payments in the same currency during an agreed period without exchanging principals and whereby one of the interest rate coupons is based on an overnight rate. Examples of the reference value for the daily interest rate are shown in the table below.

CURRENCY	INDEX
euro	EONIA
Sterling	SONIA
Yen	TONAR
Swiss franc	TOIS

The fixed interest rate is determined at the start of the contract period. The daily interest rates normally are determined at 18.00 hours daily. Settlement takes place based on payment netting. Therefore, there is only one cash flow at maturity.

14.7 Non-deliverable forward

A non-deliverable forward or NDF is an OTC instrument that is traded on the FX market whereby the difference between the contract FX rate and the spot exchange rate on the fixing date is offset on the settlement date. A non-deliverable forward (NDF) is used to hedge FX risks in currencies without a market in ordinary FX forward contracts. This is the case, for instance, for a number of Asian currencies such as the Chinese yuan, the Indian rupee, the Indonesian rupiah, the Korean won, the Philippines' peso and the Taiwanese dollar.

You could say that an NDF is an FX forward contract with cash settlement instead of physical delivery. In theory, the rate for an NDF is determined in the same way as the FX forward rate for an ordinary FX forward contract. In practice, however, the rate for an NDF differs from the FX forward rate due to supply and demand factors.

NDF SETTLEMENT

On the expiry date of an NDF contract, the two currencies are not actually exchanged in the agreed exchange ratio. Instead, the difference is calculated between the amount of the convertible currency that would have to be paid or received according to the contract rate and the amount of the convertible currency that would have to be paid or received according to the FX spot rate on the fixing date. In the case of an USD/TWD contract, for instance, the settlement takes place in US dollars.

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EXAMPLE

A Spanish importer concludes a three-month NDF in EUR/CNY and hedges against an increase in the Chinese yuan. The contract size is CNY 100 million and the contract rate is 9.45. On the contract fixing date, the EUR/CNY FX spot exchange rate is 9.25.

The settlement amount is calculated as the difference between a notional purchase of CNY at the contract rate and a notional sale of CNY at the FX spot exchange rate on the fixing date:

'Purchase' CNY 100 million at 9.45; 'pay' EUR 10,582,010.58

'Sale' CNY 100 million at 9.25; 'receive' EUR 10,810,810.81

On the maturity date, the importer receives the difference of EUR 10,582,010.58 and EUR 10,810,810.81. This is an amount of EUR 228,800.23.

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14.8 Option

An option is a derivative for which one of the parties obtains the right to

- buy or deliver a certain financial value;
- offset a difference between an interest rate or price that is fixed in the contract and the actual interest rate or price at a certain moment in the future;
- exchange the yields of two different financial instruments or
- enter into a certain transaction at a predetermined price or interest rate.

The party who obtains this right is the buyer of the option. The buyer can demand that the other party, the seller, fulfills its obligation as a result of the agreement. The seller, also referred to as writer, enters into a one-sided obligation without the right to demand that the buyer fulfills the opposite obligation.

The predetermined rate or interest rate level at which the buyer can exercise his right is called the strike price. A right to buy the underlying value or receive an amount of money when the market price/rate of the underlying value is higher than the strike price is called a call option. A right to sell the underlying value or receive an amount of money when the market price/rate is lower than the strike price is called a put option. The date on which an option contract ends is called the expiry date.

Options can be based on a wide range of underlying values, varying from shares to CO₂ emission rights. Options are traded in just about every sub-market of the financial markets. Many financial instruments have options hidden in them. Such options are called embedded options.

Some options, like share options, are traded on an exchange. Other options are traded over-the-counter, for instance the FX options that companies use for covering their currency risk. Almost all interest rate options are OTC options, too.

THE SETTLEMENT OF OPTIONS

It is not possible to say in advance whether settlement will take place during the term of an option or at maturity. For the purpose of option settlement, the price of

the underlying instrument is compared to the exercise price. If the buyer wants to exercise the option, there are two possibilities. Either the difference between the market price and the exercise price is paid (cash settlement) or physical delivery takes place. This means that a transaction in the underlying value is created. OTC traded FX options are, in principle, delivered physically

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EXAMPLE

A company has bought a EUR call / USD put options with a strike price of 1.3500, a contract amount of 5 million euro and an expiry date of 15 March 2014. If, on 15 March the EUR/USD spot rate is higher than 1.3500, the company will exercise the option.

This means that the option seller has to transfer 10,000,000 euro to the companies euro account and that the company has to transfer 13,500,000 US dollars to the seller of the option.

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The buyer of an exchange traded option can exercise his right at any time during the option term. This means that the settlement can take place at any point in time during the option term. Options to which this applies are called American-style options. Exercise of OTC currency options can only take place at the maturity date. This is called European style. Bermudan options are an intermediate form of options. They can only be exercised on a limited number of predetermined dates during the term.

Part of the settlement of an option that always applies is the payment of a premium to the seller by the buyer. This premium is usually paid one business day after the signing of the contract.

14.9 Cap and floor

A cap is an OTC interest rate instrument whereby a party has the right to offset the difference between an agreed interest rate level (the strike interest rate of the cap) and a reference interest rate, usually the three or six-month EURIBOR or LIBOR rate, at several future moments, if this reference rate is higher than the exercise price. One could refer to a cap as a call option on the EURIBOR/LIBOR. In effect, a cap consists of several consecutive options with the same exercise price: caplets, also called interest rate guarantees. Each caplet can be considered as a call option with a bought FRA as underlying value. The buyer of a cap receives a payment if the level of the EURIBOR is higher than the strike on an expiry date of one of the caplets.

The settlement amount is calculated by multiplying the difference between the reference interest rate and the strike price by the agreed principal over the term of the underlying period, i.e. 3 or 6 months. If the reference interest rate on an expiry date is lower than the strike price, the option concerned generates no value, it 'expires worthless'. The options with a later expiry date are not affected in such a case and remain intact.

Because a cap is an option, the buyer must pay a premium. There are two ways to pay the cap premium: up-front (one payment when concluding the cap) or amortized (spread over the duration of the cap).

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EXAMPLE

A company has concluded a cap with a strike price of 4.00% and a term of five years to hedge against increases in interest rates. The contract amount is 10 million US dollars and the reference rate is three months USD-LIBOR.

On 13 May, the reference rate is fixed for the underlying period 15 May 2014 - 15 August 2014 (92 days): 4.14%.

Because the caplet is in-the-money, on 15 August, the company will receive an amount of $10,000,000 \times 0.0014 \times 92/360 = 3,577.78$ US dollars.

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A floor is an OTC interest rate instrument whereby a party has the right to offset the difference between an agreed interest rate level (the strike interest rate) and the reference interest rate, usually a three or six-month EURIBOR or LIBOR, at several future moments, if this reference rate is lower than the exercise price. One could call a floor a put option on the EURIBOR/LIBOR.

A floor also consists of several consecutive options with one and the same exercise price. Floors can be used by investors that have long-term variable interest rate investments and want to protect themselves from decreases in interest rates.

14.10 Swaption

A swaption is an OTC interest rate instrument whereby a party has the right to enter into an interest rate swap contract at the maturity date of the swaption at a predetermined interest rate, the strike price. A payer's swaption gives the option buyer the right to pay the long interest rate in the underlying interest rate swap. If the swap interest rate in the market at the swaption's maturity date is higher than the strike

price, the buyer will exercise the option and thus engages the swap. He then pays a long interest rate that is lower than the current market interest rate. The buyer can also opt for cash settlement, in which case he requests the seller of the swaption to pay out the market value of the swap on the settlement date. A receiver's swaption gives the buyer the right to conclude an interest rate swap in which he will receive the fixed interest rate.

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EXAMPLE

On 13 September 2013, a company expects that it will have a long-term financing need starting on 15 September 2014 and lasting for 10 years. To hedge against increases in interest rates, the company buys a payer's swaption with a contract amount of 5 million British pounds. The strike price of this swaption is 4.75%. The period of the underlying swap is 15 September 2014 - 16 September 2024.

On 15 September 2014, the company will conclude a loan agreement with the bank for an amount of 5 million British pounds and a term of 10 years. The actual IRS rate than is 5.12%. Therefore, the company exercises the swaption and concludes a ten year payer's IRS with a fixed rate of 4.75% against six months GBP-LIBOR with a nominal of 5 million British pounds.

If the interest rate condition of the loan is six months GBP-LIBOR flat, the company has now fixed its rate for the period 15 September 2014 - 16 September 2024 at a level of 4.75%.

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