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ATTILA ISTVÁN VERES, CFA, CIPM

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MAGYAR NEMZETI BANK

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Written by Attila István Veres, CFA, CIPM

(Directorate Money and Foreign Exchange Markets, Magyar Nemzeti Bank)

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Contents

1 Introduction

Interbank foreign exchange markets are the most efficient markets in the world. They are open 24 hours a day, offering innumerable possibilities for the implementation of various trading strategies or for hedging existing currency risks. Since no participant is able to dominate these markets – not even in the short term – all market participants can be considered equal. With the use of modern information technology, even the smallest participants can enter the market quickly and cost efficiently, with real-time access to a broad information base.

Gaining insight into foreign exchange market trading techniques is a time consuming process, requiring tremendous discipline and learning. Nevertheless, foreign exchange – or "forex" for short – is an exciting world, which demands quick thinking, imagination and creativity.

A brief history

The history of currency markets dates back to a long time: currencies were already traded across the ancient Middle East. The first national monetary system, however, emerged only in the 17th century in England. In the 19th century, the gold standard – under which the money supply was tied to the quantity of gold produced – became a generally accepted system. This system was maintained until World War I, and although there were some attempts to revive it between the two World Wars it did not survive the severe crisis of the 1930s.

The birth of modern foreign exchange markets dates back to the period following World War II, when the Bretton Woods system was established and the International Monetary Fund (IMF) was set up for its supervision. Under this regime, the major currencies (e.g. the British pound sterling, the French franc, etc.) were pegged to the US dollar and were only allowed to float within a narrow band. The exchange rate of the US dollar, in turn, was pegged to gold. The price of an ounce of gold was fixed at USD 35, and the United States pledged that central banks participating in the system may

convert their currencies freely to gold at that rate. The central role of the US dollar was unquestionable; still reeling from the repercussions of the World Wars, Europe – in particular, Great Britain – surrendered its leading role to the United States, and the pound sterling as world currency was replaced by the "greenback".

Subsequently, with the recovery and rapid development of Western Europe and Japan, the relative weight of the USA – and hence, the dominant role of the dollar – began to weaken. It became increasingly difficult to maintain the system of fixed exchange rates and eventually, the United States officially terminated the convertibility of the US dollar to gold in 1971, effectively bringing the Bretton Woods system to an end, and leading to the emergence of a floating exchange rate system.

Under the floating exchange rate regime, central banks do not guarantee the parity of the currencies; exchange rates evolve on the basis of supply and demand. As a result, the stability and predictability of exchange rates ceased to exist, and market participants were forced to face a new type of risk: exchange rate risk. The need to manage risk and the potential profit to be gained from exchange rate movements gave rise to the international foreign exchange markets, where participants with various interests and motives could execute transactions.

It was in the 1980s that international markets experienced a real boom. In an increasingly globalised economic environment, cross-border trade and capital flows multiplied several times over. The technological and information revolution, in turn, allowed the foreign exchange market to also cross time zones.

The market of superlatives

The forex market boasts the highest turnover worldwide both in terms of number and volume of transactions. As forex trading is not conducted at centralized locations, such as stock exchanges in the case of shares, where the turnover of a trading day can be easily measured, its exact size can only be estimated. Despite these difficulties, the turnover data published in the

triennial report of the Bank for International Settlements (BIS) are considered to be authoritative in the market.

According to the latest BIS report, trading in foreign exchange markets averaged more than USD 5 trillion per day in April 2016. While this implies a moderate decline compared to 2013 turnover data, the foreign exchange market nevertheless remained the highest-turnover financial market in the world.

Figure 1
Foreign exchange market turnover (USD billions)

Instrument	1998	2001	2004	2007	2010	2013	2016
Spot	568	386	631	1,005	1,488	2,046	1,652
Forward	128	130	209	362	475	680	700
FX swap	734	656	954	1,714	1,759	2,228	2,378
FX swap	10	7	21	31	43	54	82
Options	87	60	119	212	207	337	254
Total	**1,527**	**1,239**	**1,934**	**3,324**	**3,971**	**5,345**	**5,067**

Source: BIS

The foreign exchange market is fundamentally an over-the-counter (OTC) market. The core of the market is the commercial banks' transactions between each other – i.e. the interbank market – which processes a large part of daily turnover.

The forex market is open 24 hours – transactions can be conducted practically any time of the day; in contrast to the stock exchanges, this market is never closed. In practice, forex trading begins in Tokyo and Sydney on Monday morning (around 10 PM GMT on Sunday), and transactions can be executed continuously until the closing time of the New York market on Friday (around 10 PM GMT). Liquidity, however, shows a degree of intraday seasonality, depending on which time zones have active business hours and which trading centres overlap at any given moment; for example, the hours of the day when for example Tokyo and London or London and New York are both "open".

The UK capital is by far the most important global centre for foreign exchange trading. London accounts for around 37 per cent of market turnover, primarily

because of its liberalised market environment and because it is in the right time zone. Other significant forex trading hubs include: New York (about 19%), and Tokyo, Hong Kong and Singapore in Asia (15% in total). Global FX trading has always been fairly concentrated, but over the past 3 years this concentration has increased. The 5 largest trading centres now process 77 per cent of global turnover.

Market participants

Foreign exchange market participants can be classified into various categories. Whether it is size, function or the reason of market entry, a participant can seldom be clearly classified into a single category. The same participant may be a market maker in some cases and a market user in others. A participant can sometimes be a wholesale player and other times a retail player. It may enter into a deal for hedging purposes in certain cases, and conduct transactions for trading – speculative – purposes in other cases.

Consider the example of a central bank. From the perspective of the domestic currency, the central bank is the body responsible for monetary policy, including exchange rate policy. The exchange rate, therefore, is not necessarily accepted by the central bank at face value, it also acts as a target variable. The central bank is capable of influencing the exchange rate not only through direct market intervention, but also by means of verbal intervention (as shown by the example of the Bank of Japan) or indirectly through its interest rate policy. In addition, when the intervention is intended to weaken the national currency and the central bank sells domestic currency to prevent any further appreciation of the legal tender, in theory the intervention may be unlimited, as the central bank can, at its discretion, technically issue any amount of the domestic currency.

At the same time, when the central bank manages foreign exchange reserves – when its operations are not denominated in the domestic currency – the central bank accesses the market as any other "market user". For example, in the EUR/USD market, with a daily turnover of over USD 1 trillion, everybody – apart from the Federal Reserve and the European Central Bank – is just one player among many others. During this activity, the central bank may

even execute hedging transactions, just like any other company attempting to hedge their exchange rate risk.

Most corporate users have some kind of natural foreign currency exposure, and in general, their primary objective is to hedge these exposures. Such exposures may comprise the currency risk associated with imported factors of production or sales to the rest of the world. For example, the continuous and significant depreciation of the Japanese yen in the first half of 1998 must have caused a big headache for numerous Japanese importers who failed to hedge their exchange rate risks, while the exchange rate movement allowed exporters to collect an increasing amount of yen revenues.

Households also enter the market, for the most part, as market users. Tourism-related conversions are perhaps the most typical example of their activities. In this case, households' susceptibility to exchange rate changes is moderate because the costs of a vacation abroad – and hence, the exchange rate risk involved – is fairly low relative to their income. Due to households' inexperience in managing exchange rate risk, it is not typical – but possible, nevertheless – that they directly enter the foreign exchange market.

In the past, households' entry to the forex market had severe obstacles, given that the minimum trade size that could be executed in the interbank markets was around USD 1 million; in addition, complicated legal documentation had to be maintained and candidates were subject to lengthy credit assessment. The spread of the internet and online trading systems made it possible for household to enter the forex market directly. The only requirements to meet are an internet connection and a minimum initial capital of a few thousand dollars. Besides quick and easy market access, importantly, households have low-cost access to the same information that previously was only available to institutional investors.

Commercial banks are important market participants. To some extent, they are the most important players, as they perform intermediary services for the other market participants in the foreign exchange markets. They are the market makers. Market participants with different currency conversion needs – both in terms of timing and direction – find each other through the assistance

of market maker banks, and these institutions provide the liquidity required for the transactions.

Certain features of foreign exchange markets make them attractive to profit-oriented investors. Since these features are not present in many other markets, forex markets offer unique opportunities. Economically, gaining a profit is made possible by the fact that there are participants in the market who are not profit-oriented and are less or not susceptible to exchange rate changes. For example, corporations usually earn their profits from their core production activities, and are typically involved in the forex markets for hedging purposes only. Exchange rate movements therefore represent an opportunity for traders with a good understanding of the markets, the instruments, the relationships between individual factors and the motivations of individual participants. They have an opportunity to profit from such movements.

In addition, owing to technological progress, the barriers to market entry have crumbled over the past decade, which significantly increased the accessibility of markets: today not only the largest banking houses, but – through various electronic trading platforms – masses of small investors also have access to the market. Consequently, the foreign exchange market has become the largest, most liquid and most efficient market in the world, practically open 24/7 for all prospective traders.

2 Spot market

2.1 Spot transactions

The simplest and most basic transaction type of forex markets is spot conversion. This means the exchange – purchase or sale – of one currency for another. By convention, the value date or settlement date follows the trade date by 2 business days. "T" designates the trade date and accordingly, the value date is indicated as "T+2".

If an investor entered into a spot transaction on Monday, the transaction will be settled on Wednesday. If the contract is concluded on a Thursday, settlement will take place only on the following Monday as neither Saturday, nor Sunday are considered business days in most major markets. Similar to weekends, bank holidays will also postpone the settlement date.

Naturally, there are exceptions. In the case of the US dollar/Canadian dollar (USDCAD) and the US dollar/Hong Kong dollar (USDHKD) currency pairs, transactions are settled one business day following the trade date (T+1 convention). It is a curiosity that in case of Middle Eastern currencies (e.g. Saudi riyal, SAR) instead of Friday, Saturday is the value date. It is yet another peculiarity that the other leg of the transaction – such as the US dollar in the case of a USDSAR transaction – is settled on a different value date; it cannot be settled on Saturdays, as Saturday is not a workday for US banks.

These settlement conventions came into being due to the fact that commercial banks use different account manager banks to settle transactions with each other, and only banks of a given country can perform settlements in a given currency. For instance, if a European bank performs a EURJPY conversion, the transfer of yen will be carried out on its behalf by its account manager bank located in Japan. Due to the time differences, transactions concluded in the afternoon in a European time zone, when Japanese banks are already closed, will only be processed on the next Japanese trading day. In this case, at least 2 days are required for reliable settlement.

At the same time, in special cases and for extra charges, it is possible to request same day, i.e. T-day or T+1 day settlement. However, as a base case, in the

interbank markets all orders placed without a specific note are executed on the second trading day.

2.2 Spot market quotes

One unique feature of the foreign exchange market is that rather than measuring the absolute value of a product or service, it measures the relative price of two currencies. The fact that the value of currencies compared to each other is not absolute but only relative has been especially true since the convertibility of the last currency to gold was terminated.

A currency pair can be broken down to two elements: the base currency and the quoted currency. The value of 1 unit of the base currency is expressed relative to the quoted currency or settlement currency. In the case of the EURUSD exchange rate, for example, the euro is the base currency and the US dollar is the quoted currency.

In theory, the currencies of the pairs could be exchanged, i.e. one could express the value of 1 US dollar in euros as well, but international standards have determined which currency of a given currency pair functions as the base currency. Currencies belonging to the former Commonwealth (Pound Sterling, Canadian dollar, Australian dollar, New Zealand dollar) and the euro are always base currencies against any other currency. As regards the US dollar, owing to its international role, it is also treated as a base currency, save for the above exceptions. When a given cross rate is quoted in accordance with international standards, it is referred to as a direct quote, otherwise it is an indirect quote.

Example 1: Direct and indirect foreign exchange market quotes

In the case of the exchange rate of the US dollar against the Japanese yen, the dollar is the base currency and the yen is the quoted currency. An electronic trading platform displays the following direct quote for the USD/JPY cross rate: 108.82. It means that

1 US dollar = 108.82 Japanese yen.

The indirect form of the same quote would be the reciprocal of the direct quote, expressing the amount of US dollars required to buy 1 Japanese yen,

$$\frac{1}{108.82} = 0.009189$$

that is

1 Japanese yen = 0.009189 US dollar.

All currencies have an ISO code, which is an internationally recognised 3-letter abbreviation. In this chapter only the most important currency codes are presented.

G10 currencies are the currencies of the top 10 developed countries of the world. Developed countries typically have sophisticated financial markets and widespread foreign trade relations. As a result, their currency markets are generally very liquid, capable of processing large volume transactions relatively quickly.

Table 1
Currency ISO codes

Foreign exchange	ISO code
euro	EUR
US dollar	USD
Japanese yen	JPY
Pound sterling	GBP
Swiss franc	CHF
Canadian dollar	CAD
Australian dollar	AUD
New Zealand dollar	NZD
Norwegian krone	NOK
Swedish krona	SEK
Chinese yuan	CNY

Naturally, it is currency pairs that are traded in the markets; in other words, one currency is exchanged for another. Accordingly, each quote involves two currencies. Currency pairs can be quoted in various forms. According to the standard arrangement, the base currency is shown first, followed by the quoted currency. For example, the euro–US dollar currency pair is expressed

as EURUSD or alternatively, a slash may be inserted between the currencies: EUR/USD. In text form, the currency pair can be expressed as euro/dollar or alternatively, separated by a dash: euro–dollar.

Example 2: Currency quotes

In general, in the currency market cross rate quotes consist of 5 digits, irrespective of the where the decimal point falls.

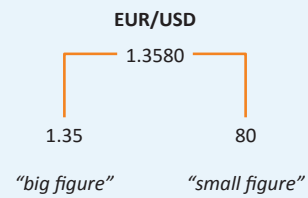
EURUSD = 1.4350

EURHUF = 270.50

EURCZK = 25.930.

The smallest unit of a price movement in a currency quote is called "pip" or "point"; in essence, it is the last digit of the quote. The last 2 digits of the exchange rate, that usually change second by second, are referred to as "small figures", while the first 3 digits of the rate are the "big figures".

Figure 2
EURUSD quote



Another special feature of the foreign exchange market is that most trades are concluded on a "Request for Quote" (RFQ) basis. This means that the party initiating the transaction (whether it is a bank, a company or a private investor) requests a quote from its market maker counterparty. By default, the quote is two-way, meaning that both the bid price and the ask price are quoted and the client decides whether to conduct a deal or not.

2.3 Order types

Upon market entry, what actually happens is that an order is placed with the market maker to execute a transaction under given conditions. The conditions may apply to the price, at which one intends to transact, or to the timing of the execution. In the case of most capital market products, investors can use similar order types. Where the foreign exchange markets differ is that in these markets all order types can be easily and effectively used without constraint on price or timing.

Another feature that characterises all markets and all orders is the specification of a validity period that defines how long the order remains active. Accordingly, we can distinguish between "day orders", i.e. orders that are valid only until the end of the day, or "Good-Til-Cancelled" (GTC) orders, which remain valid until revoked. A third option would be that the order remains valid until a pre-defined date, but this is seldom used.

Conventions may differ from market to market. In the currency market, for example, in the absence of a pre-specified time limit, all orders are Good-Til-Cancelled by default. By contrast, in the European stock exchange interest rate futures market (Eurex futures), if no specification is added then the order is valid until the end of the day and all orders are cancelled when the stock exchange closes for the day; i.e. they are treated as day orders.

Market orders

Market orders or "at market" orders are one of the simplest and most frequently used order types. In this case, the client requires immediate execution at the current price available in the market.

Limit orders

The most frequent order of stock markets plays a somewhat smaller role in the foreign exchange market, but it is of course very similar in its function. Essentially, the client defines the price level at which it wishes to conclude the deal and submits the order to the market maker. Once the price reaches the pre-specified level, the order is filled, and the counterparty confirms execution. The essence of limit orders is the fact that the client wishes to achieve a price

better than the current price and sets a lower price for buy orders and a higher price for sell orders.

Stop-loss and take-profit orders

These are frequently used order types, where execution efficiency plays an important role. In essence, the client defines the maximum amount it wishes to lose on a given open position and/or the target price at which it wishes to realise potential profits. Obviously, upon taking a position, an investor expects the price to move in the desired direction; however, it may happen that the price goes against the preliminary expectations. In the latter case, it is important to have some protection – a measure of insurance – to mitigate the risk involved (hence it is called "stop loss" order). On the other hand, in the case of a positive market development, it may happen that the price reaches the specified target level when it is night-time in the investor's time zone or perhaps the price resides at the given level for such a short period that would not allow the quick execution of the transaction. That is when the so-called "take profit" order becomes useful to close down the position and realize profits.

Complex orders

One complex order type is an OCO order. OCO stands for "one cancels the other". In short, OCO orders combine a stop-loss and a take-profit order: if one order is executed and the position is closed, the other becomes unnecessary and is automatically cancelled.

"If-done" orders

If-done orders are conditional orders. One (or more) element(s) of the order is only activated when the price reaches a certain level, in which case, for example, a limit order is triggered.

2.4 Market quotation

As opposed to stock exchange transactions, in foreign exchange markets interbank participants do not receive a commission on the turnover; their profit derives specifically from the spread between the buy and sell rates. Market makers are continuously available to conduct transactions on both sides of the market quotation.

Figure 3
Bid price (buy) and ask price (sell)

The bank commits to buy the given base currency at the bid price or sell it at the ask price. Of course, participants in the market sell the currency at the bid price and buy the currency at the ask price. The bank provides liquidity, temporarily takes over the currency risk of other market participants, and collects a profit from the difference between the bid price and the ask price (bid-ask spread).

Its quote applies to the unit of the base currency; therefore, in the example shown above there is a euro bid price and a euro ask price. Of course, the deal should be understood symmetrically: the latter means a dollar ask price and a dollar bid price at the same time, as it may happen that the "round" amount is not the amount of the base currency but that of the quoted currency, and a price is requested for the latter. Even in such cases, the quote refers to the unit of the base currency.

Example 3: Bid-ask spread

Consider, that the EUR/USD quote this morning is 1.3580 – 1.3582, and the trader turns around EUR 1 million; i.e. he buys and sells euro at these rates, respectively.

The nominal difference between the bid price and the ask price can be calculated with a simple deduction: 1.3582 – 1.3580 = 0.0002, i.e. 2 pips.

If the trader buys EUR 1 million, the value of the transaction will be 1,000,000×1.3580, that is USD 1,358,000; if he sells EUR 1 million, he needs to get USD 1,358,200 in return. The difference is USD 200; this is the profit of the market maker.

Note that since the quote refers to the base currency and it is the price of the base currency expressed in the quoted currency, any profit made on the position is generated in the quoted (or settlement) currency. The profit is always generated in forint in EUR/HUF transactions and in dollar in EUR/USD transactions. The profit&loss of a position can easily be calculated without a calculator if we know the amount realised from a 1-pip movement in the exchange rate for a given position size. This helps us calibrate the size of our position considering the available capital and the potential exchange rate movements.

Example 4: Value of 1 pip in the base currency in the case of a position of 1 million

EURUSD = 100 dollars

USDJPY = 10,000 yens

EURHUF = 10,000 forints

EURGBP = 100 pounds

2.5 Market entry

The size of the position that we are willing to undertake essentially depends on our expectations and our willingness and ability to take risk. The latter basically means the available capital. The premise of risk management – "don't put all of your eggs in one basket" – also holds true for foreign exchange market trading: you should never take such a large position that potential losses from an adverse price action wipe out all of your savings.

Currency markets offer plenty of opportunities for risk taking in terms of individual cross rates, instruments, investment horizons and various trading strategies. This allows us to spread our risks. Since risk appetite is a subjective quality that varies for each individual, it is difficult to define typical behaviours. However, it is safe to assume that there are presumably few people who would

be willing to lose all of their capital on a single position. As a rule of thumb, positions should be calibrated in such a way that limits potential losses to 2 per cent of our capital.

Consider that you have savings of USD 50,000, which you wish to invest in the currency market. 2 per cent of your capital is USD 1,000; therefore, you should set the nominal value of your position in such a way that ensures that you do not lose more than USD 1,000 on that single position. For an EURUSD position of 1 million, a price movement of 1 pip is worth USD 100; consequently, even a 10-pip movement in the "wrong" direction translates into a loss of USD 1,000.

The question, of course, is whether a 10-pip movement is too much or too little for a given currency pair. This depends on the investment horizon and on the size of exchange rate fluctuations. The latter is called volatility, and it is often expressed in percentage terms. Its level changes over time, and thus the notional size of the position that we can open also depends on the market environment. For example, in the last quarter of 2008, in the period after the default of the Lehman Brothers investment bank, the financial markets observed unprecedented uncertainty. It was not only impossible to assess the effects of the event on the real economy – including the creditworthiness of market participants –, but it was equally impossible to forecast the response of monetary and fiscal authorities. This uncertainty, in turn, was reflected in the movements of asset prices, including exchange rates.

The daily trading range of the EURUSD currency pair exceeds 10 pips even in a calm market environment. Though sometimes the exchange rate may move within a narrower band for long minutes or even hours, important news items, economic data disclosures or political announcements typically trigger larger swings. And over a weekly or monthly horizon the EURUSD currency pair exhibits movements that can only be measured in big figures, rather than pips.

In general, even if we wish to trade only on intraday movements (so called "day-trading") and our investment horizon is a few hours at most, 10 pips is considered to be a relatively small price movement, at least compared to the amount of capital used in the above mentioned example. In view of this, it is worth downsizing our position.

The level of the bid-ask spread is basically determined by the risk borne by the market maker who undertakes and intermediates the position. How quickly the market maker can get rid of the position depends on the liquidity of the market on the one hand and on the size of the position on the other hand.

According to the definition of liquidity, an asset is considered liquid if it can be sold or purchased relatively quickly without influencing the price. Obviously, the number of market participants or the depth of the market fundamentally determines the ease of execution or the extent to which an asset can be deemed liquid.

In the case of highly liquid, popular currency pairs, this quoted spread is fairly narrow. Owing to the size of the US and European economy, the size of their equity and bond markets and hence, the volume of trade and capital flows, the EUR-USD market, for instance, is one of the most liquid markets in the world. Spread size also depends on the traded quantity but to offer an example, the typical ticket size ("regular amount") in the EUR/USD currency pair on EUR 5–10 million traded is 1 pip or point. For bigger volumes, of course, the spreads are wider as the risk is greater for a price shift to take place while the market maker is closing his position.

Moreover, liquidity is a dynamic phenomenon, and its level is not permanent. It changes during the day along with the movement of trading activity between trading hubs, it changes around the publication time of economic data and it also changes in tandem with fluctuations in investor risk appetite. Indeed, even very liquid markets can temporarily "dry up".

In order to express appreciation for a good relationship with a counterparty, market makers in the interbank market sometimes quote a so called "choice price", which means that the bid and ask price is identical and the client may decide whether he wants to buy or sell at that single exchange rate.

Imaginary conversation in the interbank FX market

Dealer 1: Cable 5

["Cable" is a nickname for the GBP/USD cross rate. It was named after the Transatlantic Cable laid under the Atlantic Ocean in the middle of the 1800s first used for the transmission of telegraphs and later also used for transmitting currency prices. Even though today the information flows through optical fibre cables or satellites, instead of steel cables, the nickname stuck. The pound sterling itself is often referred to as "cable" and similarly, numerous currencies have nicknames, which typically denote the cross rate against the dollar as well. For example, "loonie" is a nickname for the Canadian dollar, as the tail side of the one dollar coin carries an image of a bird called "loon". Not surprisingly, the New Zealand dollar has been termed "kiwi".

Since prices tend to change extremely fast in the highly efficient currency market, speed is of essence, which gave rise to the use of certain abbreviations that have become market conventions over time.

As the US dollar registers the highest turnover of all currencies (one leg of 87% of all transactions is US dollar), it suffices to specify only the second currency in quotes against the dollar (e.g. "JPY", therefore, always means USD/JPY; for the rest of the currencies, the full abbreviated name of the cross rate must be indicated).

Naturally, "5" means 5 million and refers to the base currency. For the "cable", the base currency is the British pound, and for "JPY" the base currency is the US dollar].

Dealer 2: Hi. 10–15

[After a brief greeting, the "small figures" or pips are quoted. Speed is essential, and the counterparty is fully aware what the "big figure" is, anyway. The quote is two-sided; the party requesting the price may trade on either side].

#

Dealer 2:12–17

[The market has shifted, the previous quote is invalid (which can be also indicated with an "off" entry); the market maker now shows a new price].

Dealer 1: Mine.

[The decision is made. The party requesting the price indicates which side he wishes to "hit" by saying "Mine" or "I buy"; i.e. he specifies whether he wants to buy or sell GBP 5 million. If he wants to sell, he may say "Yours" or "I sell".

Another customary alternative is to repeat the price, e.g. "at 17" or simply, "17"].

Dealer 2: OK, agreed. I sell GBP agst USD at 1.5517 with value 25 Oct. My USD to X Bank, NY.

[Mandatory confirmation; the parties must agree on the key parameters. The quotation always refers to the value date defined by market convention. Even so, this has to be confirmed to avoid any misunderstanding: to make sure that both parties think of the same value date and to enable the back-office staff to have a clear understanding on which day they are expected to make the money transfer.

Of course, at this point the full price needs to be spelled out. The systems used for trading can recognise the context (currencies, valid dates, big figure) intelligently and confirmations are generally displayed by 1 or 2 clicks.

It is important to include the word "agreed", which serves as a virtual handshake confirming the deal. The currency market is a "my word is my bond" type of market; indeed, this phrase is practically the same as undertaking a contractual obligation. The terms "OK" and "Done" are equally binding.

Finally, the settlement instruction must also be communicated: where the respective currencies need to be transferred].

Dealer 1: Thanks. All agreed. My sterling to Y Bank, LND. Bibi.

[The other party should also indicate that the parties have reached an agreement. It is not necessarily required to repeat all information. Of course, the settlement instruction is also a required element].

Dealer 2: Txs. Bi.

[Thanking the other party briefly and saying goodbye].

Theoretically, any currency could be traded against any other currency, or to put it differently, any cross currency rate could be created, e.g. Mexican peso / South African rand exchange rate. In practice, these theoretical pairs are seldom traded directly, each currency is usually traded against some major developed market currency, and the cross rate is just indirectly derived from these rates, e.g. Mexican peso / US dollar and South African rand / US dollar. Although only a fraction of the theoretical currency pairs is traded, their number still exceeds 200.

Table 2
Ranking and market "share" of the 15 most heavily traded currencies

Currency	2010		2013		2016	
	%	Ranking	%	Ranking	%	Ranking
USD	84.9	1	87.0	1	87.6	1
EUR	39.0	2	33.4	2	31.4	2
JPY	19.0	3	23.0	3	21.6	3
GBP	12.9	4	11.8	4	12.8	4
AUD	7.6	5	8.6	5	6.9	5
CAD	5.3	7	4.6	7	5.1	6
CHF	6.3	6	5.2	6	4.8	7
CNY	0.9	17	2.2	9	4.0	8
SEK	2.2	9	1.8	11	2.2	9
NZD	1.6	10	2.0	10	2.1	10
MXN	1.3	14	2.5	8	1.9	11
SGD	1.4	12	1.4	15	1.8	12
HKD	2.4	8	1.4	13	1.7	13
NOK	1.3	13	1.4	14	1.7	14
KRW	1.5	11	1.2	17	1.7	15

Source: BIS

Of the 200 actively traded currency pairs, only 20–30 currencies are characterised by high liquidity, i.e. low transaction costs. Among all, the US dollar is the most heavily traded currency, the centre of the FX markets. As mentioned earlier, around 90 per cent of all transactions in the foreign exchange markets involve the US dollar.

As regards currency pairs, the EURUSD cross rate is in the lead with an average daily turnover of USD 1.17 trillion, accounting for a quarter of the total traded volume. It is followed by the USDJPY and the USDGBP currency pairs. These three currency pairs represent 50 per cent of the total turnover. By comparison, the volume of EUR cross rates (e.g. EUR/JPY, EUR/GBP) is fairly small, each below 3 per cent.

2.6 Cross rate calculations

Most market makers do not display quotes for all cross rates, at least not directly. The farther away two countries – and hence, their respective currencies – are in respect of economic relations, the less liquid the market of the given currency pair is. The consequence of the absence of trade or investment activity and hence, the lack of economic transactions, is that there is no direct exchange of the two currencies in the interbank market. In the case of remote countries, trade agreements are likely to be denominated in one of the major world currencies in any event. Globally, this role is filled by the US dollar and of course in Europe, the euro has assumed a similar function.

Accordingly, market makers quote prices against one of the main currencies (mostly in the US dollar) in the interbank market and all cross rates are defined through these quotes. For example, since presumably there is no turnover at all in the Ghana cedi/Vietnamese dong currency pair, the price of one currency relative to the other cannot be defined directly; however, the cross rate can be derived from the dollar/cedi and the dollar/dong quotes.

In calculating cross rates, two basic cases can be distinguished. In the first case, the "position" of the central currency (say, the USD) is reversed in the currency pair; in other words, the currency serves as the base currency in one currency pair (e.g. against the Swiss franc in the USDCHF currency pair) and as the quoted currency in the other currency pair (e.g. against the British pound in the GBPUSD currency pair).

Example 5: Calculation of the GBPCHF cross rate

Consider, for example, that the current exchange rate is the following:

USDCHF 1.0560

GBPUSD 1.6110

Based on these rates, the GBPCHF cross-rate can be defined as follows. If we sell 1 pound sterling, we will receive 1.6110 dollars in return. Then we sell this USD 1.6110, for which we receive CHF 1.7012.

GBPCHF 1.7012

Visually:

$$\frac{1.6110\ USD}{1\ GBP} \times \frac{1.0560\ CHF}{1\ USD} = \frac{1.7012\ CHF}{1\ GBP}$$

In the example above, we simply used mid-rates for an easier understanding of the logic applied. In reality, however, banks quote a buy rate and a sell rate for all currency pairs, and accordingly, in cross rate calculations the bid price and the ask price of the given cross rate will be a central question. Consider the following example.

Example 6: Determining the bid price and the ask price of GBPCHF

Consider, for example, that the current exchange rate is the following:

USDCHF 1.0560–1.0570

GBPUSD 1.6110–1.6120

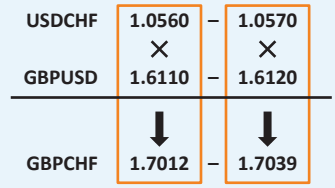
The logic is similar to that of Example 4. The important difference is that the correct exchange rate must be used for each individual transaction.

In the current example, if we sell, as market users, one British pound, we will receive 1.6110 dollars in return (GBP/USD bid price). And if we wish to sell this USD 1.6110 (USD/CHF bid price), we will get CHF 1.7012 in exchange. This will be the GBPCHF bid price.

If we wish to buy GBP 1.00, we will need to pay USD 1.6120 (GBP/USD ask price). In order to have USD 1.6120 – i.e. in order to buy this amount – we need to pay 1.6120×1.0570 = 1.7039 Swiss francs (USD/CHF ask price).

Overall, the GBPCHF quote will be the following:

GBPCHF 1.7012–1.7039



In the second case, the position of the central currency is not reversed in the currency pair; in other words, the base currency is the same in both currency pairs (e.g. against the Swiss franc and the Japanese yen, USDCHF and USDJPY). Let us look at the calculations.

Example 7: Calculation of the CHFJPY cross rate

Consider, for example, that the current exchange rate is the following:

USDCHF 1.0560

USDJPY 102.50

Based on these exchange rates, we can calculate the CHFJPY cross rate – i.e. how many yen we need to pay for one Swiss franc – as follows. If we sell one Swiss franc, we will receive 1/1.0560, i.e. roughly 0.9470

dollar in return. If we sell this 0.9470-dollar amount, we will receive 0.9470×102.50, that is 97.064 yen in return.

We may also reverse the thought process. In order to own 102.50 yens, we need to sell one dollar. But to buy this one dollar, we need to pay 1.0560 Swiss francs. Therefore, the Swiss franc/yen cross rate will be 102.50/1.0560 = 97.064.

CHFJPY 97.064

That is:

$$\frac{\frac{102.50\ JPY}{1\ USD}}{\frac{1.0560\ CHF}{1\ USD}} = \frac{102.50\ JPY}{1\ USD} \times \frac{1\ USD}{1.0560\ CHF} = \frac{97.064\ JPY}{1\ CHF}$$

We also present an example of how to calculate bid and ask prices in this second case. The biggest difference is that in the first case above, bid price had to be multiplied by bid price and ask price had to be multiplied by ask price. By contrast, in this second case, a "cross" division will take place: the ask price will be divided by the bid price and vice versa.

Example 8: Determining the bid price and the ask price of CHFJPY

Consider, for example, that the current bid prices and ask prices are the following:

USDCHF 1.0560–1.0570

USDJPY 102.50–102.60

Our starting point is that we have one Swiss franc and we want to exchange it for Japanese yen. First, we sell the CHF 1 and buy USD. We can buy the dollar at the ask price quoted by the bank. We get 1/1.0570, i.e. 0.9461 dollar for the one franc. Note that in Example 6 we did not apply

a bid-ask spread and we did not need to pay attention to which rate is used for the conversion.

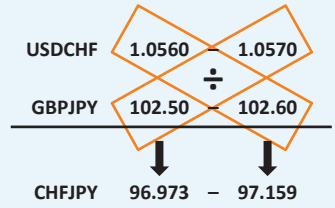
In the second step, we sell dollar for yen at the bid price, and finish "the round" with 0.9461×102.50=96.973 yens. Since on the whole, we sold francs against yens, this will become the CHFJPY bid price.

To determine the CHFJPY ask price – where we, as market users, are buying francs and selling yens – we need to reverse the above logic. If we have yens at the start, first we want to sell the yens for dollars (at the 102.60 ask price). Next, we sell the dollars for francs (at the 1.0560 bid price). Obviously, dividing the USDJPY rate by the USDCHF rate will give us the CHFJPY cross rate and if we reverse the process, we will receive the JPYCHF cross rate.

Overall, the CHFJPY quote will be the following:

CHFJPY 96.973–97.159

Note that the received values also appear "correct" in the sense that the bid price is always lower than the ask price, or otherwise the market maker would realize a loss.



In general, we may conclude that when two exchange rates are quoted as B/A and A/C, the cross rates can be written as:

$$B/C = B/A \times A/C$$

$$C/B = 1 \div (B/A \times A/C).$$

If the currency pairs used in the initial transaction are quoted as A/B and A/C, the cross rates will be:

$$B/C = A/C \div A/B$$

$$C/B = A/B \div A/C.$$

2.7 Triangular arbitrage

Cross rate calculation is a mechanical arithmetic operation whereby two currency pairs can be used to calculate the exchange rate of a third pair. In order to accomplish this, the trader only needs to "find" the proper operations, conversions and the relevant rates.

From a given currency we can always derive another currency either directly – such as the USD/CHF conversion – or indirectly, through other currencies – e.g. through the GBP by first converting USD to GBP and then GBP to CHF. Of course, countless other currencies can be included in the process; the bottom line is that theoretically speaking, it should not matter whether the conversion takes place directly or indirectly. If that is not the case, the trader is presented with an arbitrage opportunity.

Arbitrage means a risk-free profit: after performing a series of operations the trader does not have any remaining position, that is does not have any remaining risk, while realising a profit. Note that performing the operations backwards would result in losses. Below we present the circle of arbitrage with the help of three currency pairs – this is why this operation is commonly referred to as triangular arbitrage.

Example 9: Triangular arbitrage

Consider that you receive the following quotes from the broker:

USDCHF: 1.25

GBPUSD:1.80

GBPCHF: 2.30

How can we make money in this scenario? First of all, we need to be able to tell whether a currency is overpriced or underpriced relative to the other based on the above quotes. After this, our job is easy: "buy low, sell high" is the golden rule of the market, and accordingly, we need to buy the underpriced instrument and sell the overpriced one.

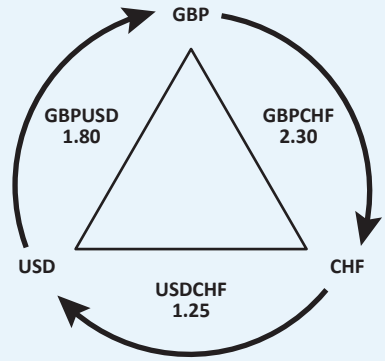
We can detect an arbitrage opportunity by taking any starting point: as the exchange rates always reflect relative values, being underpriced or overpriced remains a relative term. If the pound is overpriced relative to the dollar, then the dollar is underpriced relative to the pound, etc. However, given that the dollar functions as a central currency in global markets, let us accept that the USDCHF and the GBPUSD exchange rates are correctly priced before we examine the GBPCHF exchange rate.

Based on the USDCHF and the GBPUSD quotes, in theory, the GBPCHF exchange rate should be $1.25 \times 1.80 = 2.25$. As opposed to this, we were given a quote of 2.30, which means that based on the market quote, the British pound is overpriced compared to the Swiss franc. In theory, it would be enough to give CHF 2.25 for GBP 1.00, but the market is willing to pay as much as 2.30. If something is overpriced, it needs to be sold.

Let the sequence of trades start with the pound. If we start the round by selling one pound, we will receive 2.30 Swiss francs, for which, converted at the rate of 1.25, we can receive 1.84 dollars. If we convert this back to British pounds, we will get 1.0222 pounds. We returned to our neutral GBP position, but now we have GBP 1.0222 instead of the

GBP 1.00 we had previously, which translates into an arbitrage profit of GBP 0.0222. By moving around a capital of GBP 1 million, our profit will exceed GBP 22,000.

If we carried out the trade backward, GBP 1.00 would be converted to USD 1.80, which in turn would be converted to CHF 2.25, which, converted to GBP at the rate of 2.30 would leave us with pure, risk-free loss of GBP 0.9783.



In financial markets, this "no arbitrage" argument is frequently used to explain relationship between pricing of different instruments, as we will see later in the example of forward rate calculations. The same concept is behind the cross rate calculation. Indeed, as shown by the example above, traders can exploit market anomalies where the actual pricing is not consistent with the theoretical price to earn risk-free returns.

Unfortunately, this seldom happens in the high-turnover, liquid foreign exchange markets, for several reasons. The first obvious reason is that, contrary to the example presented above, in the real world trading involves costs. If there is only a minor discrepancy in pricing, it may persevere for a longer period with no effect as, once trading costs are deducted, essentially no profit

remains. Secondly, numerous market participants are working hard to detect this kind of mispricing. With high-capacity computers, it only takes a fraction of a second to check for triangular arbitrage opportunities for numerous currency pairs, even factoring in trading costs and market depth. As a result, no-arbitrage principle is ensured practically without human intervention in foreign exchange and other, similarly efficient, markets.

3 Forward transactions

3.1 Forward contract

Forward contracts are currency conversions at a pre-defined future date. Similar to spot transactions, they also involve the purchase or sale of a currency against another currency, with the exception that the value date of the transaction is not the second business day following the deal as is the case with the spot market convention. In a strict sense, any deal concluded with a value date other than "T+2" is considered a forward transaction, including those with a value date preceding the spot value date.

Forward conversions are typically used for hedging exchange rate risks. For example, in the case of an exporter company, the proceeds of sales are received at a future date (e.g. 90 days after delivery) in some foreign currency (e.g. euro). The company faces an exchange rate risk as the exchange rate might depreciate or appreciate, and hence there is uncertainty about the value of these proceeds expressed in the domestic currency. The company may decide to hedge this risk by entering into a forward transaction. In this specific case, the exporter sells the foreign currency, that it will receive, three-month forward against domestic currency. All parameters of the transaction, that is the exchange rate and value date in the future, are agreed in advance on the trade date. This eliminates the uncertainty about the future exchange rate and about the value expressed in domestic currency.

3.2 Forward quotations

As the forward transaction is not settled on the second business day after the trade date, in contrast to the spot convention, the price applied in forward transactions is different from that of the spot price. The reason is that the time value of money, i.e. the interest earned on the respective currencies, must also be considered. This is generally true for all forward transactions, regardless of whether the underlying product is a security, such as bonds or equities, a commodity, such as oil or iron ore, or a currency pair. The seller of the product does not receive the sales proceeds before the settlement date and hence, he does not earn any interest income on these funds. Moreover, in the case

of certain goods, the seller may even incur substantial costs, such as storage costs, insurance costs, etc. All of these cost elements, starting with the lost interest income, must be reflected in the forward rate.

In the case of forward currency transactions, two currencies are exchanged, and to obtain the appropriate forward rate, the spot rate needs to be adjusted for the pro-rated interest rates of the respective currencies. In the interbank market this interest difference is expressed by the so-called forward points, and the quotation itself is also expressed in "points". Moreover, since the contract can have more than one value date, each value date will have a different forward rate.

Table 3
Euro/Hungarian forint (EUR/HUF) forward points (8 July 2014)

	Settlement date	Forward points		Forward rates	
TN	07/10/2014	1.64	2.05	309.1795	309.3236
SP	07/10/2014	309.20	309.34	309.2000	309.3400
SN	07/11/2014	1.44	1.92	309.2144	309.3592
1W	07/17/2014	10.07	13.42	309.3007	309.4742
2W	07/24/2014	20.34	24.74	309.4034	309.5874
3W	07/31/2014	28.40	34.87	309.4840	309.6887
1M	08/11/2014	41.54	50.60	309.6154	309.8460
2M	09/10/2014	80.15	87.85	310.0015	310.2185
3M	10/10/2014	111.03	132.64	310.3103	310.6664
4M	11/10/2014	149.43	172.33	310.6943	311.0633
5M	12/10/2014	183.32	212.18	311.0332	311.4618
6M	01/12/2015	214.41	261.41	311.3441	311.9541
9M	04/10/2015	320.52	387.32	312.4052	313.2132
1Y	07/10/2015	422.19	509.52	313.4219	314.4352
1Y	07/10/2015	422,19	509,52	313,4219	314,4352

Source: Bloomberg

The table shows that the starting point of the forward quotation is the spot rate, i.e. the exchange rate applied to "T+2" settlement. If the contract has any other value date, the price will be adjusted. Any value dates can be chosen for the transaction, but there are some distinctive maturities (e.g. 1 day, 1 week, 1 month, etc.). The forward quotations used in the interbank market are typically defined only for these value dates; in the case of any other maturities – i.e. "broken dates" – the appropriate forward rates are derived from these quotes.

Example 10: Forward rate calculation

In order to determine the specific forward rate, consider the following example. In the case of the EUR/HUF forward quotes included in the table above, the 3-month forward quote is 111.03/132.64. In order to receive the forward rate, the spot rate must be adjusted by the forward points (or "pips").

For example, the exporter company mentioned above wishes to convert the euros expected to receive in 3 months' time into Hungarian forints. If the company performed a spot conversion, it would sell the euro to the market maker bank at the bid rate of 309.20. However, since the company does not yet own the foreign currency – it will only receive it from its counterparty in the future – it can only sell the foreign currency through a 3-month forward transaction. The forward rate at which the company can sell the currency will be 310.3103.

spot rate:		309.201
forward point:	+	1.1103
forward rate:		310.3113

In the case of a euro purchase transaction – similar to the spot conversion – the bank's ask price must be applied to receive the forward rate. At a spot rate of 309.34 and 132.64 forward points, the forward rate will be HUF/EUR 310.6664.

In the example above, the forward points were added to the spot rate. The reason for this is the euro versus forint interest rate differential. If the interest rate for the quoted currency is higher than the interest rate for the base currency, the forward points are added to the spot rate. In market terminology, the base currency is trading at a forward premium compared to the quoted currency.

In the example above, the euro is trading at a premium relative to the forint; in other words, under the forward contract, more forints must be paid for the same amount of euros. Forward points essentially compensate for the interest

rate differential: since the company receives the forints for the euros sold only later, it also starts earning higher forint interest rates only later.

If the interest rate for the quoted currency is lower than the interest rate for the base currency, the forward points are deducted from the spot rate. In such cases, the base currency is trading at a forward discount compared to the quoted currency. An example for that is the Australian dollar/Japanese yen currency pair. At the time of writing, in the case of the AUD/JPY cross rate, interest rates for the Australian dollar serving as the base currency were higher than the interest rates for the Japanese yen; thus in this case, the forward points must be deducted from the spot rate.

Table 4
Australian dollar/Japanese yen (AUD/JPY) forward points (as at 8 July 2014)

	Settlement date	Forward points		Forward rates	
ON	07/09/2014	–0.72	–0.61	95.6147	95.6244
TN	07/10/2014	–0.72	–0.66	95.6086	95.6172
SP	07/10/2014	95.60	95.61	95.6020	95.6100
SN	07/11/2014	–0.73	–0.67	95.5947	95.6033
1W	07/17/2014	–5.09	–4.90	95.5511	95.5610
2W	07/24/2014	–10.22	–9.96	95.4998	95.5104
3W	07/31/2014	–15.37	–15.05	95.4483	95.4595
1M	08/11/2014	–23.36	–23.18	95.3684	95.3782
2M	09/10/2014	–45.24	–44.87	95.1496	95.1613
3M	10/10/2014	–67.01	–66.59	94.9319	94.9441
4M	11/10/2014	–89.42	–88.59	94.7078	94.7241
5M	12/10/2014	–110.83	–109.87	94.4937	94.5113
6M	01/13/2015	–136.39	–135.09	94.2381	94.2591
9M	04/10/2015	–198.79	–196.49	93.6141	93.6451
1Y	07/10/2015	–264.72	–261.94	92.9548	92.9906

Source: Bloomberg

Example 11: Market quotation

As we have seen with spot transactions, due to the volatility of prices, speed is an important element in interbank market transactions. Participants often rely on established conventions to improve the efficiency of the deal.

In interbank transactions, the quote itself shows whether a currency is trading at a premium or at a discount. If the quoted "bid" forward point is lower than the "ask" forward point, then we are witnessing a premium; when the "bid" is higher than the "ask", then the currency is trading at a discount.

Table 5
Forward quotations

	Settlement date	EURHUF Forward points		AUDJPY Forward rates	
SP	07/10/2014	309.20	309.34	95.60	95.61
SN	07/11/2014	1.44	1.92	0.73	0.67
1M	08/11/2014	41.54	50.60	23.36	23.18
3M	10/10/2014	111.03	132.64	67.01	66.59
1Y	07/10/2015	422.19	509.52	264.72	261.94

Source: Bloomberg

Entering into a 1-month AUDJPY forward contract would take place as follows.

Dealer 1: AUDJPY5 1M fwd

Dealer 2: 23.36/23.18

Dealer 1: I sell

Dealer 2: OK. With spot 95.60, I buy AUD 5 mio agst JPY at 95.3684 with value 11AUG

3.3 FX swap contracts

An FX swap contract is the simultaneous purchase and sale of a given currency pair in the same amount but with different maturities. Practically, it is the simultaneous conclusion of a spot conversion and a forward contract. It can be used for various purposes: for hedging currency risk, roll-over of existing FX positions, cash management, speculation with the interest rate differential. This diversity makes the FX swap market the largest market among the different FX market transaction types (spot, forward, swap, option). Its daily turnover exceeds 2 trillion dollars.

As regards market quotations, outright forward and FX swap transactions are equivalent to each other, because the exact same forward points are quoted for FX swaps than for forward transactions. This is because considering the spot rate as a given, the question is what will be the exchange rate of the transaction's forward leg. The calculation itself is the same, except the FX swap transaction will also include a spot conversion.

From the perspective of the transactions on each leg of an FX swap, what matters is which conversion takes place on the starting value date ("near leg") and which one happens on the maturity value date ("far leg"). In this regard, we distinguish between "buy-and-sell" and "sell-and-buy" transactions. In the former case, there is a buy conversion in the near leg and a sell conversion in the far leg, in the latter case, it is reversed. Of course, the purchase and the sale apply to the base currency. In respect of the near leg, the transaction may even start from the trade date (same day) and its maturity can range from one day to any period.

To understand the use of FX swaps, consider the following simple example. An FX trader takes a long EUR / short HUF position, which means that he expects the euro to strengthen against the Hungarian forint. He will take this exposure by conducting a spot transaction, in which he buys euro and sells forint. However, on the spot value date – i.e. in two business days – the transaction must be settled (when the trader receives the purchased euro and transfers its forint equivalent). In this case, however, the objective is to take an exchange rate risk and potentially realise profit, rather than the conversion of cash flows deriving from some underlying real economic transaction (e.g. payment for imported products), therefore prior to the actual cash settlement the trader "rolls over" its position.

The position is rolled over by means of an FX swap transaction. Since the trader bought euro in the spot transaction, he can roll it over with a "sell-and-buy" euro FX swap transaction. That is, he sells euro with spot value date and buys euro with a future value date, e.g. next day. The original currency purchase and the first ("sell") leg of the FX swap offset – cancel out – each other, as the face value of the swap is identical to the face value of the original spot transaction, and the "buy" leg of the swap transaction becomes a new settlement obligation at a future date. In the meantime, the economic exposure remains the same.

The position is typically rolled over on the next day, when the trader decides whether he will continue to hold the exposure going forward. At this point, there is only one day left until the value date of the spot transaction ("tomorrow"), so the trader enters into a "tom-next" FX swap starting from the next day to postpone the settlement date by another business day.

Maturity jargon

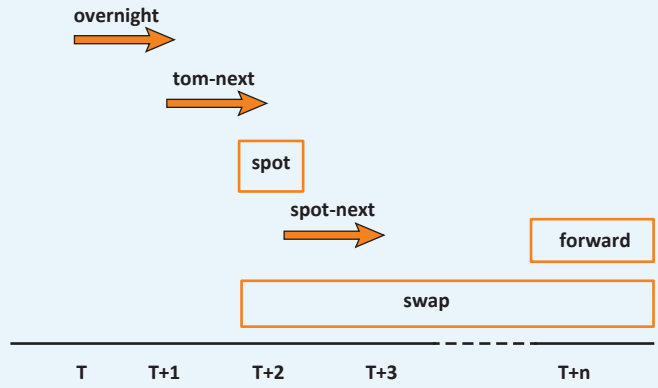
O/N "overnight": 1-day transaction, where the first leg of the transaction is the trade date ("T") and its maturity date is the next day, i.e. "T+1".

T/N "tom-next": abbreviated from the words "tomorrow" and "next", a 1-day transaction with the near leg on "T+1" and the far leg on the spot value date, "T+2".

S/N "spot-next": a 1-day transaction with the first leg on the spot value date ("T+2"), and the far leg on "T+3".

"Near leg" the first – starting – leg of the transaction

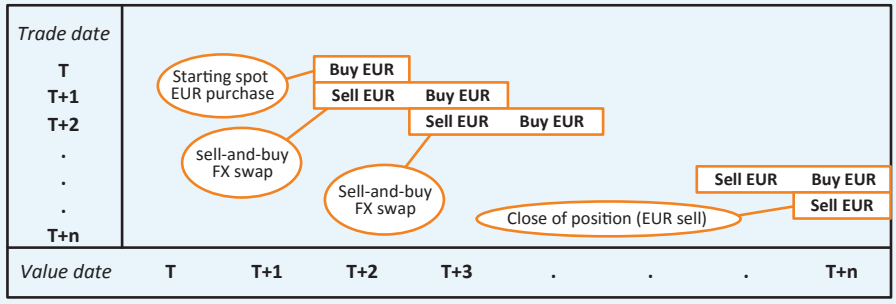
"Far leg" the "distant", maturing leg of the transaction



Settlement may be rolled over for many days ahead, not just one day, or the daily roll-over may last for any length of time. When closing the position, the trader enters into a transaction with the opposite direction as the original transaction and with a settlement date corresponding to the maturing leg of the last swap transaction. In the previous long EUR/HUF example, the closing transaction would be a spot "sell" transaction. With this, the position is closed or "squared".

As we will see later, swap pricing is a function of money market interest rates, and therefore the presence of an efficiently priced, liquid money market is a prerequisite for the efficient roll-over of FX exposures. Since shorter maturities are the most liquid maturities in money markets, it is advisable to use the shorter-term FX swap market, especially for the roll-over of large positions. Given the uncertain timing of position termination, spot positions taken for speculative purposes are typically rolled over daily via short-term FX swaps.

Figure 4
Currency position rolled over with FX swaps



Forward rate formula

So far we considered the market quotations applied as given, and used them to gain insight into the mechanics of forward price formulation. The quotations, however, are not random. They are based on a formula that expresses the relationship between the spot and the forward markets and between the money markets of the two currencies involved. In other words, it expresses the forward rate as the function of the spot rate and the interest rates of the individual currencies.

$$F = S \times \frac{\left(1 + R_{HUF} \times \frac{ACT}{360}\right)}{\left(1 + R_{EUR} \times \frac{ACT}{360}\right)}$$

Notations used in the formula of the forward rate have the following meaning:

F = forward rate

S = spot rate

R = interest rate. The interest rate for the quoted currency is in the numerator, while the interest rate for the base currency is in the denominator. Interest rates always refer to annualized interest rates. If the transaction does not cover a full year, pro-rating will be performed.

ACT = the exact number of days between the spot and forward value dates (abbreviation of "actual", i.e. the actual difference).

360 = for short-term maturities, interest calculations reflect the so-called money market convention, which assumes that the year consists of 360 days.

Interest calculation conventions

Interest calculations may vary across various money and capital market instruments and across countries. Generally, the difference lies in how the number of days elapsed are considered for the calculation. To be able to compare two instruments and their returns, it is important to understand the conventions used in those particular markets.

ACT/360 "Actual/360": the interest calculation convention most frequently used in the US and European markets. In interest calculations, the number of actual days elapsed between the two interest payment are considered, and the year is assumed to be 360 days long. For example, consider that the annualized interest rate for a 3-month money mar-

	ket deposit (deposited from 12 June 2014 to 12 September 2014) with a nominal value of USD 1 million is 1 per cent. Upon maturity, the interest paid will be USD 2555.55, because the number of days that actually elapsed between the two value dates is 92 days.
ACT/365	"Actual/365": a market convention used in the British pound, Australian dollar and Canadian dollar money markets.
ACT/ACT	"Actual/Actual": a market convention used in most government bond markets, where the number of actual days is used both in the numerator and the denominator; for example, in a leap year ACT/366 will be used to calculate the pro-rata interest rate.
30/360	the method assumes that every month has 30 days.

Analysing the formula further, it is apparent that if the interest rate for the Hungarian forint is higher than the euro interest rate, the forward rate will be higher than the spot rate; that is, in such cases the base currency – in this case, the euro – is trading at a premium against the forint in the forward market. The reason is that if an investor has euros today that he sells against the forint in a forward contract, until the maturity of the contract – i.e. until the settlement of the forward conversion – he earns euro interest even though he has already sold his euro funds forward, and got rid of the currency risk involved. Similarly, he will start earning forint interest only after the conversion actually happens in the future.

Example 12: Forward rate calculation

If the 3-month interest rate for the forint is 2.30%, the 3-month interest rate for the euro is 0.20%, and the EUR/HUF spot rate is 309.60, how much is the current EUR/HUF forward rate? The length of the period is 90 days.

$$F = 309.60 \times \frac{1 + 0.023 \times \frac{90}{360}}{1 + 0.0020 \times \frac{90}{360}} = 309.60 \times \frac{1,00575}{1,0005} = 311.2246$$

As indicated before, in the interbank market forward rates are quoted in forward points. In this case, the forward point quote would be 162.46 (311.2246 – 309.60).

Given that a forex swap transaction is the combination of a spot and a forward transaction, the rate used in the forward leg of the transaction is calculated in accordance with the same method described above. So much so, that in market jargon the phrases "forward point" and "swap point" are used interchangeably as they basically refer to the same interest rate differential. A simplified version of the forward pricing formula gives a fairly good approximation of the forward rate.

$$F = S \times \left(1 + \left(R_{HUF} - R_{EUR}\right) \times \frac{ACT}{360}\right) = 309.60 \times \left(1 + \left(0.023 - 0.002\right) \times \frac{90}{360}\right) = 311.2254$$

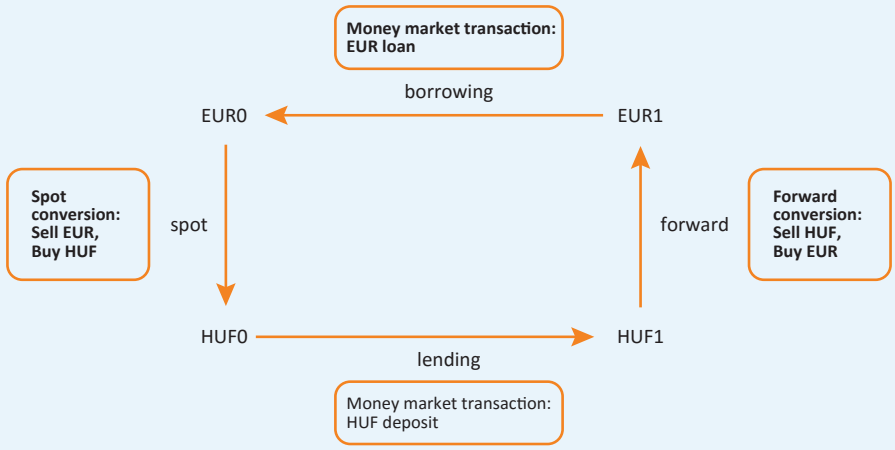
3.4 Interest rate parity

The forward pricing formula expresses a very clear relationship between the individual sub-markets. Spot and forward transactions are linked in time by the money markets. To put it slightly differently: the difference between the spot and forward rates, in essence, corresponds to the pro-rated interest rate differentials.

This link is the interest rate parity that is illustrated below in a two-dimensional chart. One dimension represents the conversion between the currencies, while the other dimension represents time. For easier understanding, trade dates and settlement dates are disregarded and today's transaction (present) is simply indicated by a zero and the future transaction (future) is indicated by

1. For example, EUR0 implies present euro, whereas EUR1 denotes a future euro and the arrow between the two points indicates the direction of the transaction. The transaction can be a foreign exchange market conversion (spot or forward, depending on when the transaction takes place in time) or a money market transaction (lending or borrowing).

Figure 5
Illustration of the interest rate parity



The formula used for the calculation of the forward rate describes the interest rate parity. In essence, this means that if each transaction in the "rectangle" is executed at the same moment in time, we would assume a risk-free position, because all uncertainty would be eliminated. Assuming efficient markets, making risk-free profit is impossible, because when mispricing occurs, active market participants execute the appropriate transactions to "steer" market prices (exchanges rates or interest rates in this case) towards their no-arbitrage levels and the interest rate parity is enforced.

What are these transactions? Our starting point will be EUR1, and the first transaction is a euro borrowing. There is always an intertemporal decision behind all money market transactions, which reflects whether we wish to consume today or in the future. If our preference is future consumption, we can invest the funds available now in order to use them for future consumption. Interbank deposits – one of the simplest investment vehicles – are a good

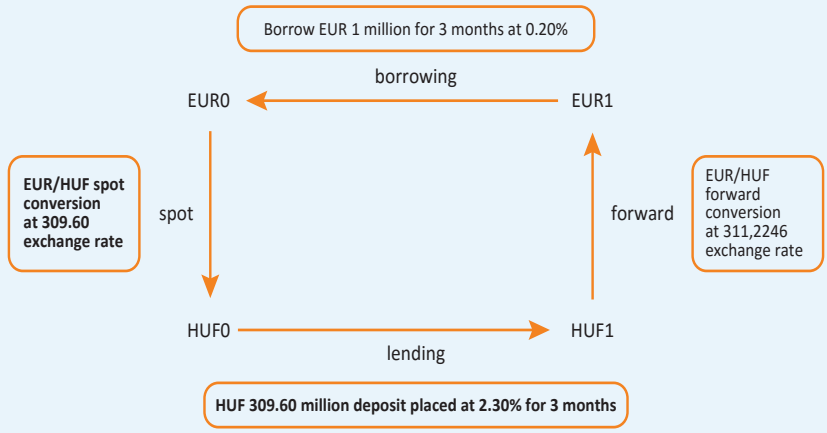
example to illustrate this concept. If we wish to consume in the present, but the required funds are not available, we can take out a loan (in an optimal case, covered by some future cash flow as collateral). In the interbank market, loan and deposit transactions are the equivalent of each other: when a bank places a deposit with another bank, essentially it provides a loan to the other bank. Borrowing, therefore, means the conversion of future money into present money. This is how we reach point EUR0 from point EUR1.

The second transaction is a spot conversion through which we reach point HUF0 from point EUR0, that is, we convert our present euros into present forints. The third transaction is placing a deposit, which takes us from point HUF0 to point HUF1. Finally, the fourth transaction is a forward contract, whereby we convert our future forints (HUF1) back to future euros (EUR1), with which we have returned to our starting point. It should be stressed again that all of these transactions are conducted simultaneously in the present.

Example 13: Interest rate parity

The example below uses the same data as shown in the calculation of the forward rate.

3-month (90-day) forint interest rate: 2.30%; 3-month (90-day) euro interest rate: 0.20%; EUR/HUF spot rate: 309.60; EUR/HUF forward rate: 311.2246.



We convert the EUR 1 million received under the loan contract at the spot exchange rate, and receive HUF 309.60 million. We then place the amount in a deposit at 2.30%, and in 3 months' time we receive HUF 311,380,200 (1 + 0.023 × (90/360)). Through a 3-month forward conversion executed today at today's forward rate – at 311.2246 – we convert this amount into roughly EUR 1,000,500 (more precisely, EUR 1,000,499.96).

There is only one transaction left: the repayment of the EUR loan. In 3-months' time we need to repay EUR 1,000,500 (1 + 0.023 × (90/360)), which is exactly identical to the amount derived from the forward conversion; therefore, we closed with a zero balance, which means that there were no market anomalies, and market pricing was in line with the no-arbitrage principle.

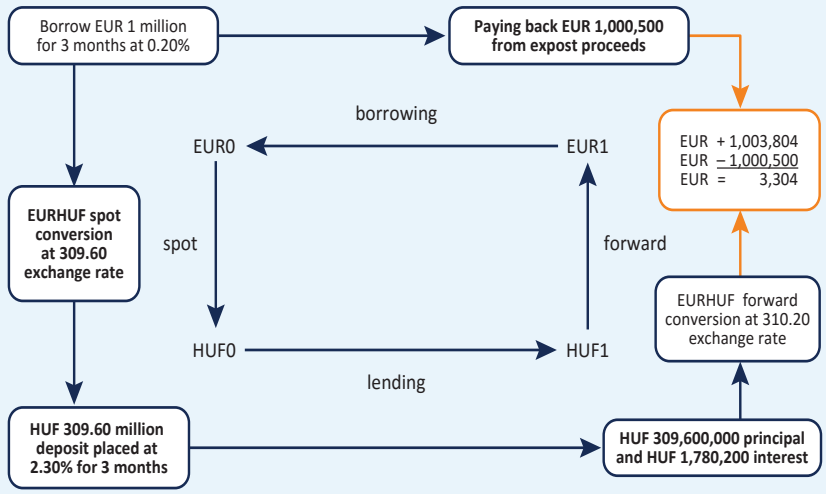
If market pricing diverges from the value calculated by the forward pricing formula – i.e. interest rate parity is not met – we may earn an arbitrage profit. Alternatively, we may rearrange the formula at our discretion and express any variable as a function of the other three variables. In general, we may conclude that – given the three parameters – a profit can be made if the fourth parameter is not equal to its value calculated from the formula.

Example 14: Arbitrage profit

Consider that the forward rate observed in the market does not match the rate calculated above: instead of 311.2246, it stands at 310.20, while all other parameters remain the same.

Executing the same transactions as before – EUR borrowing, spot conversion, HUF deposit and finally, forward conversion – will give us EUR 1,003,804 (311,380,200/310.20), which not only allows us to repay the 3-month loan (EUR 1,000,500 principal and interest) but also leaves us with a surplus of EUR 3,304.

This is pure, risk-free arbitrage profit, because we executed all four transactions today and now we only have to wait for the 3 months to pass.



One assumption behind the interest rate parity model is that the markets are frictionless. One example of such friction is that there are no transaction costs. Although this simplifying assumption helps to create the model and to understand the real world with it, the assumption is not true. We face transaction costs in the case of all four transactions. Indeed, the bid-ask spread may itself render the profitable exploitation of market anomalies impossible. This alone justifies a no-arbitrage band within which the exchange rate may diverge from its model-based "fair" value, and no market participant will profit from such a small discrepancy. In addition to trading costs, the execution of the transaction is subject to further charges, such as the fees charged for the use of certain market infrastructures during the settlement process (e.g. SWIFT network).

Another assumption is that nothing limits trading. With low creditworthiness, a market participant is unlikely to be able to play this arbitrage opportunity as he will have no access to a loan or he will face far higher lending rates than those prevailing in the interbank market.

As the saying goes, everything is worth what someone is willing to pay for it. The same is true for the pricing of forward transactions. The price fluctuates according to changes in supply and demand, and heightened demand for a particular currency may, in certain cases, permanently shift the forward price from the theoretical price derived from the interest rate parity formula.

3.5 Synthetic transactions

The no-arbitrage arguments are based on the premise that the same products should be traded at the same price; otherwise, investors would be presented with an opportunity for risk-free profit by purchasing the cheap and selling the expensive product. In order to illustrate interest rate parity better, the examples below are intentionally based on somewhat unrealistic assumptions.

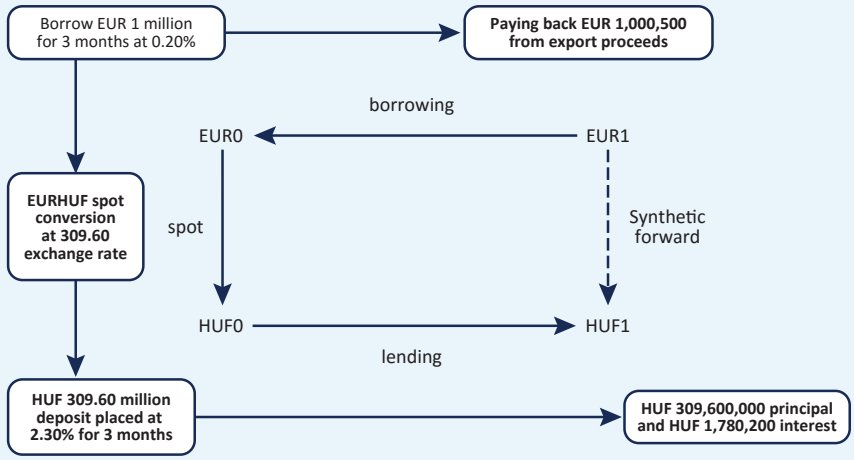
An export company expects EUR-denominated cash inflow in 3 months' time, and the company has no access to the forward market. Unable to enter into a forward contract to hedge its exchange rate risk, the export company needs to wait 3 months for the euros to arrive before converting the funds into forints at the then available exchange rate. That is, it cannot hedge the exchange risk directly. However, it might be possible to perform the hedge in an indirect way.

Selling the euros under a forward contract will generate future forints (HUF1) from future euros (EUR1). However, there is a way to get to point HUF1 from point EUR1 not only directly, but also indirectly, with a little "detour", by taking the EUR1–EUR0–HUF0–HUF1 route. In practice, this means that using the future euro cash flow as collateral the company may access euro liquidity by borrowing euros, then convert the euros into forints in the spot market, and finally place the HUF liquidity into a 3-month deposit. Once export revenues actually arrive on its account, the company repays the euro loan, and eventually it is left with the forints released from the maturing forint deposit, which is the same as if it had converted its revenues into forint 3 months earlier through a forward transaction.

Example 15: Euro sale via synthetic forward transaction

Using data of the previous example, consider that an exporter company expects a revenue of EUR 1,000,500 in 3 months. If the company takes out a loan of EUR 1 million at 0.20%, exchanges it in the spot market at 309.60 and then places a forint deposit at 2.30%, in 3 months' time – after having repaid principle and interest of the euro loan – all that remains is HUF 311,380,200.

It is exactly as if it had sold its EUR revenues at the 311.2246 forward rate, except the transaction was generated indirectly through a synthetic method, rather than directly.

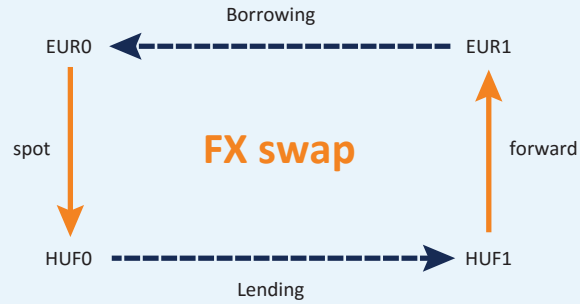


The exact same thing happened in the arbitrage profit example. The combination of an EUR loan, a spot conversion and a HUF deposit at the given rates and interests translate into a synthetic forward euro sale at a forward rate of 311.2246. By comparison, the forward rate prevailing in the market is 310.20, and the fourth transaction is an outright forward euro purchase (HUF sale) at this 310.20 rate. There are, therefore, two products (an outright and a synthetic forward conversion), which are the same in economic sense, but their prices are different. This allows the trader to exploit the arbitrage opportunity.

Any combination of the above transactions is possible. For example, if an economic agent is unable to open an FX deposit – and consequently, cannot reach EUR1 directly from EUR0 – he can generate a synthetic euro deposit as follows. In the spot market, he converts his existing euros into forints and simultaneously enters into a forward contract to hedge the exchange rate risk. In this way, he will know exactly how many euros he will have upon the expiry of the contracts and how much he earns in euro interest.

These imaginary scenarios are intended to serve better understanding. Any way we combine the transactions, we can always find supplements that can be used to close the "circle". The most important relationship that one must understand, however, is that an FX swap (which is a combination of a spot and a forward conversion) corresponds to a loan–deposit combination. This underpins that an FX swap, in essence, is about the interest rate differential between two currencies. An FX swap can be viewed as a loan in one currency versus a deposit in another currency while hedging the exchange rate risk.

Figure 6
FX swap = loan–deposit transaction



4 Trading strategies

As is the case with all investment decisions, when we take foreign exchange positions we follow a strategy or a method, in the course of which we process the available information and draw conclusions that culminate in undertaking a market exposure. Basically, we can distinguish between three model families or, if you like, approaches.

The approach of fundamental analysis seeks to determine the economic value of investments ("valuation"). The starting point of this typically model-based approach is that all instruments have a fair value, an equilibrium price, which is based on some economic relationship. If the market price of an instrument differs from this fundamental value, an investor may exploit this opportunity and earn a profit. Theoretically, this difference can exist in both directions: an instrument can be underpriced or overpriced relative to its equilibrium price. The objective is always the same: to buy underpriced assets and sell overpriced assets.

Obviously, the given economic relationship may not necessarily be stable, and as it can change over time, the existence of a relationship in the past is no guarantee for any future price movement. Moreover, we cannot be certain that the price will return to the assumed or calculated fair value over any time horizon.

Another approach is referred to as technical analysis. In technical analysis, investors attempt to develop profitable trading strategies by processing historic price and volume information.

Finally, the most popular approach is the "carry trade" strategy, whereby investors finance the purchase of high-yielding currencies from the sale of low-yielding currencies.

It should be noted that none of these approaches is the Holy Grail of forex trading. Moreover, investors seldom rely on a single approach or model. They tend to keep more than one iron in the fire when making an investment decision. The question really is how much qualitative, discretional room should be left for making the investment decision as opposed to relying on rule-based, quantitative methods.

Even in the case of the simplest investment strategies, taking a position typically does not occur in a vacuum, independently of the economic and market environment. There is always a given fundamental state in the context of which market prices are formulated: it is important to consider the current stage of the business cycle, underlying real economic activity, the objectives of economic policy, including monetary policy, etc. Carry trade – the interest advantage of a given currency against the others – may also assume a significant role, as a negative carry trade position is psychologically more difficult to hold. Technical analysis, in turn, may assist in calibrating entry/stop-loss levels, if nothing else, for the reason that owing to the large number of users, it may have a self-fulfilling effect. Finally, other considerations should also be taken into account, such as the current market positioning, interest expectations, etc.

4.1 Fundamental exchange rate analysis

Exchange rates reflect the actual and expected performance of the economies relative to each other. In the long run, fundamentals – i.e. potential economic growth, inflation environment, external and internal balances – determine the "worth" of the economy concerned. It is also obvious, however, that these factors and their direct effects on the exchange rate cannot be directly measured over the short term. Over a shorter time horizon, however, some factors such as strong capital flows, may divert the value of an asset from its fundamentally determined equilibrium level. And from a trading perspective, what really matters is to find which factors dominate over the investment horizon of the given investor.

In the theoretical literature, exchange rate developments are commonly described by the so-called random walk process, which postulates that past movements have no effect on future movements; i.e. it is impossible to predict the direction of the next movement. Random walk is a process similar to the motion of gas particles, where the particles bounce around in space, changing direction as they collide with each other and with the walls setting the boundaries of the space. Unfortunately, from a forecasting perspective this means that there is not much we can say about the future: the best forecast for a future exchange rate is always the current exchange rate.

That notwithstanding, numerous models have been constructed since the early 1980s for forecasting exchange rates. The objective of fundamental analysis is to calculate the correct, "fair" value or the "intrinsic" value of an investment. The starting hypothesis of the analysis is that the analyst preparing the forecast is able to identify the factors effecting the exchange rate, estimate the direction and magnitude of the effect, and predict changes in these factors.

In determining asset prices, fundamental analysis takes into account the relationships existing in the macro and micro environment and the demand/supply factors. This is also true for the models used for forecasting exchange rates with the proviso that examining the current state of the economy and the future developments in the economy as a whole requires the broadest possible scope of analysis. Macroeconomic analysis is focused on developments in economic growth, consumption and investment, the inflation rate, unemployment, the fiscal balance and the balance of payments.

The investment decision made on the basis of fundamental analysis, in turn, is based on two assumptions. First, the market price of an asset deviates from its "fair" or "intrinsic" value, i.e. there is an opportunity to exploit. Second, the price will eventually move back towards the fair value.

Purchasing power parity

One of the approaches applied in fundamental exchange rate analysis is the theory of purchasing power parity (PPP). Purchasing power parity measures a basket of goods and services that can be purchased in a given currency compared to another currency, taking into account the price differences across countries. Whatever currency is used to express the price of a product, in principle we should be able to buy the same amount of products for the same amount of money.

According to the theory, a currency with a higher price level, higher inflation rate or higher expected inflation rate devalues in the long run. In essence, this theory links the return of the nominal exchange rate (absolute PPP) and the real exchange rate (relative PPP) to its equilibrium level to the flows associated with tradable goods and services.

There are numerous assumptions behind the theory that prevent equalisation through exchange rate movements from taking place in practice. One such assumption suggests that the goods and services can be traded. Unfortunately, this is not the case for some services (e.g. haircuts), and even in the case of products, some factors – e.g. the shelf-life of a product – represent a strong constraint. Moreover, even if a given product can be traded, there is no guarantee that the products compared are completely identical once factors are taken into account (quality, shipping parameters, prestige value, affiliated services, etc.).

Transportation costs and the existence of trading restrictions are the largest constraints. The purchasing power parity theory can only hold true if there are no trading costs and administrative restrictions (quotas, customs duties). In reality, however, these market imperfections are present in almost all markets.

It is an additional problem that non-tradable goods and services are used during the production of almost all products. Suffice it to refer to the cost of labour, which exhibits vast differences across countries. Finally, similarly to other theories, another basic assumption is that the participants are perfectly well informed. In other words, all participants have access to a complete set of information, which, obviously, is seldom the case in practice.

Big Mac index

Computed and published by the Economist, the Big Mac Index is a practical approach to purchasing power parity, designed to make the theory more "digestible". The index takes its name from the Big Mac, a hamburger sold at McDonald's restaurants, and serves as a light-hearted guide to the theory of purchasing power parity.

According to the purchasing power parity theory, a basket of the same goods and services should cost the same across countries. At least in theory, in the long run exchange rates should move towards the level that would equalise the prices of identical baskets. In this case, the "basket" in question is a Big Mac burger, a standard product sold all over the world subject to a series of

common qualitative and quantitative criteria, while most of its ingredients are purchased locally (grain, meat, labour, energy, marketing).

The calculation of the index is extremely simple: the index is obtained by dividing the price of a Big Mac in one country by the price of a Big Mac in another country. This value is then compared to the actual exchange rate. The difference expresses the relative under- or overvaluation of the two currencies.

Of course, the Big Mac Index is also based on numerous simplifying assumptions. It disregards such factors as the social status of eating at fast-food restaurants such as McDonald's, and hence, the potential pricing strategy of the franchise, the level of competition in the local market, or the local taxes imposed on the sandwiches in the countries concerned. Moreover, the theory of purchasing power parity addresses only tradable goods and services, while there is no theoretical basis to assume that the same relationship also applies to non-tradable goods and services. In the latter case, relative costs are also influenced by capacity constraints or consumers' willingness to pay.

Alternative indices attempting to capture the issue from a different angle have also emerged, including the Tall Latte Index (Starbucks), the iPod Index (Apple) or the Billy Index (Ikea). Despite their individual deficiencies, all of the indices seek an answer to the same theoretical question. As any other model, these indices also rely on simplifying assumptions to capture an otherwise complex reality.

Practical considerations

Whichever theoretical model is used to forecast exchange rates, above and beyond the constraints of the model we also need to face an important practical problem. The forecast horizon of the model and our own investment horizon may significantly differ from one another; consequently, exchange rate movements observed over the investment horizon may well be the opposite of those indicated by the model.

In this respect, it is irrelevant what causes the exchange rate to move. The question is whether we have enough capital to hold on to the position, even if it is making a loss at some point in time. To quote John Maynard Keynes:

"Markets can remain irrational longer than you can remain solvent". In other words, markets can defy rational expectations longer than investors can maintain their solvency. There are also other issues to consider, for example what can be considered long-term, across what time horizon we expect to be "proved right", and whether markets will behave in accordance with the assumed fundamental relationship. To quote Keynes once again, "In the long run we are all dead". It has been especially true in recent years that trading has become limited to far shorter horizons.

It is possible to prepare fundamental analyses for the next 5–10 years. Moreover, it takes even longer for demographic effects to take hold. But there are very few investors who can assume such an extremely long time horizon. Investors primarily monitor the short-term effects of macroeconomic news and events. The publication of some important economic data does not prompt in-depth analyses; what matters first and foremost is whether the result is better or worse than current expectations.

Economic data

Economic or macroeconomic indicators are in essence statistical data that provide information about the current state of an economy. The data cover various areas (e.g. industry, labour market, trade) and various parameters (e.g. growth, inflation, budget) of the economy. The indicators are released at regular intervals, typically on a monthly basis or, in certain cases (e.g. GDP growth) quarterly. The exact time and date of the publication is generally known in advance, allowing market participants ample time for preparation to develop their preliminary expectations and trading strategies before the data are publicly disclosed. Of course, some indicators are more important and more closely monitored than others, and precisely because of this heightened interest and the greater market activity entailed, such information can trigger stronger volatility in prices.

Without a thorough understanding of the main indicators, fundamental analysis – the forecasting of exchange rate movements – is inconceivable. Firstly, investors must be able to identify the factors influencing the given exchange rate and the direction and strength of the effect exerted by

individual factors on the exchange rate and on one another. Moreover, they need to determine how durable the observed relationship is at any given moment, and whether the direction and strength of the effect change over time.

In developing their trading strategy, they also need to consider how long it takes for that factor to assert its effect on market pricing. Fundamental indicators typically provide medium-term guidance to exchange rate trends and movements, but these effects can be altered by countless factors over the short term, diverting the exchange rate from its theoretical, "fair" level.

Economic indicators can be classified into several different categories. In the first group, we distinguish between procyclical, countercyclical and acyclical indicators based on the direction of the relationship with the fluctuation of growth rates. Procyclical economic indicators move in the same direction as the changes in economic activity (e.g. wage costs), while countercyclical indicators move in the opposite direction (e.g. unemployment). In the case of acyclical indicators, there is no real relationship; therefore, it is difficult to use them for forecasting.

From a temporal point of view, we distinguish between leading, coincident and lagging indicators, depending on whether the change in the indicator precedes, moves in tandem with or responds with a lag to changes in the time series (e.g. economic growth) under review.

Note that monitoring and analysing any data will only make sense if the data are made available at the appropriate time in adequate quality and the information reliably reflect the economic developments. In this regard, the economic statistics of developed countries perform the best both in terms of quality and quantity. Data available in emerging economies are often less reliable and less extensive, as the countries' reporting system and reporting culture is less developed. In the following, we enumerate the key economic indicators monitored by markets.

Fiscal and monetary policy

Of course, markets closely monitor the behaviour of the government as an economic agent both in terms of its current and intended actions. Taxation and fiscal matters fall within the competence of fiscal policy. Taxation, on the one hand, fundamentally determines the disposable income of individual economic actors and, on the other hand, can influence economic growth through fiscal expenditures. Fiscal deficits must be financed, and changes in the demand and supply of government securities affect interest rates. The latter, in turn, influences the demand and supply of the given currency.

In analysing changes in the tax regime, special attention should be paid to the extent to which the given change deteriorates the budget balance and to over what time horizon this deterioration happens. Markets often "brush off" short-term modifications and ad-hoc stimulus programmes if the economic policy is otherwise deemed credible. Even a deteriorating budget balance – which, by textbook definition, would imply economic policy and economic weakness – can be assessed positively due to its expansionary effect on the economy.

The impact mechanism of monetary policy is even more direct. Formulation of interest rate policy and exchange rate policy falls within the competence of central banks. Exchange rates are shaped directly by exchange rate policy and indirectly by interest rate policy through its impact on the price (time value) of money. Central banks are the most influential participants in the market, and markets closely monitor the responses of central banks, and attempt to understand and gauge central banks' intentions and potential changes in interest rate and exchange rate policies.

In order to improve the efficiency of monetary policy, central banks also pay a great deal of attention to make the markets understand their intentions. Today, central banks transparently publish their own inflation and growth forecasts. As central banks have more information than market participants, their forecasts and explanations (press release) are at the centre of attention, especially if there are significant adjustments in the forecast. In addition, most central banks publish the minutes of the meetings of highest decision making

bodies, which provide further information to help the public understand the thinking of policy makers and the dynamics of changes in opinions.

Monetary policy is even more transparent when central banks provide a forward guidance with respect to the future path of interest rates. In professional terminology, it is called a "bias" (skewness, asymmetry) when the central bank gives an indication about the interest rate cycle, communicates about the start or the continuation of monetary accommodation ("easing bias") or, conversely, hints about the prospects of stricter monetary conditions ("tightening bias"). In certain cases, it also publishes its forecast on the interest rate path.

Finally, central banks may even commit themselves to a given level of interest rates, thereby influencing the yield curve and, through the price of money, the exchange rate. There are open-ended commitments, when the central bank does not specify how long it wishes to maintain a certain level of interest rates, but instead merely indicates that the rate will be maintained until appropriate (or, as expressed by the Fed, for an "extended period of time") to anchor expectations at least in the front end of the yield curve. Of course, it is also possible that the central bank specifies the exact timeframe of its commitment (e.g. 2 years), or it provides a state-contingent forward guidance, when the commitment to maintain the key policy rate or the use of any other monetary policy instrument is conditional upon changes in a third variable (inflation, unemployment).

"Flow"

The fundamental factors and indicators discussed above primarily affect exchange rates in the long run. However, some factors exert effects in the short term, which should be considered even by investors with a longer time horizon, as the factors in question may significantly divert the exchange rates from their equilibrium value, which otherwise primarily depends on fundamentals.

Short-run factors gain importance by their ability to trigger fund flows. We may draw conclusions about future exchange rate movements by analysing the statistics of cross-border flow of funds (e.g. capital flows). Equity investment

flows – that are typically not hedged by investors and thus affect the exchange rate directly – are particularly important. Monitoring the risk appetite of equity investors and the flows generated by them may assist in fine-tuning forecast and formulating a trading strategy.

Similarly, any event that results in currency conversion should be subject to analysis. It might even be a signal deriving from technical analysis if it triggers an intention to trade among a sufficiently large number of investors, as this may temporarily upset the supply/demand equilibrium. Of course, this "temporary" period may span a few hours or even months. A surge in risk appetite or the incorrect assessment of risks may launch a wave that may set in motion long-lasting exchange rate changes and later of course an adjustment. Naturally, the magnitude of the resulting exchange rate volatility depends on the size of the positions that are built up and then unwound in the market.

"Monitoring" positions, of course, is hampered by obstacles in OTC markets. Market maker banks can observe the behaviour of their own clients, but this has limited information content as the market as a whole may behave completely differently. In the case of stock exchange contracts, a more precise view can be obtained of the currency pairs in which significant positions are being built. However, this covers only a part of the market, and the extent to which the observed behaviour is representative of the market as a whole is still questionable.

Political events

Of the factors triggering price movements, political events are perhaps the strongest, but almost certainly the least predictable, variable. It is very seldom that a social change, which may, under certain circumstances, induce the transformation of an entire political regime, emerges in a predictable manner so that market participants can be thoroughly prepared. By definition, this includes unexpected events that demand a speedy response on the part of currency traders. In such cases, there is no time to deliberate or to prepare in-depth analyses: responses are typically "gut reactions". In addition, because of the rapid and unidirectional flow of capital, markets may quickly "dry up", i.e. liquidity decreases. On the one hand, tradable volumes decline, while on the other hand, bid-ask spreads (transaction costs) widen.

4.2 Technical analysis

Technical analysis ("charting") is the analysis of the statistical characteristics of the historical price movements of a financial instrument (e.g. price, turnover). As opposed to fundamental analysis, instead of attempting to gauge the fair value of a financial instrument, technical analysis searches for market circumstances (patterns, trends) that may facilitate the prediction of future price movements with a high degree of probability. The approach is based on the assumption that the effect of all external factors – including fundamental and psychological factors – feed into price movements, and therefore their direct analysis is useless. It is enough to concentrate on the price dynamics.

Technical analysis dates back centuries. It was applied in Dutch commodity markets as early as the 17th century. The most famous early user – and, as some sources claim, the inventor – of the approach was Homma Munehisa, descendant of a rich Japanese rice grower family. Homma made observations on rice futures prices and the various patterns formed by the prices, and used his observations for predicting future prices. His name is associated with the Japanese candlestick chart type.

The father of modern technical analysis is Charles Dow, whose theories inspired generations of analysts at the turn of the 19th–20th centuries. However, it was the information technology revolution that gave real momentum to technical analysis. As numerous analysis techniques are extremely calculation-intensive, thanks to the development of information technology, analyses could be run on extremely short time series, even on tick-by-tick data.

Technical analysis can also be considered as an independent "science". Some funds rely on technical analysis exclusively for analysing stock exchange prices and ultimately, to support trading decisions and take positions. Most frequently, however, it supplements fundamental analysis in determining target or stop-loss and take-profit levels. If a sufficiently large number of people believe in something, it may become a self-fulfilling prophecy. Therefore, even investors whose preferred method is fundamental analysis should not forget that under certain circumstances, flows triggered by technical analysis move the market.

Principles of technical analysis

Technical analysis is based on three key principles.

1. *Market prices reflect all available information.* According to this approach, the market prices in all global events (economic data, political events, natural disasters, etc.) and all relevant information. The essence of technical analysis is that whatever impact these have, their impact can be observed through changes in market prices. It is unnecessary to understand the impact mechanisms and causal relationships, it is entirely sufficient to observe the price development itself.

2. *Prices move in trends.* Price movements always follow a certain trend (uptrend, downtrend, sideways trend or ranging). Prices generally follow long-term trends but, on the one hand, even these main trends can change from time to time (trend reversal) and, on the other hand, prices move in trends even within long-term trends (short-term trends). According to the market adage, "Trend is your friend".

3. *History repeats itself.* Technical analysis examines recurring chart patterns. The patterns reflect the behaviour and thought process of market participants, i.e. they capture market players' reactions to various market events. Investors tend to react in a similar way to similar events. Indeed, they usually repeat the mistakes of their predecessors.

In addition to – and supplementing the – patterns, technical analysis uses various indicators to determine what kind of trend asset prices are moving on and what the probability of the trend's continuation or reversal is. Most of these indicators are mathematical transformations of price and volume information.

Market participants often turn to technical analysis as a supplement to fundamental analysis. If there are enough participants using a certain tool, the signal provided by the tool may well function as a self-fulfilling prophecy. Due to the presence of subjective elements in the analysis, it remained a marginal area of academic research; it is therefore difficult to assess the utility of the method with any degree of certainty.

Chart types

Charts are used to illustrate asset price developments. Technical analysis can be scaled in terms of presentation, analysis and forecast. This means that it does not matter how long a time horizon is covered by the presented price developments or into how small units we break down the given time period. It could be a time period of 10 years based on monthly data or a time period of 2 hours based on tick-by-tick data. The scaling used is determined by the objective of the analysis. Typically daily data are used, but a trader who takes intraday positions and wants to forecast what will happen in the market in the next half hour obviously works with shorter periods, even minutes or seconds.

Line chart

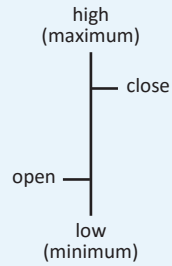
Line charts are the simplest charts used in technical analysis, plotting price developments by connecting closing prices. It easily visualises the direction, the trading band and the highest and lowest levels reached during the period displayed. However, the only information is the closing price, which is not necessarily the most representative data of the given trading period (in this case, the day). The minimum and maximum levels, obviously, only describe the highest and lowest closing prices; thus the line chart fails to glean information on the range of price movements during the days.

Bar chart

Bar charts contain more information than the simple line chart: it displays the opening price, the closing price and the daily highest and lowest prices as well. The relative position of the bars representing the opening and closing prices (left-hand bar and right-hand bar) clearly indicates the direction of price movements (upward, downward) during the given period. Note that in the case of markets that have pre-specified opening hours (i.e. they are not open 24/7, like stock exchanges) the opening price does not necessarily coincide with the closing price of the previous trading day, as asset prices may have been affected by events taking place after business hours that resulted in a price movement by the next morning. Moreover, this chart does not reveal everything about daily price dynamics either as it does not reveal the pace

with which prices moved during the day. Nor does it reveal what caused the actual price move (e.g. data publications).

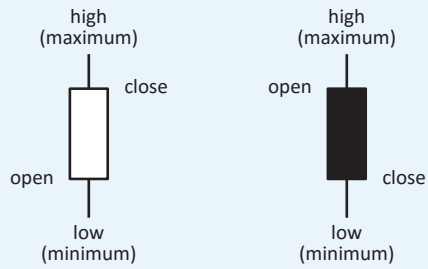
Figure 7
Bar chart



Japanese Candlestick chart

The Japanese Candlestick chart type displays similar information as the bar chart described above: opening, closing, highest and lowest prices. However, rising or falling prices are shown by the body of the candlestick, the size of which is determined by the opening and closing prices, and which can be hollow or filled (and usually coded by the colours of white or black, respectively). The wick indicates the range of price movements outside of the body, that is the lowest and highest prices of the time period in question.

Figure 8
Japanese Candlestick chart



Trends

After visualising the prices, analysts can start examining the trends in which prices move, and make predictions about future price movements. When changes in prices point to a direction, we talk about a trend. There are uptrends and downtrends, but analysts also distinguish market trading in a range (also called flat or sideways markets).

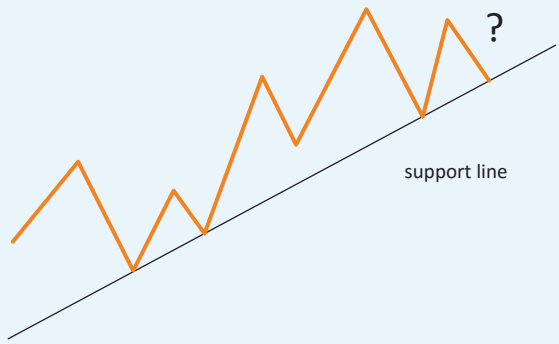
The trend with higher highs and higher lows is called an uptrend. The downtrend is the exact opposite (local troughs and peaks take increasingly lower values). Range trading takes place when no straightforward trend emerges.

Trendlines

After determining that there is a trend, trendlines can be constructed in the price chart, and the trendlines can be used for forecasting prices. According to one of the key principles of technical analysis, prices move in trends. Therefore, once we are capable of identifying a trend, we can use it for making our trading decision.

In the case of an uptrend, for example, we obtain the "support line" by connecting at least two lows (troughs). The support line provides support to the market, therefore – since history repeats itself – next time around the price hits the support line, prices will not fall below that line and the upward trend continues. It should be noted that, from a technical point of view, it is irrelevant what it was that halted the fall in prices in the past or where the demand was "coming" from that finally pushed the prices further upwards – the only thing that matters is that this has already taken place in the past. Technical analysis merely focuses on the price information itself and disregards all fundamental considerations.

Figure 9
Support line in an uptrend



Similar to the support line, there are also resistance lines, which indicate the point at which the rise in prices halted for whatever reason. Again, it is totally irrelevant what fundamental event or factor triggered the additional supply. What matters is that the price increases turned back at the resistance level in the past and we can expect the recurrence of this pattern in the future.

Figure 10
Resistance line

Buy and sell signals

As technical analysis became more sophisticated, a broad range of patterns was observed and used for forecasting. In all cases, the objective is to determine whether the given trend will continue or a trend reversal will occur. To put it simply, analysts attempt to identify trading signals based on which they can take potentially profitable positions. Naturally, these signals are either buy signals or sell signals.

Approaching a support line, for example, is a buy signal as that point marks the appearance of additional demand that previously lifted the price from the support line. For example, this may signal the end of an uptrend when the descent of the price came to a halt. The market may have attempted to break through the line, but failed due to the appearance of surplus demand. Similarly, approaching the resistance line entails a sell signal.

The more often an event occurred in the past, the stronger the signal is, if we expect the recurrence of the same event. For example, when the price has "bounced back" twice from a given support or resistance level already, we talk about a "double bottom" or a "double top".

4.3 Carry strategy

Carry trade is perhaps the most important driver of capital markets. The strategy is reasonably simple: investors purchase a currency or currencies that pay high interest rates (long position) and finance the purchase by selling a currency or currencies with low interest rates (short position). Needless to say, the investor earns the higher interest and pays the lower interest, and the only goal is to capture the interest rate differential. Meanwhile, the investor runs the exchange rate risk and the net profit and loss outcome of the exposure largely depends on the exchange rate developments over the investment horizon.

This strategy is not only applied in foreign exchange markets, because "carry" is an important return component in all asset classes. The total return of an asset typically consists of two components: a regular income – such as dividends for equities or rental income for real estate – and the price change of the asset (appreciation or depreciation). In the foreign exchange market, the regular income component is the interest or more precisely, the interest rate differential, as the investor earns interest on one element of the currency pair (on the long side) and pays interest on the other (on the short side). The latter can be viewed as the financing cost of the position.

Of course, carry can be both positive and negative, but the carry trade strategy should be essentially understood as a positive carry position taken by an investor. In this case, if the exchange rate remains unchanged, if you wish

"nothing happens", the carry still continuously "works" for investors holding a long position. The goal is to identify assets – or, in forex markets, currency pairs – whose expected future price movement does not offset – or wipe out – the existing carry advantage.

Although carry trade strategies are highly popular, they are not justified by any economic theory. On the one hand, the return on assets varies from country to country, and in theory we may assume that this difference reflects the differences in risks in the long run. So there might be a difference between the nominal interest rates, but not between the risk-adjusted rates. In the case of currencies, for example, higher interest rates might reflect a higher expected rate of inflation, which in principle shall lead to the devaluation of the currency of the higher inflation economy.

According to the theory of so-called uncovered interest rate parity, the expected change in the exchange rate is equal to the interest rate differential between the two currencies. This means that the currency with the higher interest rate should devalue in the long run. And – according to the theory – the degree of devaluation will be identical to the interest rate differential. If the conditions for the uncovered interest rate parity are met, then it is not worth to buy a currency with a high interest rate and sell a currency with a low interest rate, because what one gains on the higher interest, one will loose on the exchange rate devaluation.

Theory and practice are, however, often as far from each other as they can get, especially in the short run. Higher interest rates generally imply higher risk, but equalisation usually takes a long time, often years, to occur. In the meantime, investors try to arbitrage the interest rate differential. Of course, there is no free lunch, i.e. no arbitrage opportunity of risk-free profit, but investors' behaviour is not necessarily rational in a market environment.

The carry trade strategy exploits precisely the fact that the conditions for pure uncovered interest rate parity are not in place in the short run. In other words, a higher yielding currency will not exhibit the devaluation implied by the interest rate differential between the currencies.

Essentially, there are two important fundamental factors in practice that may significantly increase the value of a currency, along with the demand for it. One of them is economic growth, which generally leads to large capital inflows, which continuously drive up the exchange rate. The other is a high interest rate, which can also attract capital and induce continuous demand for a given currency. This continuous demand ensures trend-like appreciation of the currency with the higher interest rate, despite the theoretical considerations.

There are several explanations that may explain how it is possible for a theoretically unprofitable strategy to nevertheless be profitable. Prices are moved by different factors and countless participants enter the market with various motivations and different investment objectives. These factors affect prices continuously and since these effects have time-varying dynamics and strengths, the prices observed in reality may diverge from the theoretical price from time to time.

Although the strategy is profitable, it is clearly not risk-free, and the downside risks involved must be continuously addressed in relation to market volatility, valuation levels, positioning and liquidity conditions. The carry advantage must be adjusted for risk, and one must keep in mind that the relationship between previously stable currency pairs may change and investors may face unprecedented swings. Substantial positions may build up that may call into question the possibility of simultaneous exit at any given level of market liquidity.

Carry positions build up and wind down through typical cycles. Initially, a slow build-up of positions can be observed. In this early stage, the volume of the total speculative positions is fairly small compared to the size of the market. In addition, thanks to prudent and gradual approach, taking the exposure is a fairly easy exercise for any participant. However, owing to the continuous flow, the exchange rate of the currency pair is subject to a continuous, albeit not too strong, appreciation pressure. The strategy seems very successful at this stage as investors earn the positive carry along the price appreciation. Further down the line, as the success of the strategy procyclically attracts more and more capital inflows, a gradual portfolio realignment takes place, and a persistent trend emerges in the market. This is a positive feedback loop.

As the size of the total positioning grows, the market becomes more and more vulnerable. If anything changes in such an environment – whether it is an economic policy measure or a natural disaster – it will affect the risk appetite and/or risk-taking capacity of all investors and everyone may rush to close their positions at the same time. At this point, however, the liquidity of the market will be insufficient to support this exit, which triggers a rapid and significant price adjustment.

Dollar/yen carry trade

One of the greatest – or at least, most memorable – exchange rate movements in the history of modern foreign exchange markets was exhibited by the dollar/yen cross rate in October 1998. In the span of a few days, the dollar/yen exchange rate plummeted by around 15 per cent. On 2 October the exchange rate closed the week at 135.50, and it finished trading at 116.65 on the next Friday.

That year was a prime example for the gradual build-up of carry trade positions followed by hasty exits. Masses of investors took long dollar and short yen positions in the hope of simply earning the interest rate differential between the dollar and the yen. This trading strategy was also supported by the exchange rate policy of the Bank of Japan, which indicated several times in the course of 1996–1997 that it wished to see a weaker yen.

As regards the interest rate differential, up until the end of September the Fed funds rate stood at 5.50 per cent, while the Japanese policy rate was 0.50 per cent. Therefore, this 5 percentage point difference could be earned by using the long dollar, short yen strategy, typically rolled over across short maturities.

Of course, since there is no free lunch, investors in return assumed the dollar/yen exchange rate risk. Since the dollar continuously strengthened (and the yen weakened), the positions performed extremely well until the end of the summer. Both components of the total return were positive: the interest rate differential was in favour of the US dollar and the US dollar appreciated gradually.

Figure 11
Dollar/yen exchange rate in 1998

Source: Bloomberg

When the exchange rate broke through 140 yen, the Japanese authorities started to voice concerns that the yen had now became too weak. Although this was only verbal intervention, it signalled a radical break with the exchange rate policy of previous years. Next, the Federal Reserve cut the Fed funds rate twice in a row, once at the end of September and shortly afterwards in mid-October.

An interest rate differential of 4.50 percentage points was still significant in itself. But the prospect of a potential further decline in the differential, and the recognition that the central banks deemed the exchange rate movement excessive – which could have led to a concerted market intervention – spurred investors to downsize or close their positions. The problem was that, while it took months for the positions to build up, and even that exerted a significant exchange rate effect, a large number of investors scrambled to exit their positions within a relatively brief period at the beginning of October. The "door was to narrow" for the crowd to get out, and in the span of a few days, the market saw a significant depreciation of the dollar with a parallel strengthening of the yen.

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