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The role of currency swaps in the domestic banking system and the functioning of the swap market during the crisis

MAGYAR NEMZETI BANK

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The views expressed here are those of the authors and do not necessarily reflect the official view of the central bank of Hungary (Magyar Nemzeti Bank).

Contents

Abstract

The basic purpose of this study is to didactically demonstrate the factors shaping the currency swap stock of domestic banks prior to the crisis and to provide a descriptive analysis of how the structure and the functioning of the market changed during the crisis.

The main conclusions of the study are as follows. In addition to the wide ranging applicability of the transaction, the rise in the currency swap stock of domestic credit institutions is also attributable to macroeconomic factors. The bulk of the exchange rate risk resulting from the high external borrowing requirement and rising external debt was carried by the domestic private sector, while the foreign sector shared a decreasing portion of the risk. The rapid increase in the swap stock was also due to the fact that the synthetic production of foreign currency funds with currency swaps was often more successful than the direct inflow of foreign currency funds. On the basis of the decomposition of the domestic banking system's on-balance sheet foreign currency position, we can state that it increased mainly as a result of items that also increased the balance sheet total.

Following the outbreak of the global financial crisis in the autumn of 2008, the conditions for ensuring foreign currency liquidity deteriorated significantly, which had a substantial effect on implied forint yields, and the turnover and structure of the swap market. While the total average turnover of the domestic FX swap market did not drop radically when the crisis was spreading, market liquidity did decline significantly for a few days and access to foreign currency liquidity became limited. The active role assumed by parent banks and shortening maturities contributed to moderating the decline in turnover. Anecdotal information relating to the tightening of counterparty limits vis-à-vis domestic banks is supported by the decline in the number of non-resident counterparties.

The crisis also contributed to changes in the structure of the swap stock. The average remaining maturity of the gross stock began to decline directly after the Lehman bankruptcy, at the time of global dollar liquidity problems, followed by a rise starting from early 2009, principally owing to transactions concluded with parent banks. Domestic subsidiary banks managed to increase maturity primarily through cross-currency swap transactions concluded with intra-group counterparties, but non-group counterparties also concluded transactions with longer maturity with domestic banks.

JEL: E44, F31, F32, F34.
Keywords: FX swap, currency swap, foreign currency based loan, crisis, counterparty limit, margin call, liquidity requirement.

Introduction

Analysis of the currency swap market is of key relevance in terms of financial stability and monetary policy. First, currency swap transactions play an important role in providing the domestic banking system with access to foreign currency liquidity and the closing of its on-balance sheet open foreign currency position: these transactions enable the swap of the currency of liabilities and assets (synthetic production of foreign currency liabilities and assets). Second, it is important to monitor trends on the FX swap market in terms of monetary policy, as foreign participants frequently use FX swap transactions to take up forward positions and cover their exchange rate exposure resulting from the holding of forint assets. Thus, important information can be obtained from the development of outstanding amounts and implied FX swap yields in relation to strategies adopted by foreign participants, and indirectly, their exchange rate expectations and yield spread expectations.

The currency swap market played a key role during the turbulence of 2008 following the bankruptcy of Lehman. The international financial market turmoil emerging from the second half of 2007 spilled over onto the market of currency swap transactions as well. The anomalies underlying the operation of the currency swap market posed major risks in terms of the stability of the banking system and the macroeconomy. Liquidity risks increased with the growing difficulty of foreign currency financing through currency swap transactions. First, due to the severe disruptions on the market, there was the risk that market participants would be forced to purchase foreign currency necessary for fulfilling their obligations on the currency spot market, and this process would lead the substantial weakening of the forint exchange rate and the opening of the total foreign exchange position of the banking system. This latter adverse scenario did not materialise. In September-October 2008, although the forint exchange rate weakened significantly, the swap stock increased in parallel with the opening of the on-balance sheet foreign currency position of the domestic banking system. The effect of swap market disruptions on domestic banks over the short term was mostly reflected by high spreads and short maturities, a rise in the ratio of parent bank transactions and higher counterparty concentration. Over the medium term, particularly from the spring of 2009, the effects of the crisis materialised through the on-balance sheet adjustments of domestic banks in the form of reduced swap exposure and the limiting of new net lending.

The basic purpose of the study is, first, to provide a didactic description of how and what factors determined the currency swaps of domestic banks, and second, to present a descriptive analysis of how the structure and operation of the market changed during the crisis. In relation to this, we place emphasis on the following issues.

- What motivates certain participants (domestic banks, foreign banks) to use currency swaps? How are strategies linked to currency swaps interrelated?

- What macroeconomic factors contributed to changes in the swap stock?

- Why were cross-border foreign currency loans not directly borrowed in place of the synthetic production of foreign currency funds with currency swaps as well?

- Which segments of the currency swap market underwent long-term changes as a result of the crisis?

- Can information relating to the contraction of counterparty limits in the post-Lehman period be proved? Was the effect of "margining" caused by counterparty risks significant on the rise in the swap stock?

- Did the internal structure of the swap stock undergo major changes in terms of financial stability?

The *first chapter* of the study describes the basic characteristics, possible application of the FX swap transaction and its form in the stylised balance sheet of banks. The *second chapter* focuses on the macroeconomic background of the increase in currency swap transactions, the *third chapter* discusses the factors determining the swap demand of the domestic banking system and their connection with strategies adopted by foreign participants, and the *fourth chapter* presents the operational disruption (supply factors) on the FX swap market during the crisis. In the *fifth chapter,* we analyse the effect of the crisis and the accompanying fluctuations of the forint exchange rate on the risk management practice and the liquidity situation of domestic banks, while the *sixth chapter* focuses on their impact on the swap stock at banking system level and its internal structure.

1 Characteristics and applications of the FX swap transaction

1.1 DESCRIPTION OF THE FX SWAP TRANSACTION

An FX swap transaction may be classified among foreign currency market transactions, as it practically corresponds to the swap of cash flows denominated in different currencies. In the framework of the transaction, the parties agree to swap the currency they hold (at time T_0) with another currency at a spot exchange rate and swap it back at a later date (T_1), at a forward exchange rate that also involves the prevailing yield spread (Table 1).[1] Thus, the FX swap consists of a spot currency sale-purchase transaction (spot leg) and a forward transaction (forward leg): after settlement of the spot leg, the counterparty risk of the transaction equals that of the forward transaction.

Table 1

Cash flows of the FX swap transaction in the original currency

(foreign currency purchase in the spot leg, HUF purchase in the forward leg)

	Deal date	Maturity
FOREIGN CURRENCY	+1	−1
FORINT	$−S_0$	F

Note: S_0 indicates the spot exchange rate at the time of conclusion, while F indicates the forward exchange rate at the time of conclusion.

The FX swap transaction can be understood as borrowing in one currency, with concurrent depositing in the other currency, where the receivable arising in one currency serves as collateral for the liability outstanding in the other currency. Thus, the advantage of the FX swap over an uncovered interbank transaction (deposit) is that – due to the very nature of the transaction – it is covered, and therefore the limits of market participants vis-à-vis each other in relation to FX swaps are wider in the normal operation of markets than counterparty limits relating to traditional, uncovered interbank lending.[2] In general terms, the FX swap is not a financing instrument, but a derivative product enabling the swap of the currency of a given financing instrument (e.g. credit, deposit); it therefore carries a lower credit risk than uncovered interbank lending.

The spot leg of the FX swap transaction affects the *on-balance sheet* items of domestic banks, and in parallel, the forward leg of the transaction at the time of conclusion appears as an *off-balance sheet* item; thus the whole foreign currency position of the bank (balance sheet+off-balance sheet) remains closed as a result of the transaction (Chart 1). In the spot leg, for a transaction resulting in currency liquidity, the balance sheet foreign currency account increases (DEV_0)[3], while the forint account decreases *(HUF_0)* with the amount equalling the principal of the transaction; the off-balance sheet foreign currency liability *(DEV_0)* and forint receivables *(HUF_{0T})* simultaneously increase. The amount of forint receivables is determined according to the forward exchange rate. This also means that the FX swap transaction can in itself modify the on-balance sheet foreign currency position of domestic banks (the difference in the forint amount of on-balance sheet foreign currency assets and foreign currency liabilities expressed with the exchange rate of the reference date) with the currency amount appearing in the balance sheet. In parallel with the above, the off-balance sheet position[4] of the bank expands by the same amount, with an opposite sign (expressed in foreign currency). Thus, the total foreign currency

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[1] See Mák and Páles (2009) for more details.

[2] Contrary to currency repo transactions, however, the collateral function of the other currency is generally not supported with more refined collateral management instruments applied in connection with repo transactions in the normal operation of the markets (Csávás et al., 2006). In fact, the crisis strengthened the application of collateral management instruments.

[3] Throughout the whole paper, the notation DEV in the formulas refers to the foreign currency (currency other than HUF).

[4] Difference in the value of foreign currency receivables and foreign currency liabilities expressed in forints.

Chart 1

The FX swap transaction shown through the stylised bank balance sheet

(foreign currency purchase in the spot leg, HUF purchase in the forward leg)

FX SWAP TRANSACTION
Deal date (0. point in time)

	ASSETS	LIABILITIES		
1a. Spot leg of FX swap	$-HUF_0$ $+DEV_0$		1a. Spot leg of FX swap	Swap counterparty
ON-BALANCE SHEET	$-HUF_0 + DEV_0$	0		
OFF-BALANCE SHEET	$+HUF_{0T}$	$+DEV_0$		
1b. Forward leg of FX swap	$+HUF_{0T}$	$+DEV_0$	1b. Forward leg of FX swap	
	ASSETS	LIABILITIES		

ON-BALANCE SHEET

OFF-BALANCE SHEET

Note: In the chart, HUF and DEV indicate the currency of the balance sheet items, while the lower indices of forint items indicate their amount. Of the above, the first numeral indicates the determination date of the amount, while the second one indicates the maturity date. If the date of determination and maturity corresponds, the lower index is only one numeral.

position of the bank *(on-balance sheet + off-balance sheet)* does not open *solely* as a result of the FX swap transaction. The on-balance sheet and off-balance sheet forint amounts (HUF_0, HUF_{0T}), however, do not offset each other: the two amounts differ by an amount corresponding to the yield spread priced in the forward exchange rate (forint-foreign currency).[5]

The FX swap transaction does not in itself result in foreign exchange rate exposure. Considering the total cash flow, the market value of the transaction is independent of changes in the foreign exchange rate due on the principal during the full term. The market value of the spot leg (due on principal) changes as a result of changes in the exchange rate by a rate equal to the change of the market value of the forward leg – during the full term of the transaction (Table 2). The market value of the forward leg depends on the relationship between the spot exchange rate of the forint at maturity (S_T) and the forward exchange rate (F). If the exchange rate weakens by a rate larger than the value determined by the yield spread $(r_{HUF} - r_{DEV})$ (i. e. $F < S_T$), the transaction produces a loss, otherwise it is profitable (in the case of a HUF purchase in the forward leg). This is why the forward transaction is adequate for assuming an exchange rate position (Annex 1). For determining the market value of the entire FX swap transaction at maturity, it is necessary to consider the total cash flow, that is, the future value of the spot leg's cash flows, in addition to the value of the forward leg expressed in forints. (The trader needs to draw a forint loan to cover the forint amount paid in the spot leg, while he may lend the received amount of foreign currency. In other words, the trader could have deposited the forint amount paid at the initial leg of the transaction as a forint deposit, he would have had to draw a foreign currency denominated loan on the foreign currency amount received. Thus, the difference between the forint and foreign currency yields constitutes the opportunity cost of spot cash flows from an economic point of view.)

Table 2

Market value at maturity of the total cash flow of the FX swap transaction receiving foreign currency liquidity in the spot leg

(cash flows at conclusion are expressed in future value)

Currency	Deal date	Maturity	Total
FOREIGN CURRENCY	$+1 \cdot (1 + r_{DEV}) \cdot S_T$	$-S_T$	$r_{DEV} \cdot S_T$
FORINT	$-S_0 \cdot (1+r_{HUF}) = -F \cdot (1+r_{DEV})$	F	$-r_{DEV} \cdot F$
Total	$(1+r_{DEV}) \cdot (S_T-F)$	$F-S_T$	$r_{DEV} \cdot (S_T-F)$
			Exchange rate risk due on foreign currency rate

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[5] In certain transactions, it is the forint amounts and not the foreign currency amounts of the spot and forward leg that correspond. In such case, the foreign currency amounts of the spot and forward legs differ by an amount equalling the yield spread.

For typical FX swap transactions, only the exchange rate risk linked to the foreign currency interest remains. Due to the yield spread between the two currencies, the swapped back quantity of one currency differs from the quantity swapped in the spot leg (in relation to forint/foreign currency transactions, the quantity of swapped and swapped back forints frequently differs, but remains the same in foreign currency). Thus, the total amount of the yield spread is payable in one of the currencies (forints). By contrast, for a forint/foreign currency swap transaction concluded by a domestic bank, in the event of the lending of the (other) currency received in the spot leg, the interest income actually arises in the original currency, and its value in forints is not known in advance. The value of interest payable in foreign currency, expressed in forints at maturity, may vary from the value corresponding to the forward exchange rate determined at conclusion.[6]

Owing to the structure of the FX swap transaction, it enables the swap of liquid assets (cash, account money) in different currencies through the spot leg and concurrently the hedging of the resulting change in the foreign currency position through the forward leg. As a result of the above, the transaction facilitates liquidity in the necessary denomination without a change in the original foreign currency position. In other words, the application of a currency swap transaction allows a financing instrument's currency to be changed and the financing instrument of a given currency may be synthetically replicated (credit/deposit + currency swap). At the same time, by jointly applying FX swap and spot transactions, market participants can assume a synthetic forward foreign currency position and can thereby close their existing exchange rate exposure; in such a case, the spot leg of the FX swap transaction and the spot transaction of an opposite direction neutralise each other and the residual forward leg is equivalent to a forward transaction (Annex 2).

In the course of analysing changes in the swap stock, in addition to FX swap transactions, we also examine cross-currency swap transactions. In economic terms, the general difference between these transactions and the above described FX swap transactions is that the former are typically concluded with longer maturities (FX swap transactions generally have a maturity of up to one year, while cross-currency swap transactions have a maturity of over one year). In addition, the cash flows of cross-currency swap transactions also involve the swap of interest payments in different currencies (thus, it may also be understood as a swap of bonds in two different currencies). The FX swap and cross-currency swap transactions will be denoted collectively as currency swap transactions in the remaining parts of the study.

Box 1

Pricing of FX swap transactions: within what limits should implied yields move? What levels do these approximate?

On effectively functioning markets, the forward exchange rate priced in FX swap transactions depends on three factors: the initial exchange rate, maturity and the yield spread between the two currencies and the risk premia priced in these. On the basis of the principle of covered interest rate parity, the forward exchange rate can be calculated as follows:

$$F_{HUF/EUR} = S_{HUF/EUR} \cdot \frac{1 + r_{HUF} \cdot \frac{t}{360}}{1 + r_{EUR} \cdot \frac{t}{360}} \ ,$$

where **S** is the HUF/EUR initial (spot) exchange rate, **F** is the HUF/EUR forward exchange rate, r_{HUF} is the uncovered forint interest rate, r_{EUR} is the uncovered annual euro interest rate, and **t** ($t = T_1 - T_0$) indicates maturity measured in days.

The value of the $F_{HUF/EUR} - S_{HUF/EUR}$ difference expressed in forints is multiplied by 100 and given in swap points. If upon quotation, the interest rate of the basic currency (EUR in this case) is lower than the interest rate of the counter-currency (HUF in this case), the swap points have a positive value (a negative value in the opposite case). On the FX swap market, the swap points expressing the yield spread are typically used (and not the forward exchange rate priced in the transaction).

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[6] This risk can (could) be avoided if the accumulated values in both currencies are (would be) swapped in the forward leg.

On the one hand, the development of swap point reflects the yield spread between the two currencies. The implied yield spread between the two currencies can be calculated from the swap point quoted for the given maturity by rearranging the above identity, which, in the case of an effectively operating FX swap market, approximates the difference between the interbank yields of the two countries with the appropriate maturities.

$$(r_{HUF} - r_{EUR}) \cdot \frac{t}{360} \approx \frac{F - S}{S}$$

If supply contracts in one of the currencies of the transaction, its yield increases, and this is also manifested in a change in the swap points. Thus, the implied foreign currency interest rate can be approximated through the difference between the domestic interbank yield with the appropriate maturity and the implied yield spread. If this were not possible, arbitrage would be possible on effectively operating markets, as the FX swap can also be synthetically produced through the combination of a loan and a deposit.[7]

In relation to transactions providing HUF liquidity in the spot leg, the difference between the priced forint deposit and the foreign currency loan interest rate is required from the (non-resident) bank which provides the EUR liquidity. Quotation of the forward exchange rate priced in this type of transaction, derived from the bid and ask yield quotations, is expressed as follows:[8]

$$F^{ASK} \le S \cdot \frac{1 + r_{HUF}^{ASK} \cdot \dfrac{t}{360}}{1 + r_{DEV}^{BID} \cdot \dfrac{t}{360}}$$

This forward exchange rate shows the forint amount asked for by the bank quoting the FX swap (providing HUF liquidity in the spot leg) upon maturity in exchange for one euro.

In relation to transactions providing HUF liquidity in the spot leg, it pays the difference between the interest rate of the forint loan and the foreign currency deposit to the swap counterparty. Quotation of the forward exchange rate of this type of transaction from the bid and ask yield quotations is expressed as:

$$F^{BID} \ge S \cdot \frac{1 + r_{HUF}^{BID} \cdot \dfrac{t}{360}}{1 + r_{DEV}^{ASK} \cdot \dfrac{t}{360}}$$

This quotation shows the forint amount offered by the bank quoting the FX swap (acquiring HUF liquidity in the spot leg) in exchange for 1 euro.

Under normal circumstances, the forward exchange rate and swap points priced in the actually concluded transactions lies within the band between the above bid and ask quotations. The width of the band depends on the difference between the ask and bid yields prevailing on the market, which is typically determined by the liquidity of the given markets and institutional characteristics. Therefore, the band of the yield spreads derived from quotations expressed in swap points is determined by the difference between the (lowest) forint bid yield quotation and the (highest) ask euro yield quotation and the difference between the (highest) forint ask yield quotation and the (lowest) bid euro yield quotation. Otherwise, arbitrage would be possible even with price quotations.

$$r_{HUF}^{ASK} - r_{DEV}^{BID} \ge r_{HUF} - r_{DEV} \ge r_{HUF}^{BID} - r_{DEV}^{ASK}$$

For transactions with short maturity (one day and one week), this also means that the implied forint interest rates are typically found within the interest rate corridor, as under normal circumstances this corridor basically determines the lower and upper limit of the

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[7] See Mák and Páles (2009).

[8] The market-maker bank asks for the ask (higher) forint yield on the lent forint deposits and pays the bid foreign currency yield on the foreign currency denominated loans.

yield quotations. Rearranging the above inequality to the amount of the implied yield spread and the appropriate foreign currency yields:[9]

$$r_{HUF}^{ASK} \geq r_{HUF} - r_{DEV} + r_{DEV}^{BID} \approx r_{HUF}$$
$$r_{HUF}^{BID} \leq r_{HUF} - r_{DEV} + r_{DEV}^{ASK} \approx r_{HUF}$$

During normal operation of the markets, the interest rate corridor commonly defines the approximate band of short maturity (1 day – 1 week) bid and ask yield quotations, and thus the short maturity derived implied yield typically moves within the interest rate corridor.

1.2 MANAGEMENT OF COUNTERPARTY RISKS IN CONNECTION WITH FX SWAP TRANSACTIONS – LIMIT SYSTEM AND MARGINING IN GENERAL

Similar to other financial market transactions, the counterparty risk of FX swap transactions is that the bank concluding the transaction suffers a loss upon default by the counterparty, if – upon the date of the default event – the market value of the transaction is positive for the bank, i.e. it claims a receivable vis-à-vis the defaulting customer (BIS, 1998).

In terms of counterparty risk, the FX swap functions identically to a forward transaction, in view of the fact that after payment of the transaction's spot leg, the parties do not have further claims vis-à-vis each other in relation to the spot transaction. The market value of the FX swap transaction is zero at the moment of conclusion, similarly to forward transactions. The market value of the forward transaction continuously changes over the term, depending on the development of the prevailing spot exchange rate and the interest rates used for the pricing of FX swaps. On the date of maturity, for example, the value of the forward transaction corresponds to the difference between the forward exchange rate and the prevailing spot exchange rate.

If it becomes clear before maturity that the counterparty will not be able to fulfil its future obligation arising from the forward transaction, the bank must conclude the forward transaction on the market again. In certain cases, conclusion of the new transaction is only possible under less favourable market conditions, and thus the bank suffers a loss.[10]

We will demonstrate with the following simple example how the amount of loss arising from default depends on the forward exchange rate. Let us assume that a non-resident bank holds a short forward forint (long foreign currency) position vis-à-vis a resident bank and the resident bank files for bankruptcy before maturity. If on the date of default, the prevailing market forward forint exchange rate is stronger than the forward exchange rate priced in the transaction, the market value of the transaction for the non-resident bank is negative (Chart 2). In such a case, the non-resident bank pays the market value of the transaction to the resident bank. The non-resident bank, however, does not suffer a loss solely on the basis of the bankruptcy, as its transaction would be unprofitable even without the counterparty's bankruptcy. If, however, the prevailing forward exchange rate is weaker than the forward exchange rate of the transaction, and the transaction would hence be profitable for the non-resident, it will lose this profit and suffer a loss corresponding to the difference between the two forward exchange rates.

The amount of potential loss resulting from default by the counterparty is basically determined by three factors: the credit exposure amount, the probability of default and the fraction of the obligation which can be recovered from the counterparty (recovery rate). The credit exposure also depends on several factors: the *potential* highest *future exposure* is added to the *current exposure* (BIS, 1998).

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[9] On the basis of the above formulas, it is possible that if the average interbank euro yields exceed the bid euro yields or the euro interbank yield is less than the ask euro yields, the implied forint interest rate may move out of the band limited by the bid and ask yields. The extent of the above, however, is negligible and the moves outside the band are not typical under normal circumstances.

[10] This is the so-called replacement cost risk or pre-settlement risk (BIS, 1998). This is distinguished from the settlement (Herstatt) risk, which arises if – following the transfer of one leg of the spot or forward transactions – a participant does not receive the currency to be settled at the other leg due to default of the partner (for details see Tanai, 2006).

Chart 2
Market value of the forward forint sale transaction and loss arising upon default by the counterparty as a function of the forward exchange rate
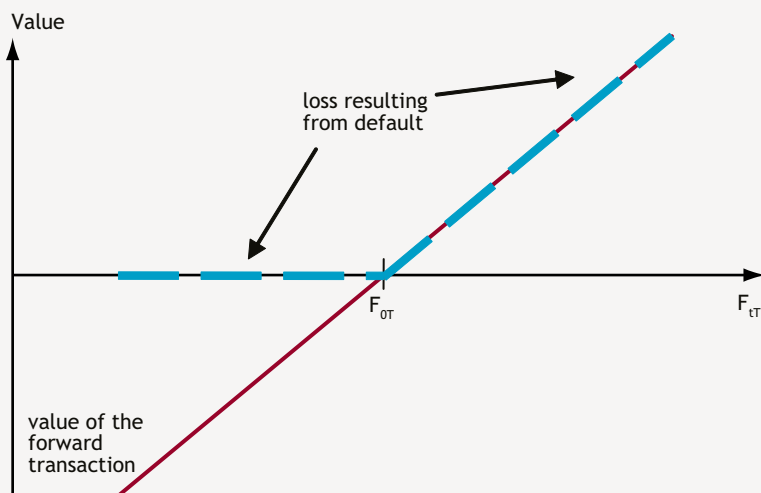
F_{0T}: *forward forint/euro exchange rate determined upon conclusion of the transaction, relating to time T; F_{tT}: forward forint/euro exchange rate at time t, relating to time T.*

The current exposure reflects the amount of loss the bank would suffer if the default of the counterparty were to occur immediately. In an FX swap, this amount can be determined as the market value of the forward transaction if it is positive. Quantification of the future potential exposure is more complex; its magnitude is generally determined on the basis of statistical methods (e.g. the amount of maximum potential loss arising during the transaction with 99 per cent probability).

The most common method of reducing counterparty risk is the application of *counterparty limits*. The counterparty limit defines the upper limit that may not be exceeded by the combined current and future exposure of all instruments (including FX swaps) carrying credit risk vis-à-vis the given counterparty. In determining such limits, banks take into account the risk linked to the counterparty, e.g. on the basis of its credit rating. In addition, the country in which the counterparty bank or its owner operates may also be a factor. Banks generally set counterparty limits for each customer, but they also limit the amount of total exposure vis-à-vis counterparties belonging to the same bank group. Banks conducting risk management at the group level also take into account the consolidated exposure of a given customer vis-à-vis all members of the bank group. Banks belonging to the same bank group, however, typically do not set counterparty limits vis-à-vis each other. It is possible to apply a further breakdown of the counterparty limit of a given customer, depending on maturity. The distinction by maturity serves the purpose of preventing the absorption of most of the counterparty's total limit in connection with the conclusion of a larger transaction with long maturity (Ramaswamy, 2004).

The other method of reducing counterparty risk is for the customers to ask for collateral from each other *(collateralisation, margining)*.[11] The rules relating to the management of collateral are generally set out in the CSA (credit support annex) attached to the ISDA master agreement which defines the cases, frequency and form of collaterals requested and also sets out the legal background for collateral management. In international practice, the use of cash collateral is most common in OTC transactions; the use of securities is less common due to various technical and institutional limitations.[12] The application of margining is less common in relation to foreign currency market derivative transactions, including FX swaps, than in the case of other derivatives (interest rate derivatives), due to their shorter maturity. Margining was primarily applied by market participants before the emergence of the subprime crisis in 2007, in relation to FX swap transactions with longer maturity and cross-currency swap transactions, although it was gradually used for shorter maturity transactions as a result of the crisis. During the crisis, without exception all central

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[11] In addition to the partner limit system and margining, other techniques exist to reduce the partner risk, such as the netting of payments per transaction, or in the case of default, so-called close-out netting.

[12] For example, collateral received in cash is easier to mobilise and transfer for the fulfilment of collateral placement obligations vis-à-vis other customers than collateral pledged in the form of securities (BIS, 2007; ISDA, 2009).

banks maintained the collateralisation of FX swap transactions with daily margining (or, equivalently, that of covered foreign currency denominated loan transactions). Similarly to counterparty limits, margin call agreements are not concluded on transactions concluded within a bank group.

Upon a major shift in foreign exchange rates and yields, the market value of the forward leg of FX swap transactions also changes significantly. The amount of the collateral is commonly determined on the basis of the transaction's market value (mark-to-market). The current market value of a short forint forward transaction can be expressed with the following formula:

$$(F_{tT} - F_{0T}) \cdot \frac{1}{1 + r_{HUF}^{tT}}$$

where F_{0T} is the exchange rate set upon conclusion of the transaction, relating to time T, F_{tT} is the forward exchange rate at time t, relating to time T, and r_{HUF}^{tT} is the forint yield on the period between times t and T.

During the term, with changes in the exchange rate, the transaction may produce a net positive present value for one party. If the amount thereof exceeds a limit, the counterparty is required to provide extra collateral to the in-the-money position party. Commonly, the positive present value expressed in foreign currency should be deposited with the counterparty.

In defining the additional collateralisation obligation, basically three types of approaches can be distinguished:

– initially there is a (initial or maintenance) margin deposit of a *smaller amount* (which, for example, may be approximated with a maximum 1 day exchange rate change observed in the past) and this is adjusted in accordance with the daily current change of the exchange rate;

– initially there is the collateralisation of a *larger amount* (which, for example, may be approximated with the extreme values of exchange rate changes relating to longer periods observed in the past) and this is subsequently topped up or reduced only upon extremely large fluctuations in the exchange rate;

– initially *there is no* collateralisation, and subsequently collateral is required only upon extremely large fluctuations in the exchange rate.

The first method is generally considered to be more conservative (e.g. applied by central banks), while market participants frequently applied the third approach.

The application of the limit system and the practice of collateral requests represent counterparty risk management techniques that do not preclude each other. Upon their simultaneous application, the two types of risk management methods are interacting with each other, as well. If a counterparty puts up collateral in the transaction, the transaction basically does not utilise the limit that it faces, as it constitutes a covered transaction in terms of counterparty risk. And this enables the conclusion of a transaction even if the credit risk of the counterparty's transactions approximates or possibly reaches the limit. On the other hand, the contractual regulation of cases in which collateral is requested in the future reduces the amount of future credit exposure underlying the transaction. And this can further reduce the amount by which the given transaction utilises the limit of the counterparty (BIS, 1998).[13]

1.3 APPLICATION AND RISKS OF FX SWAP TRANSACTIONS

In this chapter, we examine in detail the characteristics and underlying risks of the hedging of foreign currency lending and foreign currency *based* lending with currency swap transactions and alternative strategies based on the use of swap transactions. The term net swap stock refers to the difference in the stock of outstanding transactions involving a HUF

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[13] In the turbulent period caused by the crisis, however, banks vis-à-vis which the partner limits were substantially reduced, even to zero, were not able to conclude new transactions even with the placement of collateral. That is, the practice of collateral request functioned less effectively during the crisis.

purchase in the forward leg and the volume of outstanding transactions involving a forint sale in the forward leg (from the point of view of domestic banks).

1.3.1 Foreign currency lending and foreign currency based lending using FX swap transactions

In recent years, banks financed a portion of foreign currency and foreign currency (e.g. Swiss franc) based loans with domestic currency (e.g. Hungarian forint) or other foreign currency (e.g. US dollar) denominated funds. In the framework of FX swap transactions, they borrow short-term foreign currency denominated cross-border loans and lend domestic currency (hereinafter forint) denominated loans. First, this enables the generation of foreign currency liquidity necessary for the provision of foreign currency loans (through the spot leg), and second, the cover of the exchange rate risk arising from the foreign currency receivable vis-à-vis the forint debt (through the forward leg) until the end of the maturity of the FX swap (Chart 3). The banks thereby close a portion of their on-balance sheet position arising from foreign currency lending (that is, the difference between the on-balance sheet foreign currency assets and foreign currency liabilities) with the help of FX swap transactions.

Chart 3

Simplified scheme of the comparison of raising direct and synthetic foreign currency funds in case of the foreign currency lending of a domestic bank

Note: In the case of raising synthetic foreign currency funds, the FX swap + forint government securities strategy of non-residents (case A) may be considered as synthetic foreign currency lending. The spot + FX swap strategy of non-residents practically corresponds to the assumption of a synthetic forward (short forint) position. In case C, the non-resident renews its previously concluded FX swap transactions, or carries out yield spread speculation of an opposite direction, combined with a longer term FX swap transaction, or makes available the forint funds (deposit, mortgage bond) provided to the bank through the spot leg of the FX swap.[14]

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[14] See Chapter 1.3.3.

In this manner, the entire domestic banking system produces synthetic foreign currency funds from a portion of forint funds, with the help of currency swap transactions. Most of the synthetic production of foreign currency funds at the sector level was performed by banks converting their household and corporate forint deposits to foreign currency funds through short-term currency swap transactions concluded with non-residents: the inflow of synthetic foreign currency funds contributes to the expansion of the on-balance sheet and off-balance sheet foreign exchange position. By contrast, in relation to the direct raising of foreign currency funds, the hedging of the exchange rate risk is also performed within the balance sheet: its advantage compared to hedging with FX swap transactions is that it is possible with fewer transactions. The direct and synthetic production of foreign currency funds may complement each other; they do not necessarily represent substituting forms of financing (Chart 3). Chapter 2.2. deals with the systemic comparison of the two methods of raising foreign currency funds in greater detail. The remainder of this chapter places emphasis on the characteristics and risks underlying foreign currency lending and foreign currency based lending through the use of FX swap transactions.

Foreign currency *based* lending differs from foreign currency lending in that in the former case, the disbursement and repayment of the loan is made in forints while in the latter case the loan is actually disbursed to customers in foreign currency.

With respect to *foreign currency loans,* too, the customer can (itself) convert the received foreign currency amount to forints (or the economic participants to whose account the transfer is made), and it can provide for the necessary foreign currency amount for repayment through the spot market sale of its forint revenue. At the sector level, the proportion of the foreign currency provided by the bank and *subsequently converted* by the economic participants into forints depends on the subsequent decisions of customers, the portfolio allocation decisions of various economic participants, macroeconomic relationships and the currency of payment obligations and revenues. A substantial portion of foreign currency originating from the provision of foreign currency loans is rechanneled into the banking system as a forint deposit (liability), that is, the economic participants convert the transferred amounts into forints.

In the case of *foreign currency based loans,* the creditor bank *automatically, directly* performs conversion into forints upon the provision of the loan and conversion to foreign currency upon repayment (either on its own or the customer's behalf). If it converts to forints the placed foreign currency amount *to the benefit of the customer* through a spot transaction concluded with another bank, the spot transaction used for conversion will not appear in the balance sheet of the given bank. If the bank converts the foreign currency amount to forints for the customer (internal conversion), the bank sells the foreign currency received in the spot leg of the FX swap on the spot foreign currency market *(on its own behalf)* and buys forints with it, and the spot transaction appears in the balance sheet of the bank (Chart 4 illustrates the latter case). The direction of this spot transaction is opposite to the spot leg of the FX swap transaction (thus, the bank concludes a spot and a swap transaction). In the case of the repayment of a foreign currency *based* loan, the transactions are of an opposite direction.

Chart 4
Provision of foreign currency and foreign currency based loans with forint funds, using FX swap transactions

PROVISION OF FOREIGN CURRENCY LOAN WITH THE USE OF FX SWAP TRANSACTIONS

PROVISION OF FOREIGN CURRENCY BASED LOAN WITH THE USE OF FX SWAP TRANSACTIONS
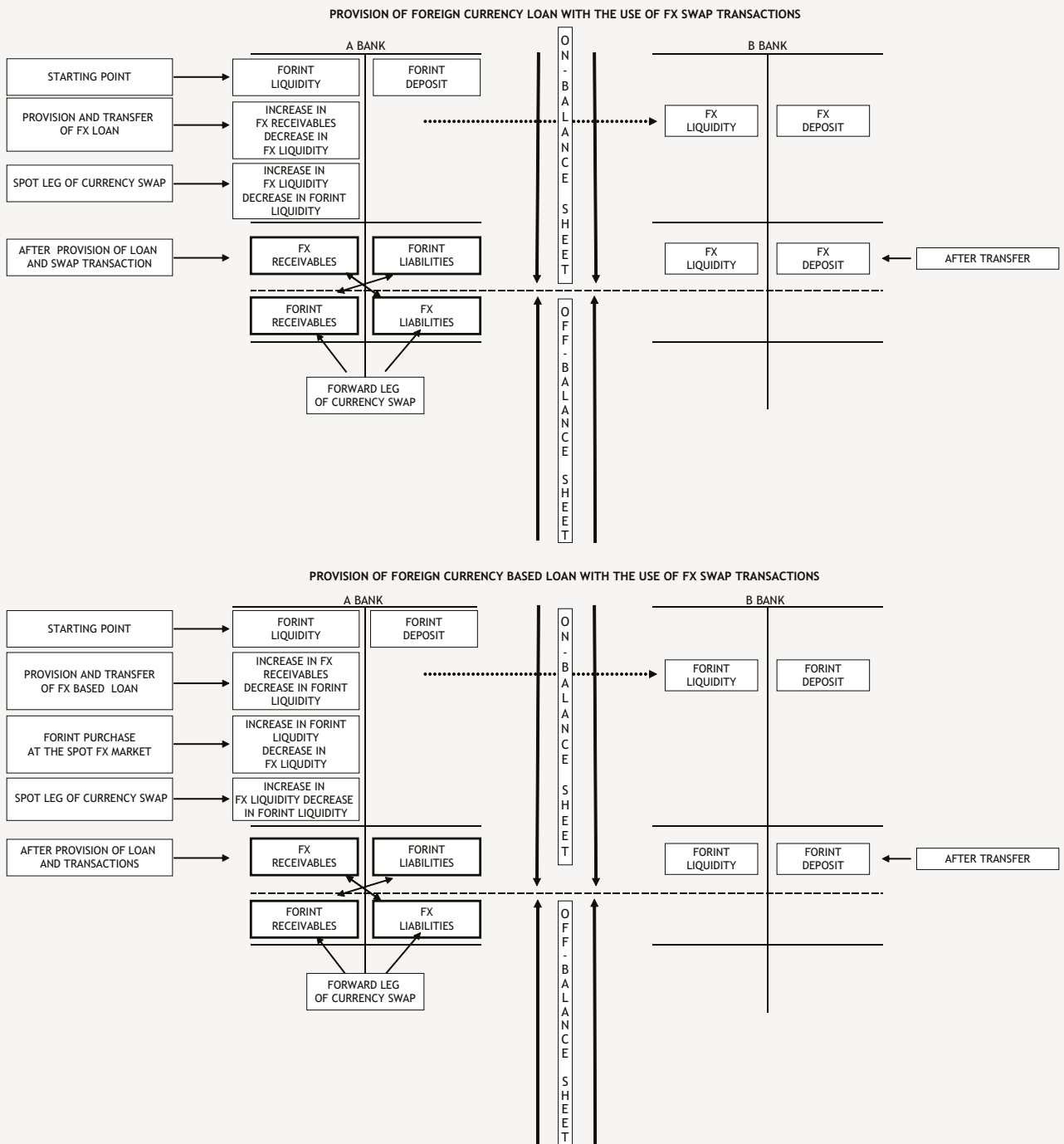
Note: Foreign currency liquidity corresponds jointly to foreign currency account money and cash, HUF liquidity to forint account money and cash. In relation to foreign currency based lending, we assume that the bank concludes the spot transaction on its own and not the customer's behalf.
Source: MNB.

Box 2

Foreign currency and foreign currency based lending and the balance sheet total of the banking system

In the case of foreign currency lending, the lending bank opens and increases a foreign currency deposit account; in case of a foreign currency based loan, it opens and increases a forint deposit account. Generally, the foreign currency amount must be transferred to another bank (lending and transfer is frequently performed in one step) and liquidity necessary for the transfer must be available. If the bank only has HUF liquidity available for this purpose, it can convert it on the foreign currency market. Upon application of a simple spot transaction, the total foreign currency position of the bank would open up, while it remains closed if an FX swap transaction is applied. This is one of the reasons why the use of FX swap transactions has gained ground.

In relation to both foreign currency loans and foreign currency based loans, the balance sheet total of the bank and the entire banking system increases at the moment of lending.

In the course of foreign currency lending:

1. it either opens a foreign currency deposit account for the customer from where the transfer is made (two steps),

2. or the transfer is made immediately to the foreign currency deposit account of another customer at the same bank (one step),

3. or the loan is transferred immediately to a foreign currency account managed by another bank[15] (one step).

In the course of foreign currency *based* lending, the bank:

1. either opens a forint deposit account for the customer the forint amount is transferred from such account to another account (two steps),

2. or it immediately transfers it to the account of another customer (one step),

3. or it immediately transfers it to the forint account managed by another bank (one step).

In the first case, upon disbursement of the loan, the forint deposit account opened for the customer momentarily appears on the liabilities side of the bank's balance sheet which is cancelled immediately after the transfer. The amount of the loan, however, is transferred to another forint account; the balance sheet total increases overall on a banking system level. (The balance sheet total decreases to the original level with repayment of the loan.)

Thus, *following* the disbursement of the foreign currency and foreign currency based loan, *the banking system's balance sheet total increases,* but not necessarily on an individual basis. If the amount of the loan is transferred to a deposit account managed by a foreign bank (e.g. import), the balance sheet total of the foreign banking system increases, *that of the domestic banking system does not – following* disbursement. In this case, namely, as a result of the change caused (in itself) by the lending in the balance sheet of the domestic banking system, the banking system converts its liquid assets into loans repayable. In this case, the balance sheet total of the domestic banking system increases *prior to* the disbursement of the loan: as a result of foreign funds, for example.

With regard to the two types of loans (foreign currency and foreign currency based), the overall difference in relation to hedging with FX swaps is that currency swap transactions are applied to jointly hedge the production of foreign currency liquidity and the exchange rate risk in relation to the foreign currency loans provided by domestic banks, while these are applied to hedge the exchange rate risk in relation to foreign currency based loans – if the bank converts the foreign currency to forints on its own behalf.

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[15] Domestic participants, however, convert a substantial portion of revenue originating from the resulting foreign currency deposit into forints which is ex-post apparent in the composition of the asset and liabilities side of the balance sheet.

In relation to hedging with FX swap transactions, namely, the (forward) exchange rate used upon maturity for conversion is already known upon conclusion of the transaction and determined by the yield spread: in this case, the profit of the bank, as a whole, does not depend on whether the amount of exchange rate weakening (due on principal) exceeds the yield spread. In relation to both foreign currency based and foreign currency loans, the interest rate spread priced in the FX swap transactions through the forward exchange rate *(see Chart 1: HUF_{0T} – HUF_0)* partly offsets the difference between interest received on the foreign currency loans and paid on the forint deposits.[16] In this case, the profit of the bank resulting from the foreign currency lending also depends on whether the bank actually priced the same interest rate spread in the foreign currency loan and the forint deposit as in the FX swap transaction.

$$HUF_{0T} - HUF_0 \approx \frac{t}{360} \cdot (r_{HUF} - r_{DEV}) \cdot S_0 \cdot DEV_0$$

However, it is important to emphasise that exchange rate risk management in the banking system with FX swap transactions is commonly performed at a "macro level" (on the level of the total balance sheet) and not for individual transactions. On a given day, transactions are basically concluded in an amount and direction determined by changes in the on-balance sheet foreign currency position (foreign currency assets-foreign currency liabilities). The net stock of swap transactions newly and previously concluded, but not matured, approximates the open on-balance sheet position of the banking system. There is no total correspondence because the off-balance sheet items do not only include the FX swap forward leg. In addition, foreign currency based loans have longer maturities than FX swap transactions, typically with annuity based repayment which further diversifies the picture.

1.3.2 Risks and characteristics of hedging foreign currency and foreign currency based lending with short-term transactions

The maturity of foreign currency and foreign currency based loans may vary significantly from the maturity of forint funds and FX swap transactions due to the primary characteristic of banking, i.e. maturity transformation. Therefore, it can be worthwhile to examine whether the strategy based on the renewal of FX swap transactions enables the hedging of the exchange rate risk due on principal in the case of maturity mismatch (Annex 4-5).

In relation to hedging with short-term FX swaps, upon disbursement of foreign currency based loans and repayment, the same procedures are applied as in the case of the FX swap and foreign currency based loan with the same maturity. The difference is related to the fact that short-term FX swap transactions need to be renewed upon maturity.

The total open position of the bank remains closed upon rollover of the FX swap transactions. Because upon rollover, the forward leg of the previous transaction and the spot leg of the new transaction appears as an on-balance sheet item; these run in opposite directions, thus the on-balance sheet foreign currency receivable remains unchanged. In parallel, among off balance sheet items, the forward leg of the previously concluded FX swap transaction is cancelled (forint receivables and foreign currency liabilities decrease). At the same time, the forward leg of the transaction concluded for its rollover increases the amount of off-balance sheet forint receivables and foreign currency liabilities. Thus, the overall amount of off-balance sheet foreign currency liabilities remains at the same level[17] (see Annex 6 for more details).

The yield spread priced in the forward exchange rate of FX swap transactions compensates the interest rate spread arising from the difference between the foreign currency interest received on foreign currency loans and forint interest paid on forint deposits in the given periods. Such compensation is regarded as complete if the interest rate period (repricing period) of the forint deposits and the foreign currency denominated loans with variable interest rates corresponds to the

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[16] The difference between interest rates priced in foreign currency loans and forint deposits may vary from the interest rate spread priced in the FX swap transactions: the amount of such difference also depends on the degree to which domestic banks pass on costs and their increase and the margin level they apply. In this case, by interest we mean only the portion of the APR that does not cover other costs.

[17] In some of the transactions concluded by market participants, the nominal amount paid in foreign currency is equal in the spot and forward leg, and the amount of foreign currency received in the spot leg in the new transactions corresponds to the amount of foreign currency payable in the forward leg of the previously concluded transactions. In this case, the priced interest rate spread is expressed by the difference between the forint amounts payable in the spot leg and received in the forward leg. However, there is also a different practice: in certain cases, the amounts payable in forints and not in foreign currency match. In such cases, the amount of the priced interest rate spread can be derived from difference in the foreign currency amounts.

maturity of the FX swaps used (rolled over) for hedging. Otherwise, the hedging of foreign currency denominated loans with FX swaps also contains interest rate (spread) risk: the difference between the interest rate priced in foreign currency denominated loans with a longer interest rate period or with a fixed interest rate and the interest rate of forint deposits may vary from the interest rate spread resulting from the rollover of FX swap transactions with shorter maturity. Because upon disbursement of the loan, the forward interest rate spread priced for the given period does not necessarily correspond to the actual interest rate spread subsequently applied, which is priced in the new FX swap transaction.

The majority of foreign currency denominated loans provided by domestic banks feature variable interest rates (typically with 1-3 month repricing), while forint deposits have short maturities. Accordingly, while the exchange rate risk is hedged with a rollover of 1-3 month FX swap transactions, the interest rate spread risk can also be neutralised. The interest rate spread risk, however, is not eliminated if hedging is performed with the rollover of FX swap transactions with shorter maturities.

Although the total foreign currency position remains stable upon the rollover of FX swaps, the *direct* HUF liquidity requirement and surplus changes due to exchange rate fluctuation.[18] The change appearing in the balance sheet, caused by the exchange rate fluctuation, actually arises as a HUF liquidity requirement or surplus – as the resultant of the cash flows of the forward leg of the maturing transaction and the spot leg of the new transaction, as in this case, the forint amounts payable in the spot and forward leg may differ. In parallel with the above, the change in off-balance sheet forint receivables in an opposite direction does not affect HUF liquidity upon rollover. The off-balance sheet forint receivables change depending on the difference between the forward exchange rates priced in the previous and newly concluded swap transactions. This is basically determined by two factors: changes in the interest rate spread relating to the maturity (period) of the two transactions and the spot forint exchange rate. This means that with weakening of the forint exchange rate, the HUF liquidity requirement increases upon rollover, otherwise a HUF liquidity surplus arises as a result of the series of transactions.[19]

First, this HUF liquidity effect arises only on a direct, individual level.[20] Second, as an "offset" of the possibly arising HUF liquidity requirement, later, upon maturity of the loan, the change caused by the weakening exchange rate linked to this period arises as a HUF liquidity surplus, as the amount repayable in forints increases proportionately.[21] In other words, the hedging of the foreign exchange rate risk of the foreign currency denominated loan is ensured over the entire maturity; although the related HUF liquidity requirements and surpluses arise as distributed over time (in case of hedging with short-term FX swaps), the sum of them is approximately zero over the entire maturity.

Thus, the hedging of longer-term variable rate foreign currency based loans (financed from short-term forint funds) with short-term FX swaps is not linked to an exchange rate risk or an interest rate spread risk,[22] but rather to a rollover risk. Because in the event that the FX swap and forward markets dry up, the banking system is able to discharge the foreign currency obligations of the maturing swap transactions by downsizing its foreign currency assets or spot foreign currency market transactions. The first case runs into limits due to the longer maturity of the foreign currency assets. And the latter case leads to the opening of the total foreign exchange position of the banks and thereby to a rise in exchange rate risk; and if it occurs on a systemic level, it may lead to the weakening of the exchange rate on the currency spot market. It is also possible that the FX swap transactions can only be rolled over with a shorter maturity, which also increases the interest rate spread risk of hedging. If a margin call agreement is also concluded (credit support annex) in connection with the swap transactions, in the event of marked depreciation of the exchange rate, the collateralisation requirements commonly payable in foreign currency also rise, which increases the foreign currency liquidity risks.[23]

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[18] In such a case, the combined amount of account money and cash on the asset side of the bank is defined as HUF liquidity.
[19] See Annex 4 and 6 for more details.
[20] See Chapter 5.4. for more details.
[21] See Annex 4 and 6 for more details.
[22] Or to an exchange rate risk linked to foreign currency interest rates.
[23] See Chapter 5.2.

1.3.3 Alternative uses of FX swap transactions: why do the swap counterparties of banks use FX swaps?

In addition to the financing of foreign currency lending, FX swap transactions are also used to pursue other strategies. This chapter describes these alternative utilisation strategies. First, because banks providing foreign currency loans can also use FX swap transactions to set up other types of strategies, and second because it is important to assess the possible motivations of the swap counterparties of domestic banks to conclude FX swap transactions that are necessary for the hedging of the exchange rate risks of domestic banks.

1.3.3.1 Production of a synthetic forward position with FX swap transactions

FX swap transactions differ from forward transactions by virtue of the fact that upon conclusion, there is also a cash flow in the initial leg. Thus, a synthetic forward position may be produced with the use of an FX swap transaction and a currency spot market transaction in an opposite direction to the initial leg, the net cash flow, hence market value of which corresponds to that of a forward transaction (cash flow basis derivation). This means that the market value of the position at maturity depends on the relationship between the spot exchange rate of the forint at maturity (S_T) and the forward exchange rate (F). If the spot exchange rate weakens by a rate larger than the value determined by the interest rate spread $(r_{HUF} - r_{DEV})$ (i.e. $F < S_T$), the transaction produces a loss for the swap counterparty, otherwise it is profitable in case of FX swap transaction providing foreign currency liquidity in the spot leg. This is why the FX swap transaction can also be applied in assuming an exchange rate position.

Market participants conclude an FX swap transaction providing foreign currency liquidity in the spot leg to establish a synthetic forward position if they speculate on weakening of the forint exchange rate. In this case, they sell forints in the forward leg of the FX swap. This also means that domestic banks are more likely to find a swap counterparty for the financing of foreign currency lending if the market participants have strong exchange rate weakening expectations.

Participants taking up forward positions can function as stable swap counterparties of banks hedging long-term loans with short-term FX swap transactions if they continue to maintain the forward position against the forint, and as a result, they roll over the previously concluded FX swap transactions in accordance with the new market conditions. The cash flows of the forward leg of the maturing FX swap and the spot leg of the new FX swap neutralise each other, therefore a spot transaction is not necessary to close the maturing forward leg.

This strategy differs from the originally long-term forward position in that its liquidity requirement or surplus arising from the variation of the spot forint exchange rate from the forward exchange rates arises upon rollover and not upon the final closing of the position. Furthermore, this variation does not (only) depend on conditions existing upon the launching of the position and the spot exchange rate valid upon (final) closing, but (also) on conditions existing upon rollover.

Recent years have witnessed a massive increase in the popularity of carry trades, speculation exploiting the interest rate spread between currencies. In this case, the speculator provides a short-term loan in a currency (forint) with a higher interest rate and becomes indebted in the currency of the currency pair with the lower interest rate.[24] If non-residents conduct such activity on a wider scale by taking up synthetic forward positions with the help of FX swap transactions, the net swap stock of the banking system available for hedging the exchange rate risk declines. This strategy results in a profit if the spot exchange rate does not weaken until maturity by a rate higher than the swap point.

1.3.3.2 Hedging of forint government securities purchases and holding with FX swap transactions

Swap counterparties can use FX swap transactions not only for taking up forint positions, but also for the opposite, the closing and hedging of positions taken up previously (with the purchase of forint instruments). This is the case if non-residents receive the liquidity necessary for the purchase of forint government securities through the spot leg of the FX swap, then roll over these shorter-term transactions during the term of the government securities until maturity or up to an earlier date.

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[24] See Mák and Páles (2009).

If the swap counterparty rolls over the FX swaps until the maturity of the government securities, the government securities holding+swap strategy is equivalent to the synthetic foreign currency loan, but it also constitutes yield speculation; the non-resident receives the fixed forint yield priced in the bond and pays the yield spread priced in the rolled over, short-term FX swap transaction. Thus, if during the term of the government securities, the forint-foreign currency yield spread declines more than the one priced into the long-term yields, the forint government securities purchase + FX swap strategy is more favourable for the investor than the direct provision of a foreign currency loan (Annex 8).

In the case of a liquid FX swap market, the flexibility of the application of FX swap transactions may represent an advantage in pursuing a forint government securities + short-term FX swap strategy: during the term of the bond, the non-resident investor may freely decide when and for how long to hedge or take up the resulting exchange rate risk with the conclusion of FX swap transactions and its closing with a spot transaction. Thus, the currency of the loan provided by the non-resident can be quickly changed with an FX swap transaction.

Banks providing foreign currency based and foreign currency loans with longer maturities are more likely to find counterparties applying the government securities + FX swap strategy in the course of the rollover of FX swap transactions, if the non-resident investors do not wish to take up the risk of the forint exchange rate or wish to hedge it.

The individual swap counterparties may also pursue mixed strategies, which is frequently motivated by differences in the maturity of the government securities, the desired period of the assumed exchange rate position and the maturities of FX swap transactions; it is possible that a swap counterparty hedges the exchange rate risk of the previously purchased government securities with a spot+swap transaction, or it does not roll over the maturing FX swap, and overall it assumes an exchange rate risk by closing the swap transaction with a foreign currency spot transaction.

It is also possible that the combined strategy applied at the sector level is the result of the various strategies pursued by individual participants of the foreign sector; for example, if certain participants only hold government securities, while others establish only a synthetic forward short forint position (with the use of a spot + rollover swap), at the sector level it appears as if the government securities purchase is hedged with FX swap transactions.

1.3.3.3 Interest rate spread speculation with FX swap transactions of different maturity

In the event of simultaneous application of opposite direction FX swap transactions with different maturities, the net swap stock and on-balance sheet position of the given participant remains at an unchanged[25] level under this strategy; in this case, the bank is not hedging the exchange rate risk either, but satisfies customer demand and carries out speculation on the yield spread. In this case, the gross swap stock and turnover, however, simultaneously increases in relation to the transactions in both directions.

This strategy may be appropriate for yield spread speculation, because the yield spread priced in the FX swap transaction with a longer maturity may deviate from the yield spreads (and the amount thereof) priced in rolled-over transactions of an opposite direction. Thus, if a bank expects the yield spread to decrease by a larger rate in comparison to the one priced in the current yield curves, thus in the FX swap transactions as well, it is worth concluding transactions providing HUF liquidity (forint loan) with longer maturities in the spot leg and transactions acquiring (borrowing a forint loan) HUF liquidity with shorter maturities in the spot leg (Annex 3 and 7).

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[25] By net swap stock, we mean the difference in the stock of transactions in directions opposite to each other. The balance sheet foreign currency position may change if the interest rate spread is expressed in the foreign currency amount and not the forint amount in relation to the forward legs.

2 Macroeconomic background to the growing stock of currency swaps

The rise in the stock of currency swaps is closely related to the indebtedness of the countries of the counterparties participating in the transactions, the structure and size of foreign capital flows and the portfolio allocation decisions of economic agents.

Portfolio allocation decisions are made by all sectors, i.e. the domestic private sector, the public sector and the non-resident sector.[26] These decisions, generally determined by the forint-foreign currency interest rate spread, the expected risk premia and exchange rate expectations, are interrelated through identities in the balance of payments. Thus, if the portfolio allocation in a sector is changed, it is possible that it is caused by changes in the behaviour of another sector. In this chapter we attempt to show how certain factors may have contributed to the rise in the stock of currency swaps in recent years by retrospectively analysing the development of certain items of macro-level balance sheet identities and those affecting the banking system over several years.

On the basis of the macro-level relationship defined in the study of Bethlendi et al. (2005), the net financing requirement of the country (combined deficit of the current account balance and capital account balance, *NFR*) corresponds to the sum of:[27]

1. non-debt generating capital inflow *(ΔND)*

2. forint instrument purchases of non-residents *(ΔD^{HUF})*

3. taking up of the long forint derivative position by non-residents *(ΔDER$_F$)*[28]

4. changes in the net foreign currency debt of the broadly-defined general government *(ΔD$_G^{FX}$)*

5. changes in the total open foreign currency position of banks *(ΔOP$_B$)*

6. taking up of forint derivative position by the domestic private sector *(ΔDER$_P$)*

7. and changes in the net foreign currency loans of the domestic private sector *(ΔD$_P^{FX}$ + ΔL$_P^{FX}$)*.

In relation to the debt generating financing of external debt, either non-residents take up a long forint or residents take up a short foreign currency position. In this context, the taking up of the exchange rate position arising from the long forint derivative transactions of non-residents is a key component of the exchange rate position related to the financing of the external deficit, which is simultaneously related to the deficit and its financing. And non-residents assume much of the exposure to the forint exchange rate *(–DER$_F$)* through the use of currency swap transactions concluded with domestic banks. This is why it is worth taking as a starting point the external borrowing requirement changing over time.

In the sub-chapter below, the term 'net swap stock' refers to the volume of outstanding transactions of non-residents involving the sale of forints in the forward leg less the amount of transactions involving the purchase of forints in the forward leg. This has a sign opposite to the amount under point 3 of the above listing.

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[26] Bethlendi et al. (2005).

[27] See Annex 14.

[28] The taking up of the forint derivative position by non-residents (DER$_F$) has a sign opposite to the net position of non-residents taken up in recent years through the forward leg of the swap stock.

Balance sheet identity may also be drawn up for the long forint derivative position (taken up through the banking system) of the non-resident sector:

$$\Delta \text{DER}_{\text{F}} = \text{NFR} - \Delta \text{ND} - \Delta \text{D}^{\text{HUF}} - \Delta \text{D}_{\text{G}}^{\text{Fx}} - \Delta \text{D}_{\text{P}}^{\text{Fx}} - \Delta \text{L}_{\text{P}}^{\text{Fx}} - \Delta \text{DER}_{\text{P}} - \Delta \text{OP}_{\text{B}}$$

On the basis of the formula, it is evident that there is a connection between an increase in the swap stock $(-\Delta DER_F)$ and the foreign currency lending of domestic banks to the domestic private sector $(\Delta L_P{}^{FX})$, although numerous other factors are also involved. In technical terms, the increase in the swap stock is attributable to the fact that the rise in the net financing requirement is exceeded by the combined rise in the other variables on the right side – one element of these is foreign currency lending in the banking system. Since the above formula reflects a balance sheet identity, and the variables on the right side are correlated, the ceteris paribus change in the variables on the right side cannot be interpreted.

2.1 THE MACROECONOMIC BACKGROUND TO THE DOMESTIC BANKING SYSTEM'S CURRENCY SWAP STOCK ON THE BASIS OF EXPERIENCE RELATING TO RECENT YEARS

The external borrowing requirement reached a high level in recent years, then showed a declining trend since 2006; after the crisis, from 2009 Q2, the country was in a net saving financial position. In the period between 2002 and 2006, the external borrowing requirement of the domestic economy rose to a high level, in accordance with the structural indebtedness trend, bank supply pressure and fiscal loosening. Between early 2002 and the end of 2003, the increase in the external borrowing requirement and its sustained high level occurred in parallel with a significant general government deficit resulting from loosening fiscal discipline and a decline in the net savings of households. The deterioration in the financing capacity of households is related to the structural indebtedness characterising emerging countries. Following macroeconomic stabilisation, the income prospects of households improved, and consumer impatience emerged due to previously deferred consumer spending.[29] The structural indebtedness trend accelerated in 2001, attributable to a considerable degree to loan supply pressure in the banking sector and the introduction of state subsidised home loans. From early 2004 (after the conditions of state subsidies were tightened), the net financing capacity of the household sector temporarily improved until early 2006, followed by a substantial increase from 2008, while the financing requirement of the corporate sector initially decreased with the decline in investment activity and then rose above the previously measured level. Since the introduction of fiscal austerity measures, however, the broadly-defined general government balance has considerably improved. Following the crisis in October 2008, from 2009 Q2 the external balance of the country rapidly improved, in parallel with the dynamic rise in the net savings of the private sector.[30] In 2009, notwithstanding the substantial decline in GDP, the budget deficit only rose to a small degree.

The financing of external debt *(NFR)* is possible through debt generating *(D)* and non-debt generating items *(ND)*.[31] In the period since 2002, **debt generating items played a dominant role in financing the balance of payments** (Chart 5). The high rate of debt generating funds increases the vulnerability risks. The adverse shift occurring in the financing structure was particularly strong in 2007 with a significant net outflow of capital. Since 2008 (not including the first quarter), financing has basically consisted of only debt generating items. From 2009 Q2, since the financing requirement has been negative, a net receivable arose vis-à-vis non-residents, but there was no inflow of non-debt generating funds.

As a result of the high financing requirement and the adverse change in the financing structure, the net external debt of the domestic economy substantially increased. The role of the credit institution sector in intermediating foreign net (debt generating) funds to domestic economic participants increased significantly (Chart 6). Between 2002 Q1 and 2008 Q3, the ratio of foreign net borrowing in the credit institution sector (within the net foreign borrowing of the domestic economy) rose from 23% to approximately 47%; after the crisis in October 2008, the pace of the increase exceeded the

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[29] Bethlendi et al. (2005).

[30] This is principally attributable to the decline in the loan portfolio linked to both supply and demand factors.

[31] Non-debt generating capital inflows are defined as direct capital investments (including reinvested earnings and intercompany loans and equity portfolio investments). All other financing items are defined as debt generating items. International reserve is regarded as an item reducing debt generating capital.

Chart 5

**The external borrowing requirement and the structure of financing**

(as a percentage of GDP)

- Debt generating financing
- Non-debt generating financing
- Financial derivatives
- External financing requirement
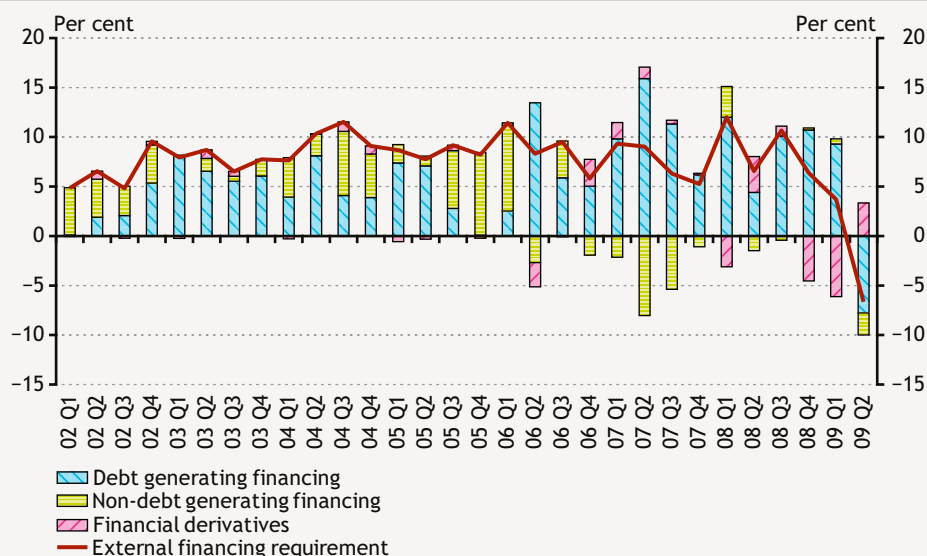
level measured earlier, owing to the large amount of funds provided by parent banks, and then settled back to roughly 47% from the second quarter of 2009. Direct foreign indebtedness – not including the intermediation of the credit institution system – is high in the case of companies and the government sector (through the government securities market). **As a combined effect of the rise in external debt and the intermediary role of the banking system *(intermediation)*, the banking system's reliance on foreign funds increased.**

The rise in net external debt seen in recent years obviously contributed to the opening of exposure to the forint exchange rate.[32] This is because external debt corresponds to the amount of the open long forint/foreign currency
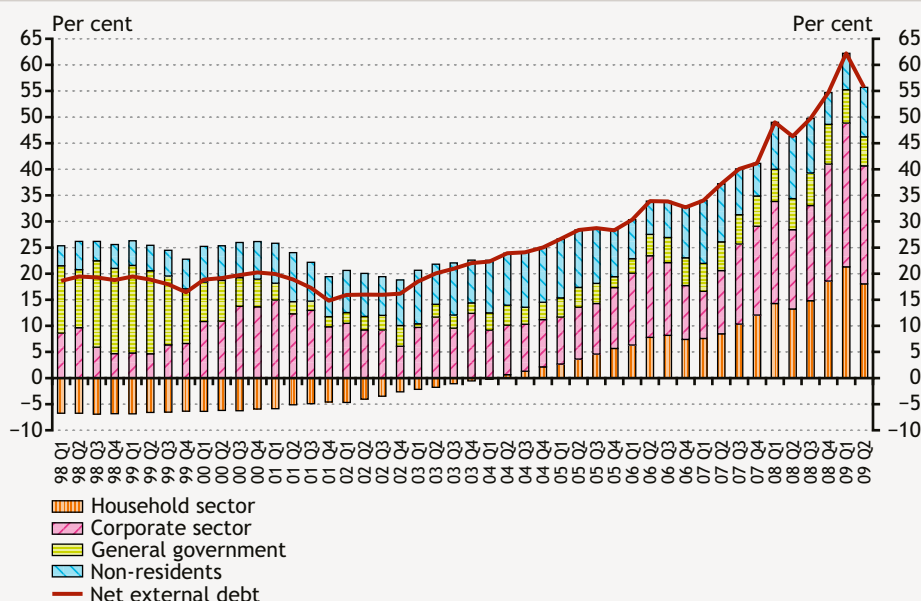
Chart 6

The net external debt-to-GDP ratio

- Banking sector
- Corporate sector
- General government
- Net external debt
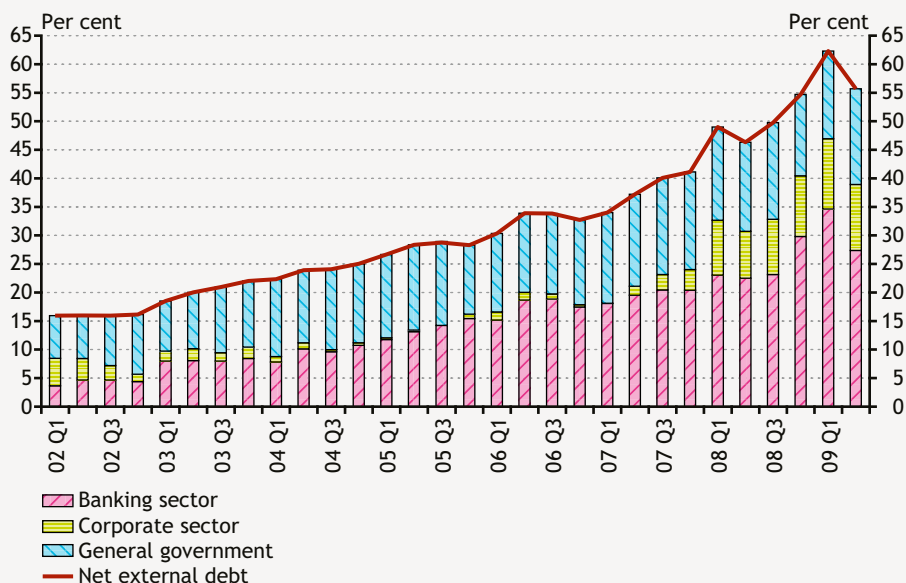
Source: MNB.

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[32] For support of this argument, see Bethlendi et al. (2005).

Chart 7
Open foreign currency position of different sectors
*(as a percentage of GDP)*

Source: MNB.

position taken up by the individual sectors (Chart 7). The exposure assumed by the individual sectors is determined by the portfolio allocation decisions of the different economic sectors; it depends on the yield spread, the Hungarian risk premium and changes in the exchange rate. The foreign currency position assumed by the individual sectors depends, on the one hand, on the currency of the foreign currency loans borrowed or placed by the sector, and on the other hand, on the position arising from derivative transactions (forward transactions, forward leg of FX swaps) concluded by the individual sectors. Derivative transactions are not typically concluded by the household sector; the non-resident sector typically concludes FX swap transactions with the credit institution sector and forward transactions with the corporate sector. The domestic credit institution sector also concludes forward transactions with the corporate sector, but the volume of such transactions falls short of the net currency swap transactions concluded with the non-resident sector.

In recent years, the opening of the foreign currency position resulting from the rise in external debt was predominantly assumed by the domestic private sector, and within this sector by the household sector to an increasing extent. The public sector bore most of the exchange rate exposure originating from net external debt until the first half of 1999; it was then borne by the corporate sector, and the whole of the non-resident sector played a growing role in taking up the long forint position up until 2003 (Chart 8). The foreign currency position of non-residents relative to external debt continuously increased until the end of 2002 and then gradually declined until 2006 Q3. Subsequently, notwithstanding the upturns in September 2006, March 2007 and 2008 H1, the role of non-residents in bearing the exchange rate position arising from external debt continued to decline on the whole until 2009, but remained at a positive level. *First,* this may imply that the level of the risk premium in this period did not sufficiently motivate foreign investors to take up an appropriate share of the open foreign currency position arising from foreign debt in accordance with the levels measured in the previous years, notwithstanding that the open foreign currency position of the non-resident sector increased in nominal terms. *Second,* this may suggest that domestic participants assessed the level of payable risk premium to be sufficiently high to take up the exchange rate position of the forint, i.e. indebtedness in foreign currency (with expectations linked to the relative stability of the exchange rate). In 2000-2001, the corporate sector bore approximately 80% of the exchange rate risk arising from external debt; from 2002, however, it bore a decreasing proportion of the open foreign currency position, compared to previous levels, until the end of 2007 Q1. In parallel with the increase in external debt, the role of the corporate sector again began to rise in bearing the exchange rate exposure. In parallel with the rise in foreign currency loans, since early 2004, the household sector took on a growing share of the

Chart 8
Open foreign currency position taken up by different sectors in proportion to net external debt
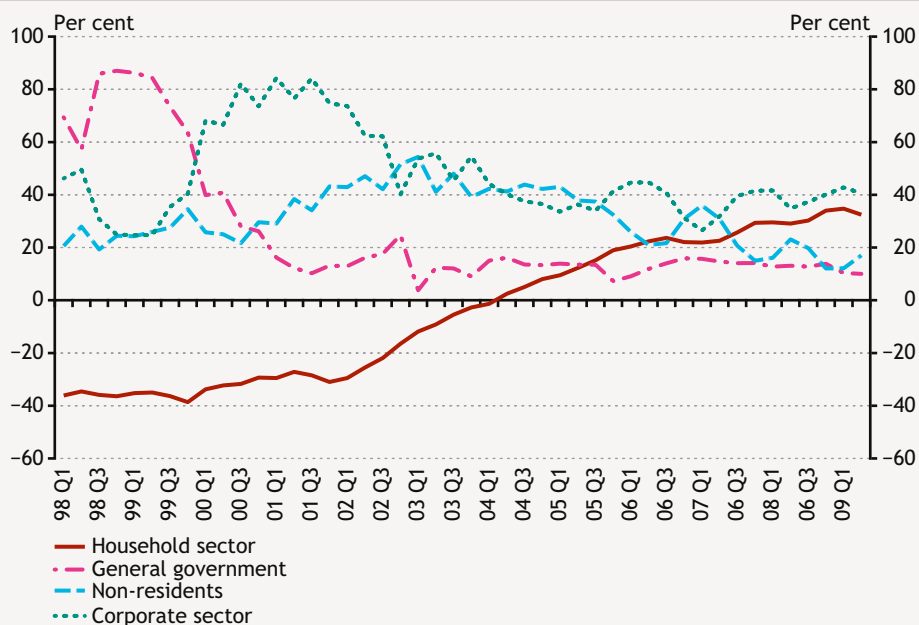
Source: MNB.

open foreign currency position arising from external debt (its share within external debt rose from 0% in early 2004 to 35%).[33]

The indebtedness of the private sector in foreign currency was significantly affected by the tightening of the state subsidies for forint-denominated housing loans at the end of 2003, bank supply pressure and changes in the forint-foreign currency interest rate spread. Between 2001 and 2003, subsidised home loans were the engine of growth in household lending. But with tightening of the subsidy system, the cost of these loans increased and demand declined. The activity pressure relating to established capacities prompted banks to develop foreign currency based loans.[34] In addition to the modification of the subsidy system, demand for foreign currency loans was also fuelled by the fact that in the second half of 2003, the forint-euro interest rate spread significantly increased in connection with the financial turmoil. The proliferation of foreign currency lending points in the direction of a higher financing requirement and indebtedness through the lower interest burden – particularly in relation to households with liquidity constraints – and higher indebtedness. With intensifying risk-based competition, Swiss franc denominated lending gained ground in foreign currency lending.[35]

The indebtedness of the private sectors in foreign currency resulted in an unhedged position in the household and small business sector. Some revenues and expenditures in the corporate sector (typically in the segment of large and medium-sized companies) arise in connection with foreign trade activity, and thus indebtedness in foreign currency does not lead to the assumption of an unhedged position. From 2003, however, expansion in foreign currency lending was also seen in the household and small and micro enterprise segment, where natural hedging is not common.[36] The private sector thereby assumes an exchange rate risk, as some of its forint expenditures are financed with foreign currency or foreign currency based loans.

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[33] Before 2004, households bore an exchange rate exposure that was opposite to the direction of the position arising from net external debt; their foreign currency receivables (deposits) exceeded the amount of drawn foreign currency loans, and thus they took up a position against the forint. This position was gradually eliminated between 2002 and 2004. This also means that before 2004, the amount of exchange rate exposure taken up by the other three sectors (non-residents, corporate and general government sector) together was higher than net external debt.

[34] Bethlendi et al. (2005).

[35] Report on Financial Stability (April 2008).

[36] Bodnár (2009).

Chart 9

Open foreign currency position of various economic sectors vis-à-vis the banking system

(as a percentage of the banking system's balance sheet total, adjusted for exchange rate changes)
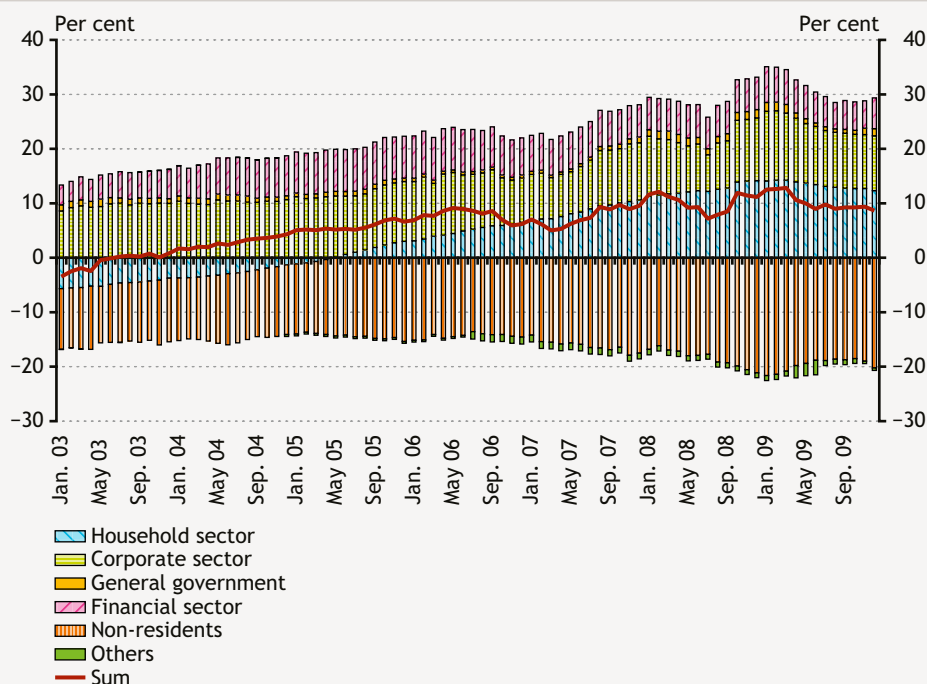
Note: The positive values indicate the degree to which the foreign currency assets of the banking system vis-à-vis the given sector exceed the foreign currency liabilities vis-à-vis the given sector (on-balance sheet). The foreign currency position of the financial sectors basically increased as a result of foreign currency loans provided to leasing companies.

To a large extent, the exchange rate position of the domestic private sector is taken up through the balance sheet of the banking system, which contributes to the opening up of the on-balance sheet foreign exchange position. Since the beginning of 2003, the foreign currency position taken on by the household sector through the balance sheet of the banking system (foreign currency assets – foreign currency liabilities), adjusted for exchange rate changes, has increased by approximately HUF 4,500 billion, while the exchange rate exposure of companies and financial enterprises (primarily leasing companies)[37] expanded by roughly HUF 2,000 billion and HUF 1,200 billion, respectively, until the middle of 2009. In proportion to the total assets of the banking system, it was primarily the foreign currency position of the household sector that rose (overall by approximately 19 percentage points). The position of the government sector taken with the intermediation of the banking system is of a low level. A reversal of the trend was observed after October 2008: the rising trend determining the on-balance sheet foreign currency position of these sectors halted and reversed (Chart 9).

External foreign currency funds play a major role in the management of the on-balance sheet exchange rate risks of the banking system. Its net foreign currency debt vis-à-vis the non-resident sector has increased significantly since 2003, by roughly HUF 4,000 billion, adjusted for exchange rate changes. Notwithstanding the foreign expansion of certain domestic banks, in connection with domestic indebtedness, the rise in external foreign currency funds was greater than in the case of external foreign currency receivables. This, however, was unable to offset the expansion of the foreign currency position of the resident sectors moving in the opposite direction. This was also reflected by the opening of the exchange rate position measured in proportion to the banking system's balance sheet total (Chart 9).

The foreign currency position of the domestic private sector (intermediated through the banking system) expanded at a higher rate than the direct net foreign currency cross-border debt borrowed by the banking system, and thus the on-balance sheet foreign exchange position of the banking system expanded substantially since 2003. The marked rise (approximately HUF 2,500-3,000 billion) in the banking system's on-balance sheet open position is partly attributable

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[37] Leasing companies, however, only have an exchange rate exposure through the banking system; their total foreign currency position remained closed on the basis of foreign currency loans provided to households.

Chart 10
Currency swap stock and open foreign exchange position of the banking system
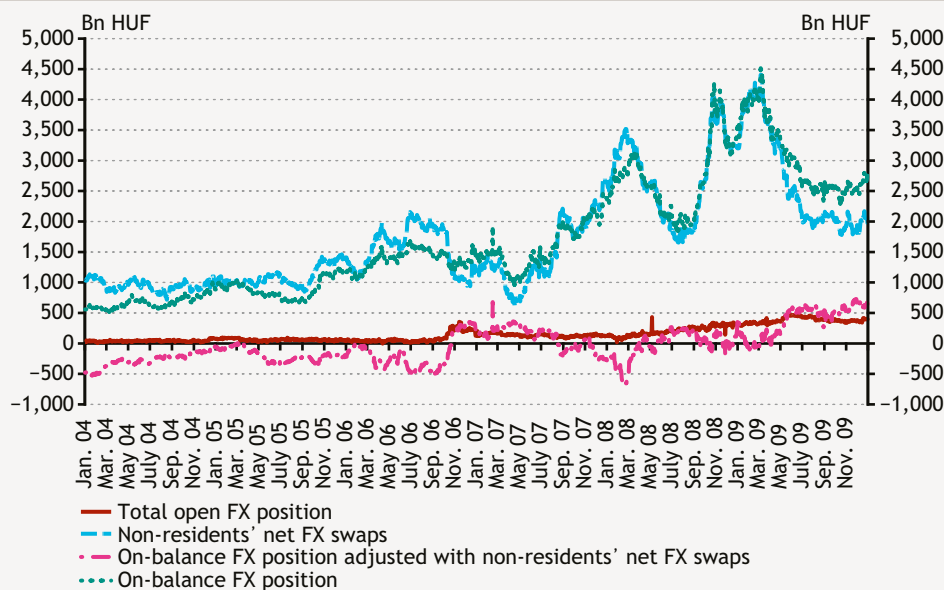
Source: MNB.

to the intermediary role of the banking system, i.e. the considerable increase in the balance sheet total, although during this period the increase of more than ten percentage points was also significant relative to total assets (Chart 9). Following the crisis in October 2008, however, the on-balance sheet position began closing.

The banking system maintains its total open foreign currency position at a stable, low level. Banks typically close the on-balance sheet open position with currency swap transactions concluded with non-residents (Chart 10). Banks hedge their on-balance sheet exposure almost entirely with off-balance sheet transactions (typically FX swap transactions); pursuant to Government Decree 2000/244, if the total open foreign currency position exceeds two per cent of the own funds of the institution prior to the deduction of any overrun, supplementary capital needs to be raised on eight per cent of the aggregate open position. We should add that even if the on-balance sheet position would close on the level of the entire credit institution system, it may be necessary to redistribute foreign – commonly foreign currency – funds among the banks within the domestic credit institution sector, in which currency swap transactions may also play a major role.[38] When applying a currency swap transaction (or jointly a spot and forward transaction), foreign currency liquidity can be ensured by keeping the open position closed, and the market risk is hedged until the end of the currency swap's maturity. The applied currency swap transactions, however, generally have shorter maturities *(maturity transformation)* than the placed foreign currency loans, thus a rollover risk exists also in connection with the hedging of the exchange rate risk with currency swap transactions.[39]

2.2 AN ALTERNATIVE TO USING FX SWAP TRANSACTIONS: FOREIGN CURRENCY AND FOREIGN CURRENCY BASED LENDING WITH DIRECT FOREIGN CURRENCY FUNDS

Synthetic production of foreign currency funds at the level of the domestic banking system was primarily performed by banks converting household and corporate forint deposits to foreign currency funds through short-term currency swap transactions concluded with non-residents. The question arises as to why direct foreign currency funds were not used instead of synthetic production. The fact that the non-resident resident sector bore a shrinking share of the exchange rate exposure arising from the increase in net external debt did not necessarily entail either nominal growth in the domestic

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[38] Foreign currency liquidity could also be ensured with a simple spot foreign currency transaction (conversion), but in this case, the exchange rate and interest rate risk position of the bank would not be closed, entailing an additional capital requirement.

[39] See the chapters below for more details.

banking system's swap stock or in proportion to the balance sheet total (not a *sufficient* condition).[40] Other factors must have contributed to the growth of the swap stock, which took a particularly marked upturn from early 2007. This question needs to be explored, despite the fact that external foreign currency funds have also increased significantly in recent years, in addition to the net swap stock.

The answer is linked to several domestic factors. In order to analyse the above, it is worth assessing the two alternatives (raising direct foreign currency funds or synthetic foreign currency funds), with respect to the costs and assumed risks relating to the domestic banking system and non-residents.

Looking at banks' balance sheets, one possibility of raising foreign currency funds is through the collection of deposits from resident customers. The volume of foreign currency deposits originating from domestic participants, however, falls significantly short of the volume of foreign currency loans provided to domestic participants; this is how the domestic private sector partly assumed the rising level of forint exposure arising from net external debt from the non-resident sector (see Chapter 2.1.). This is why banks are required to hedge the remaining portion of foreign currency lending by alternative means, even though customer deposits are regarded as the most stable type of funding. We should add that foreign currency deposits generally have shorter maturities than foreign currency loans, and thus the banks assume a rollover risk in this case as well. Furthermore, although the total customer deposit portfolio is regarded as a stable source of funding, the currency distribution thereof can change significantly, partly as a result of the changing exchange rate expectations of domestic customers.

Direct foreign funding is another possible form of financing foreign currency lending. Following the outbreak of the subprime crisis in 2007, it was more difficult for the banking system to raise foreign funds directly on the market. This was reflected by the shortening maturities and the higher cost of funding from the market, and both these developments led to growing rollover risks. Due to the high ratio of foreign financing, the Hungarian banking system was also forced to adapt to the adverse international trends. The price of foreign funds also showed an increase as a result of parent bank CDS premia and the premia of foreign currency bonds issued by domestic banks on the primary and secondary markets.[41] Domestic banks without a parent bank background were most negatively affected by the increase in funding costs. In

Chart 11

Net external foreign currency funding, net domestic foreign currency placements and swap stock in proportion to the balance sheet total
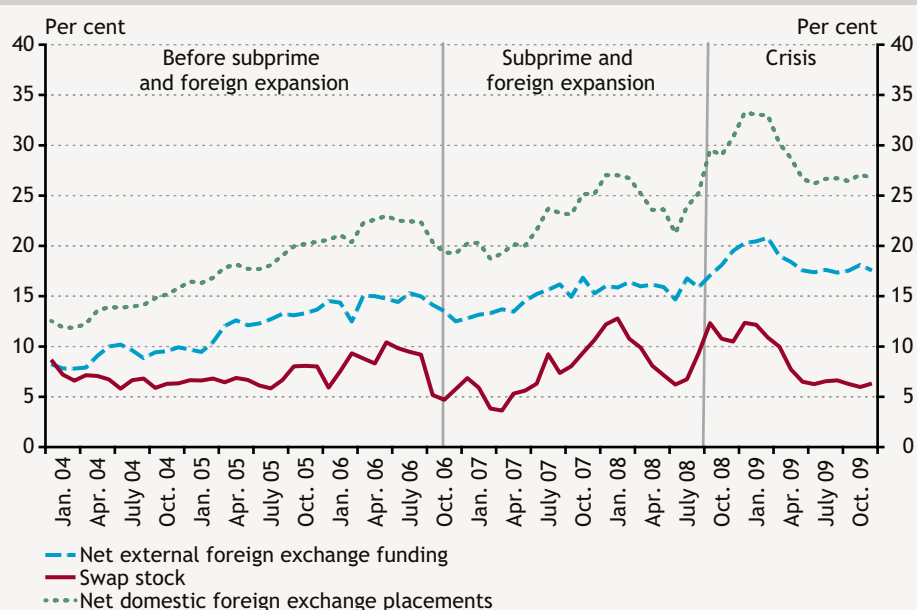

Source: MNB.

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[40] Theoretically, this could also occur if the entire non-resident sector would finance net external debt by only providing direct foreign currency loans to the domestic banking system.

[41] See also Report on Financial Stability (April 2008) and Report on Financial Stability (April 2009).

Chart 12

Premium of foreign market foreign currency funds and implied foreign currency yields over international interbank yields
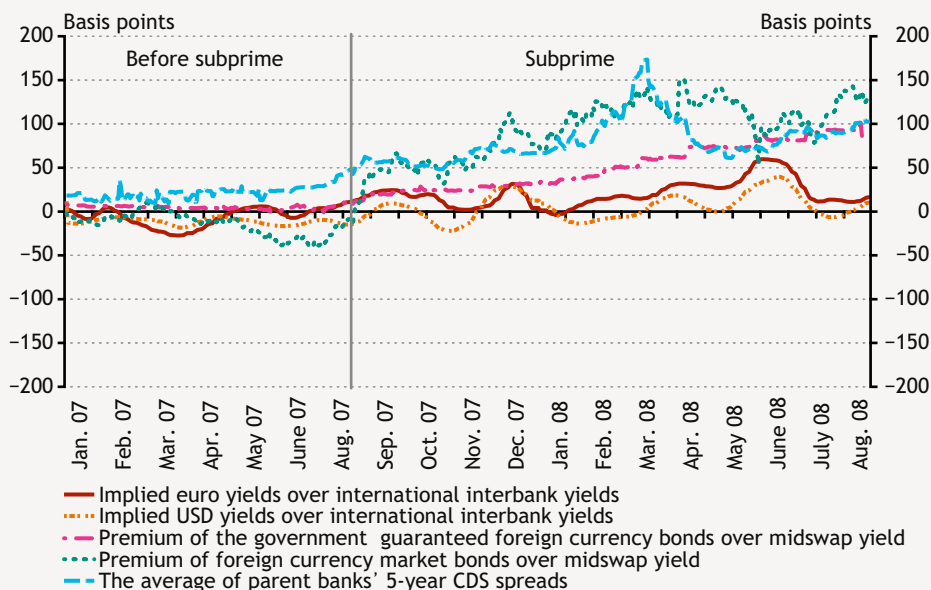
Note: *The premium of market foreign currency bonds issued by domestic banks and government guaranteed foreign currency bonds can be regarded as an index which shows the weighted secondary market premia based on outstanding stock, on the basis of publicly accessible data. The implied euro yield premia reflect smoothed time series calculated from actual transactions, relative to the interbank euro yields of corresponding maturities.*
Source: *Thomson Datastream.*

parallel with the deterioration in the conditions of raising funds on foreign markets, the volume of net external foreign currency funds remained unchanged in proportion to the balance sheet total between the outbreak of the subprime crisis and October 2008, while banks with foreign subsidiaries increased their foreign currency placements in the framework of foreign expansion (Chart 11). In the meantime, the volume of domestic foreign currency loans increased further (also in proportion to the balance sheet total), and thus the banking system needed to secure the financing for this by other means. On the basis of the co-movement of direct and synthetic foreign currency funding witnessed in recent years, it seems that in many cases the two forms of financing complemented each other.

Synthetic production constitutes the third possible method of raising foreign currency funds; this is performed by the conversion of forint denominated funds through currency swaps. This method of financing gained ground after the beginning of 2007. The synthetic raising of funds represented a cheaper form of financing overall for the domestic banking system. This is basically attributable to two factors: first, following escalation of the subprime crisis, the premia of direct foreign currency funds increased by a higher rate than the premia priced in currency swap transactions (Chart 12). Second, the entire banking system mostly converted corporate and household forint deposits to foreign currency funds through the use of swaps; the ratio of sight deposits is high, i.e. on the whole, the converted deposits have a lower interest rate than the forint interbank yield. Under normal market conditions, with perfect competition and rationally behaving economic participants, the fact that the price of raising synthetic and direct foreign currency funds varies over the longer term, however, theoretically conflicts with the no-arbitrage condition.

The yield advantage of synthetic foreign currency funds produced with FX swaps over traditional foreign currency funds can be highlighted with the following figures. During the period of dynamic foreign currency lending (January 2004 – September 2008), the average forint interest rate paid by domestic banks on household and corporate forint deposits was 5.4 per cent (interest rate weighted with the end-of-month portfolio; sight, current account and fixed deposits combined). For the same period, the 3-month and 6-month BUBOR interest rate averaged 8.3 per cent. The level of the interest rate, nearly 3 percentage points lower than the market rate, is partly attributable to the 30-40 per cent ratio of non-fixed deposits and partly to the fact that the level of deposit competition between domestic banks is measured as being

between the Cournot oligopolistic and perfect competition, i.e. the interest rate paid on forint deposits is lower than the level of perfect competition.[42]

Since the FX swap yields during this period do not vary significantly from the interbank money market interest rates, the cost of the foreign currency funds synthetically produced by swapping HUF liquidity in the form of deposits in the entire domestic banking system was approximately 3 percentage points lower than the market foreign currency interest rates.

Financing with foreign funds offers an alternative to foreign currency lending with forint funds. In relation to the period 2004–2007, Balás and Móré (2007) found that the interest rate of interbank foreign currency funds drawn from foreign sources typically exceeded the euro money market interest rates by 0-0.5 percentage points. Thus, if we compare the cost of synthetic foreign currency funds with the interest rate of foreign interbank funds, the use of FX swaps could produce interest rate savings of up to 3-3.5 percentage points even before the crisis. Following the emergence of the subprime crisis, this market premium increased significantly (by approximately 100-150 basis points).

When evaluating the figures, however, we need to take into account that a part of the interest rate gain arising from the use of FX swaps may have been passed on by the banking system to its customers through the pricing of the foreign currency loans, thus the total amount may not have necessarily increased banks' profit. In addition, in the course of the calculations we disregarded the fact that the collection of a portion of the forint (primarily fixed) deposits involves higher costs due to the development of branch networks. For the calculation we applied the prevailing average interest rates weighted with the given monthly stock. This may affect the interpretation of our results, as in the course of deciding between the various forms of raising foreign currency funds, in theory we would need to compare the cost of raising marginal, i.e. new funds. This latter factor, however, does not substantially affect our results, as we also estimated a difference of approximately 3 percentage points on the basis of the amounts and interest rates applied in the new forint deposit contracts.

Synthetic production within the banking system may have carried higher rollover and liquidity risks than the direct raising of external foreign currency funds in most of the period analysed. The maturity structure of direct foreign currency funds also varied from that of foreign currency loans, which poses a liquidity risk for the domestic banking system. The average remaining maturity of the swap stock was even shorter than that of direct foreign currency funds. As a result, two different types of rollover risks may increase for banks; it is possible that they will be able to raise funds again in the future only at a higher price (e.g. interest rates), under less favourable conditions, or in an extreme case, they will not be able to roll these over at all. The former type of financial risks, arising from the swap stock (duration gap, interest rate risk), are managed in the bank's treasury, but the latter type of risks is increased by the raising of foreign currency funds by synthetic means, due to the shorter maturity of the swap transactions.

Synthetic production of foreign currency funds by non-resident counterparties may have been necessitated by the fact that they adopted different strategies to exploit the high liquidity and flexibility of the market using FX swap transactions. This is partly attributed to the fact that turnover on the FX swap market substantially increased between 2003 and 2008, owing to its wide range of applicability. Because, for example, a non-resident swap counterparty can use the FX swap transaction for various purposes: for taking up a forward position, for the disbursement of a synthetic foreign currency loan jointly with the purchase of forint government securities and for yield spread speculation (see Chapter 1.3.3.). For the entire period, the turnover of FX swaps significantly exceeded the turnover of forward transactions, and thus forward positions were more likely to be taken up through swap transactions.

In macroeconomic terms, there is a major difference between the spot+swap and government securities+swap strategy of the non-resident sector: while the former only results in the pass-through of the exchange rate risk arising from net external debt, the government securities+swap strategy results overall in the financing of external debt. In relation to the spot+swap strategy of non-residents, the domestic banking system finances foreign currency lending with domestic forint savings.

From the point of view of non-residents, the entire sector not only directly finances domestic banks, but also the government; a part thereof increases forint liabilities in the balance sheet of the banking system. If a non-resident

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[42] Móré and Nagy (2004).

purchases forint government bonds, the forint amount arising from this purchase is eventually deposited on the forint account of a domestic participant. This enables the banking system to synthetically produce foreign currency funds with swap transactions. The bank commonly concludes the swap transactions with non-resident participants, and thus the non-resident participants can generate synthetic foreign currency loans through the combined application of forint government securities purchases and swap transactions concluded with banks, the credit risk of which is lower than the forint loans provided directly to the bank. Because the non-resident participant bears a credit risk exposure vis-à-vis the Hungarian government; above and beyond such risk, it only takes up the counterparty risk of the swap transaction concluded with the bank (which is hedged by virtue of the nature of the transaction itself). The non-residents purchasing forint government securities and the non-resident swap counterparties of domestic banks are not necessarily the same entities. In such case, the open exchange rate positions of the two non-resident participants neutralise each other at the sector level. The ratio of forint financing through the general government within net external debt gradually declined from 60% to 20% between the end of 2002 and June 2009, while the level of foreign currency financing through the private sector increased from approximately 45% to 65%. This may imply that the supply of synthetic foreign currency loans (swap+government securities) by non-residents, relative to net debt, declined in comparison to direct net foreign currency loans supplied to the private sector.

During the entire analysed period, the ratio of synthetic foreign currency funds significantly fluctuated at the level of the banking system. On average for the period, the ratio of synthetic foreign currency funds and customer foreign currency deposits was roughly corresponding. The two time series typically changed in opposite directions from the second half of 2006. Co-movement was particularly marked in the period January – July 2008, when the net swap stock of the banking system declined in parallel with the rise in the proportion of customer foreign currency deposits (Chart 13). Synthetic foreign currency funds were characterised by greater volatility compared to customer foreign currency deposits; as a result, they generally moved in a direction opposite to the ratio of direct external foreign currency funds (the latter estimated as a residual). Direct external and synthetic foreign currency funds moved in opposite directions after the crisis, at the end of 2008 and in early 2009. During these periods, domestic banks substituted synthetic production with the raising of direct foreign currency funds. It is important to note that the ratio of external funds remained high over the entire reviewed period, i.e. direct external foreign currency lending played an important role in the financing of external debt and closing the on-balance sheet position of the domestic banking system.

Chart 13
Ratio of synthetic foreign currency funds to the total foreign currency assets of the banking system
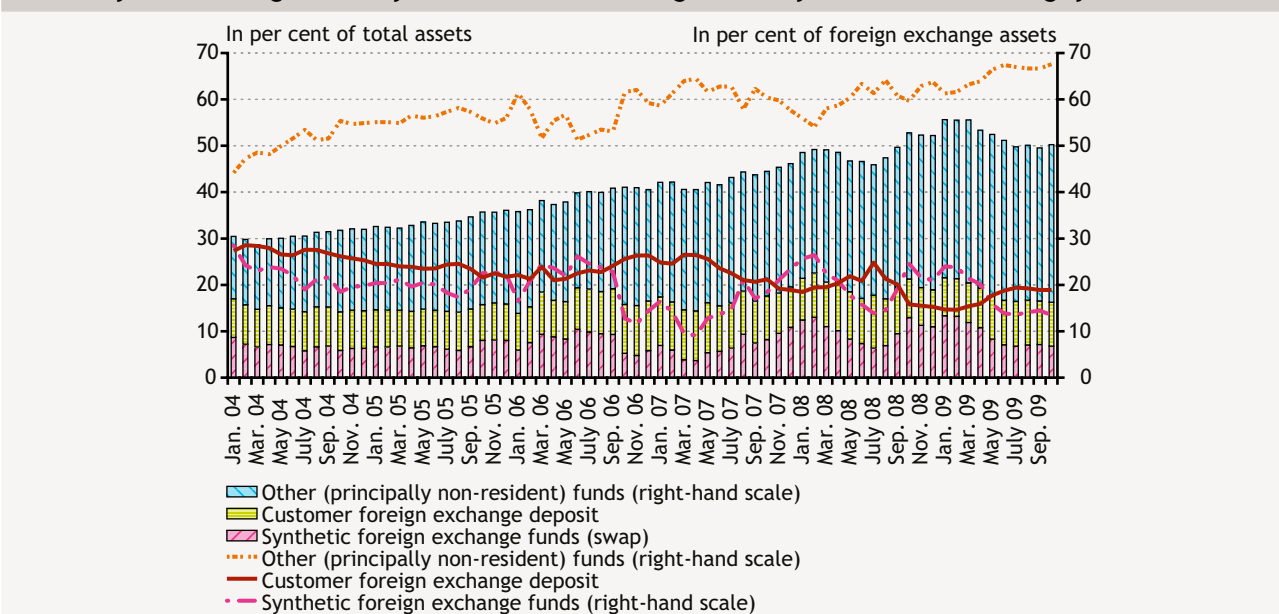
Note: Customers consist of households, companies, local governments and other financial enterprises (leasing companies). Other funds are estimated as a residual. In relation to foreign currency assets, the chart does not include loans provided to domestic credit institutions. Other (principally non-resident) foreign currency funds are estimated as a residual.

Thus, overall, in addition to the wide-ranging applicability of the transaction, the rise in the currency swap stock of the domestic credit institution system is also attributable to macroeconomic factors. In recent years, up to the crisis, the external borrowing requirement reached a high level; debt generating items played a dominant role in the financing thereof, leading to a significant rise of the net external debt of the country, and in parallel, the reliance of the banking system on external funds. The rise in net external debt obviously contributed to the opening of the exposure to the forint exchange rate. Much of this exposure was borne by the domestic private sector, accompanied by the taking up of an unhedged foreign currency position in the household and small enterprise sector. This was performed through the balance sheet of the banking system, contributing to the opening of the on-balance sheet foreign currency position, which in turn was commonly closed by the domestic banking system with currency swap transactions.

The fact that the non-resident sector assumed a shrinking share of the exchange rate exposure resulting from increasing external debt could have been entirely attributed to *the rise in the ratio of direct foreign currency cross-border loans* provided to the domestic banking system, i.e. this would not have necessarily led to the rapid increase of the swap stock of the domestic banking system. The latter development is related to several factors: conditions for raising direct external market funds deteriorated since the start of the subprime crisis, which resulted in a rise in market premia and a contraction in access to foreign funds, particularly in the case of banks without a non-resident parent bank. In addition, for most of the period, the production of foreign currency funds with swap transactions proved to be a cheaper method of financing overall, partly as a result of the higher ratio of sight deposits. The rise in the swap stock of the non-resident sector may have been necessitated by the fact that it adopted different strategies (spot+swap, government securities+swap) to exploit the high liquidity and flexibility of the market by using FX swap transactions. Following the swap market disruptions in October 2008, however, domestic banks attempted to increase the ratio of direct external foreign currency funds.

3 Decomposition of changes in the on-balance sheet open foreign currency position according to composition, volume and exchange rate effect

Changes in the on-balance sheet foreign currency position of the banking system and thus in the currency swap stock, through the hedging of the foreign currency position, may be attributed to three types of effects: the composition, volume and exchange rate effect. In this chapter, we undertake a breakdown of these effects on an aggregate basis, in the context of the total balance sheet of the banking system and for each sector. At the end of the chapter, we assess how the composition effect and the volume effect are connected through the strategy of non-resident swap counterparties.

There is a *composition effect* **if the customers of banks keep the amount of assets (loans) and liabilities (deposits) at a stable level while change their denomination structure.** For example, they expand their foreign currency loan portfolio by simultaneously reducing their forint loans, or downsize their foreign currency deposit portfolio simultaneously with an increase in forint deposit placements; in other words, the total assets of the banking system remains at the previous level. In this case, it is not necessary to increase funds to produce a rise in foreign currency assets and it is unnecessary to reduce assets because of decrease (downsizing) in foreign currency funds. The composition effect may arise in the non-resident, domestic private or government sector, if these participants transform the currency based structure of their loans and deposits, whereby the on-balance sheet foreign currency position changes.

There is a *volume effect* **if the on-balance sheet foreign currency position changes as a result of items that result in an increase or decrease in total assets.** In this case, for example, it is necessary to raise forint funds for the expansion of foreign currency loans, or if the repayment of maturing foreign currency funds is realised via a reduction in HUF liquidity. This effect occurs if household foreign currency loans increase, while forint loans and foreign currency funds remain at an unchanged level. In this case, the bank produces synthetic foreign currency funds by raising forint funds and their conversion with currency swap transactions. If the increase in foreign currency assets in this form exceeds the rise of foreign currency liabilities classified into this category, the on-balance sheet foreign currency position of the banking system increases as a result of the volume effect.

The third factor is the *exchange rate effect*. In relation to the balance sheet position, the exchange rate effect arises from the change in on-balance sheet foreign currency assets and liabilities expressed in forints as a result of changes in the foreign exchange rates *(balance sheet exchange rate effect)*. This amount corresponds to the amount by which the net foreign currency amounts of forward legs used for hedging, expressed in forints, change in reaction to foreign exchange rate fluctuations – during the given period, assuming that the on-balance sheet foreign currency position is essentially only hedged with swaps. The balance sheet exchange rate effect contains the cross rate effect, as well: if the currency of the balance sheet's foreign currency assets (e.g. CHF) differs from the currency of the foreign currency liabilities (e.g. EUR), and the dominating currency on the asset side weakens in comparison to the one on the liabilities side, this results in the opening of the balance sheet position expressed in forints. Some of this exchange rate effect only arises as revaluation: if the currency swap transaction does not mature (e.g. its maturity is identical to the foreign currency loan), the increase in the on-balance sheet foreign currency position in forints equals the rise of the net swap stock.

Due to the differing maturity structure of on-balance sheet assets, liabilities and currency swap transactions, the exchange rate effect may be accompanied by a liquidity requirement (see Chapter 1.3.). If foreign currency lending is financed with short-term FX swap transactions, and the actual foreign exchange rate is weaker than the forward exchange rate priced

in the maturing FX swaps, the direct *HUF liquidity* requirement increases in the case of transactions to be rolled over, as the forint amount received in the maturing leg is lower than the forint amount payable in the spot leg of the new transaction for the same amount of foreign currency *(rollover effect)*. (The opposite occurs in relation to transactions of an opposite direction.) In parallel with the rollover of the transactions, however, a foreign currency loan of a similar amount does not generally mature: thus, although the value of the foreign currency loan expressed in forints increases in the balance sheet, the available HUF liquidity does not increase with the amount of exchange rate weakening. For this reason, the total open position of the banking system remains closed upon rollover, but additional HUF liquidity is required for the rollover. Furthermore, the rollover effect resulting from the maturity mismatches of assets, liabilities and maturing swap transactions *only arises as a HUF liquidity requirement*; therefore, the net swap stock does not increase further, and upon rollover it only increases the swap stock expressed in forints (see subchapter 5.4.). In respect of swap transactions where two foreign currencies are swapped (e.g. CHF/EUR), the liquidity requirement arises directly in the foreign currency. Such foreign currency liquidity can also be produced by conversion of HUF liquidity with swaps, and thus it may also indirectly occur as a HUF liquidity requirement.

The margin call effect is related to changes in foreign exchange rates. Similarly to international practice, the majority of domestic banks rolling over larger swap stocks need to provide collateral to their counterparties with certain frequency, due to the counterparty risk of the FX swaps. In the event of substantial depreciation of the exchange rate, they need to increase the foreign currency amount of the required deposit in the form of a foreign currency deposit or foreign currency collateral. In most cases, the banks can meet the additional foreign currency liquidity requirements through the use of their HUF liquidity and the conclusion of new FX swap transactions. In this case, the margin call increases the swap stock as a volume effect; the on-balance sheet foreign currency position increases because the foreign currency assets of the given bank rise with the amount of the foreign currency deposit placed with the swap counterparty, and this is hedged through swap transactions. If we assume that collateralisation is continuous in accordance with the exchange rate fluctuations and it is provided through swaps, the amount of the margin call's change for the given month (expressed in forints) can be basically approximated with the amount of the balance sheet exchange rate effect for the given period, if the on-balance sheet foreign currency position and the swap stock does not change, and the swap transactions do not mature in the given period. If the bank is able to fulfil its payment obligations, upon maturity of the given swap transaction (to which the margin call agreement relates), the amount of foreign currency deposit is returned. The foreign currency liquidity resulting from this can be used for settling (foreign currency) payment obligations arising from the maturing leg of currency swaps concluded as a result of the margin call.[43] This means the volatility of the net swap stock may not only be determined by foreign exchange rate fluctuations, but also by the maturity of the underlying transactions (Table 3).[44] The margin call effect of transactions concluded in a foreign currency pair (e.g. CHF/EUR) is determined by changes in the cross rates (e.g. CHF/EUR).

With the method applied for decomposing changes in the on-balance sheet position, we carry out the breakdown of the composition, volume and exchange rate effect separately on the asset and liabilities side, and within the types of effects, considering the asset side effects with a positive sign and the liabilities side effects with a negative sign (see methodological description in Annex 16).

The advantage of this decomposition method is that it enables a breakdown of the asset and liabilities side and the composition, volume and exchange rate effect for each sector (household, corporate, non-resident).

On the basis of the above decomposition, it can be established that the increase in the cumulated on-balance sheet foreign currency position since early 2003 was principally caused by the volume effect, although the composition effect also played an important role in shaping dynamics in periods when the exchange rate of the forint significantly changed.

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[43] If the swap transaction concluded for collateralisation does not mature upon the maturity of the swap transaction serving as a basis of the margin call agreement, the bank can reduce the net swap stock (in parallel with the closing of the on-balance sheet position) with a swap transaction of an opposite direction (providing foreign currency liquidity in the spot leg). It can alternatively use it to repay its maturing foreign currency liabilities or on foreign currency placements. In the latter cases, the overall on-balance sheet foreign currency position does not change.

[44] If the fluctuation of the forint exchange rate is high, the shorter maturity of the transactions decreases its effect on the margin call and the dynamics of the swap stock.

Table 3
Comparison of the various exchange rate effects

	Comparison of the individual exchange rate effects		
	Rollover effect	**Margin call**	**On-balance sheet exchange rate effect**
1. When does it occur?	Upon maturity of the swap transactions, if the prevailing (forint and cross) exchange rate varies from the exchange rate of the maturing forward legs. (Projected onto stock rolled over on the given day.)	During the maturity of the swap transaction, commonly under extreme (forint and cross) exchange rate fluctuations.	Always upon changes in the forint exchange rate. Also upon changes in the cross-rate if the currency of foreign currency assets and foreign currency liabilities is different. Projected on the total balance sheet foreign currency position and stock.
2. Does it have a liquidity effect?	Yes, it generally arises in forints.	Yes, collateralisation is generally in foreign currency.*	Partly (and partly only a revaluation.)
3. Does it increase the swap stock?	No, only the value of the swaps expressed in forints.	Yes, it arises as a volume effect. It also increases the stock expressed in foreign currency if collateralisation is provided through swaps.	No, it basically shows the revaluation of the total stock expressed in forints. But its amount is related to the margin call's effect.
4. In the course of estimation, do we assume unchanged stock in the given period?	No, as we take into account the number of transactions rolled over which mature on the given day.	No, as we take into account the number of transactions rolled over which mature on the given day.	Yes, we assume unchanged stock in each month for the quantification of revaluation.
5. Data serving as a basis for estimation	Individual swap transactions, daily frequency D01 report	Individual swap transactions, daily frequency D01 reports	Monthly balance sheet data

Note: The rollover effect and margin call estimates are described in the Chapter 5. We did not separately perform rollover effect and margin call estimates for transactions concluded in a foreign currency pair (e.g. CHF/EUR).
* Domestic banks typically collateralise in foreign currency, but if they finance it through swaps, this first requires HUF liquidity.
Source: MNB.

In certain periods, the *composition effect* contributed to the closing of the on-balance sheet open position, and in certain periods it resulted in the opening of the foreign currency position, but up to the onset of the market turmoil occurring in October 2008, on the whole it moderately contributed to the closing of the balance sheet foreign currency position on a cumulative basis (by approximately HUF 600 billion). This effect was the strongest during the strengthening of the exchange rate observed between the spring and July of 2008 and it typically arose on the liabilities side. Upon outbreak of the crisis, i.e. in October 2008, during the weakening of the exchange rate, the composition effect moved in an opposite direction, i.e. it resulted in an increasing on-balance sheet position (Chart 14 and Annex 9).

As a result of the *volume effect*, however, the currency swap stock increased substantially, by approximately HUF 3,000 billion in the analysed period, until September 2008. (On a cumulative basis, the approximately HUF 10,900 billion volume effect appearing on the asset side up to September 2008 significantly exceeded the volume effect of an opposite direction on the liabilities side, amounting to HUF 7,900 billion.) Following the crisis in October 2008, however, on aggregate the volume effect resulted in the closing of the on-balance sheet foreign currency position until the spring of 2009.

The role of the *exchange rate effect*, however, only strengthened from the beginning of 2008. This is generally attributed to two causes: first, the on-balance sheet position, and thus the forint/foreign currency swap stock, reached a significantly higher level by that time than in the previous years, and second, changes in the exchange rate increased substantially – the exchange rate strengthened significantly from the spring of 2008 until July, and then weakened considerably starting from the crisis in October 2008. Until July 2008, the exchange rate effect reduced the on-balance sheet position expressed in forints by approximately HUF 500 billion from January 2004; thereafter, the cumulated exchange rate effect increased to roughly HUF 600 billion as a result of a weakening forint exchange rate and changes in the cross-rates.

In the breakdown of sectors as well, we can establish that prior to the crisis in October 2008, the opening of the on-balance sheet position was primarily attributed to the volume effect on a cumulative basis. The change of exposure vis-à-vis the household and corporate sector attributable to the volume effect contributed to the opening of the foreign

Chart 14

Cumulated change of the on-balance sheet open FX position since the beginning of 2004 and its decomposition
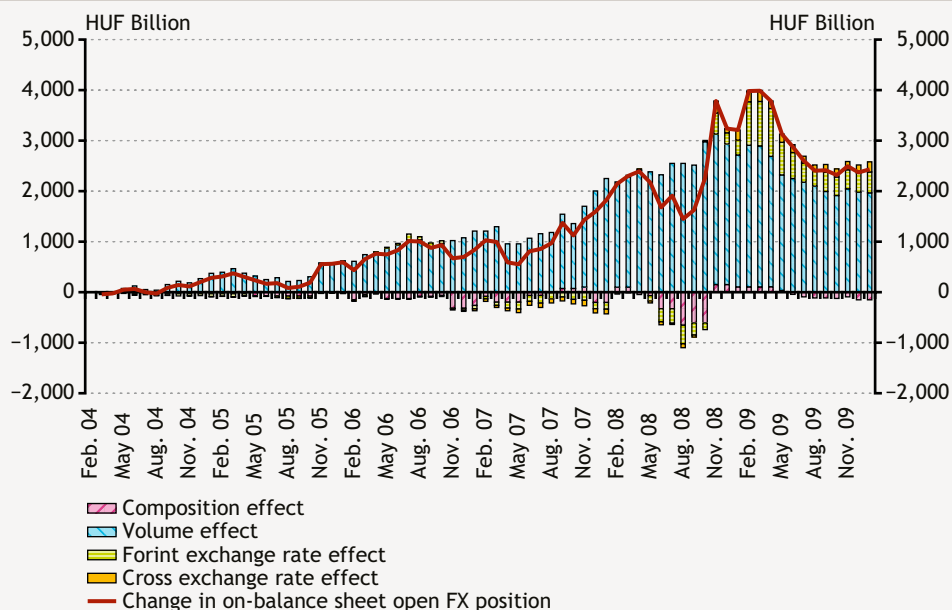

Sources: Supervisory balance sheets, D01 report, MNB.

currency position, while the change of exposure vis-à-vis the non-resident sectors resulted in its closing. With regard to the level of the foreign currency position, the composition effect played a major role only in relation to the corporate sector. For the household and non-resident sector, it only affected the dynamics of the balance sheet foreign currency position to a major degree. The composition effect materialised on the loan and deposit side in relation to the corporate sector and on the deposit side in case of the household sector, in periods characterised by larger fluctuations in the exchange rate. This is partly attributable to the multi-currency loans provided to the corporate sector, the currency of which could be modified by the companies. With respect to the non-resident sector, the composition effect modified the on-balance sheet position on both the asset and liabilities side of the banking system, although its effect was negligible in comparison to the volume effect in terms of the entire period. This implies that the growth in demand for currency swaps in the banking sector is the result of increasing corporate and household foreign currency lending, and to a lesser extent, the conversion of foreign currency funds to forints and the conversion of forint loans to foreign currency in the corporate sector. The composition effect also strengthened in the household and corporate sector in 2008: only on the deposit side in relation to households (Annex 9, Chart 2-4).

The composition effect of non-residents co-moved with the spot + swap strategy of non-resident swap counterparties and later with the composition effect of residents at the end of 2006, and particularly later, in 2008, during the period of major exchange rate changes (Chart 15). This latter can be regarded to be the mean reverting activity of the domestic private sector: the private sector contributed to the stabilisation of the forint exchange rate through the adjustment of the currency structure of its loans and funds. In other words, if we take into account that the forint exchange rate significantly weakened in the autumn of 2008, this may also imply that the foreign swap counterparties speculating on weakening of the forint were the initiators in this period, the domestic private sector adapted to the conditions through the intermediation of the banking system and this led to the widened on-balance sheet position. The composition effect of the domestic private sector and the spot + swap strategy of non-residents moved closely together with changes in the forint exchange rate (Table 4). This may be related to the fact that initially the domestic banks frequently concluded transactions at the initiative of non-residents and subsequently they did so at their own initiative, due to higher reliance on swaps.

Chart 15

The (estimated) spot + swap strategy of non-residents and changes in the composition effect of the domestic and non-resident sector
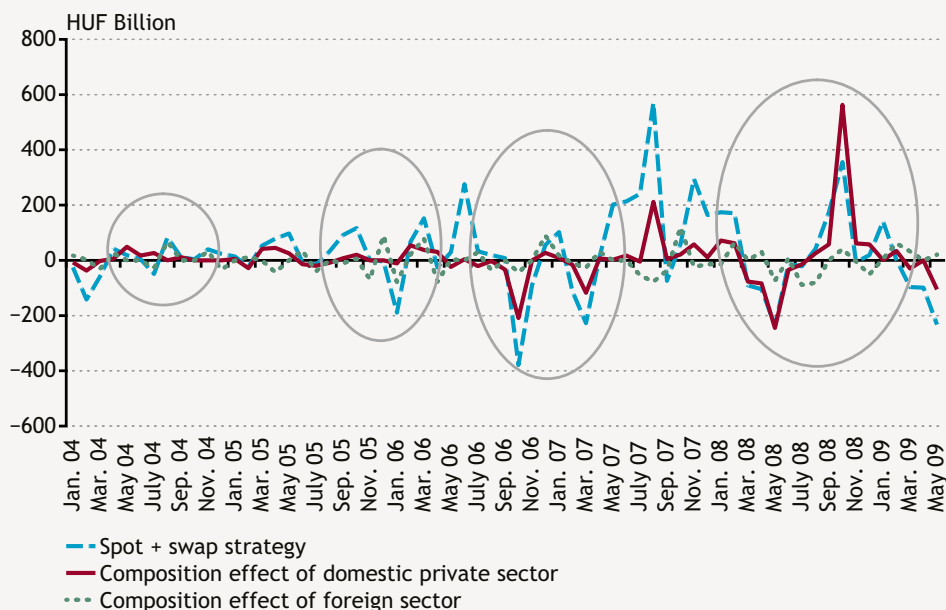
Note: In the chart, the spot+swap strategy of non-residents has a positive value if forints are purchased in the spot leg of the swap (taking up of synthetic short forward position). The composition effect of the domestic private sector and non-resident sector is positive if the on-balance sheet foreign currency position of the banking system increases. We estimated the spot+swap strategy of non-residents by calculating for each day the minimum absolute value of spot market HUF purchases and the change in the net swap stock if these changed in opposite directions and used these with the sign of the change in the swap stock. Finally, we cumulated these for the given month.
Source: MNB, own calculations.

The volume effect moved partly with the swap+spot strategy of non-residents and partly with the forint placement+swap strategy of non-residents (Table 5). The non-resident sector provides forint funds principally on the government securities market, and hence through the general government, while the ratio of forint funds provided directly to the banking system is negligible in comparison. Thus, a part of the volume effect may have been linked to the fact that non-resident counterparties purchased government securities with the forint amounts acquired through the spot leg of the currency swap, thereby providing synthetic foreign currency funds to the domestic economy. The other, substantial part of the volume effect is related to the fact that the funds partially contributing to the growth in foreign currency based lending were financed by domestic forint savings (and not indirect foreign inflows of funds) at the sector level, and the resulting exchange rate risk was hedged by domestic banks with a spot+swap strategy concluded with non-residents.

In the analysed period (between 2003 and September 2008), the government securities portfolio of non-residents increased approximately by only HUF 1,300 billion – significantly less than our estimate of the cumulated volume effect observed in the period (Annex 10). Thus, even if the total increase in the government securities portfolio had been produced through swap transactions, the aggregate value of the swap+government securities strategy would still fall significantly short of our estimate of the volume effect for the entire period. Moreover, if we also take into account the

Table 4

Correlation of the spot + swap strategy of non-residents with the composition effect of the domestic private sector and non-residents

	Composition effect of domestic private sector	Composition effect of non-residents
January 2004–June 2006	41.6%	42.8%
July 2006–May 2009	73.6%	12.4%

Source: MNB, own calculations.

Table 5
Co-movement of the swap + forint asset purchase, spot + swap strategy of non-residents with the volume effect

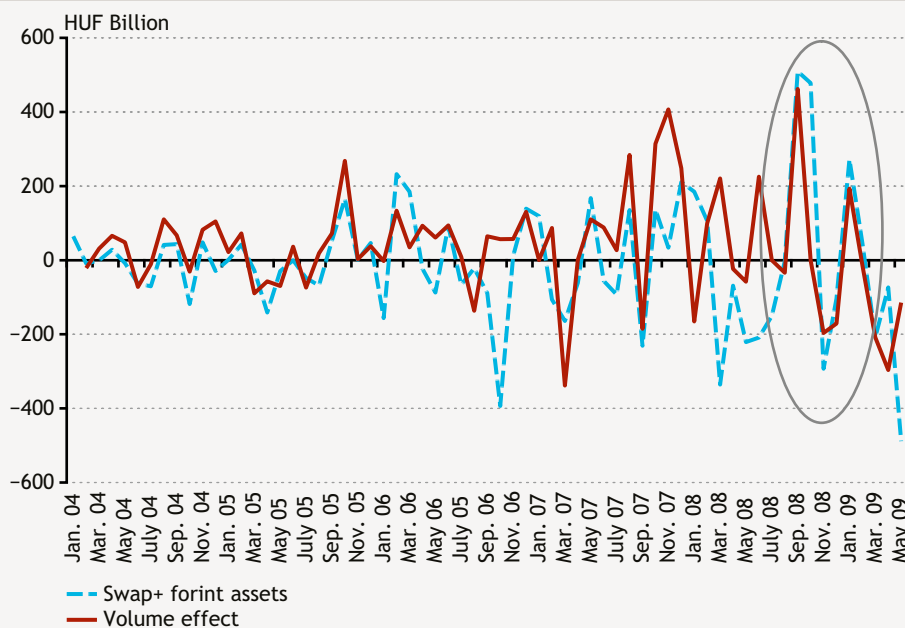|	Swap+ forint assets	Spot + swap
January 2004–June 2006	64.9%	31.6%
July 2006–August 2008	25.7%	**46.7%**
September 2008–May 2009	**74.9%**	57.9%

Source: MNB, own calculations.

forint funds provided by the non-resident sector to the banking system, the cumulated change in forint funds up to September 2008 does not reach the volume effect of the banking system calculated for the given period.

Following outbreak of the crisis (from the end of 2008), co-movement between the government securities+swap strategy of non-residents and the volume effect strengthened (Chart 16). In addition to the decline in the supply and demand for foreign currency loans, this may also have been due to the fact that the net swap demand of non-residents also declined with the sale (or maturity) of government securities by non-residents, possibly leading to the closing of the on-balance sheet foreign currency position of the banking system.

Thus, based on the decomposition of the domestic banking system's on-balance sheet foreign currency position, we can conclude that its expansion is principally attributed to the volume effect, i.e. it increased in reaction to items that also affected the balance sheet total. Foreign currency loans extended to the domestic private sector contributed to the combined increase in the balance sheet total and the on-balance sheet foreign currency position. The composition effect, i.e. the modification of the foreign currency structure of loans and deposits by bank customers, was moderate in terms of the whole period in comparison to the volume effect; it only affected the dynamics of the swap stock within the period up to the crisis. The composition effect materialised on the deposit side of households and on both the loan and deposit side of companies, as a result of the multi-currency loans.

Chart 16
Co-movement between the volume effect and the forint assets + swap strategy of non-residents

Note: In the chart, the swap + forint assets strategy of non-residents has a positive value if the non-resident purchases forints through the spot leg of the swap. The volume effect is positive if the on-balance sheet foreign currency position increases. We estimated the swap + forint assets strategy of non-residents by calculating for each day the minimum absolute value of the change in forint government securities + bank funds and the change in the net swap stock if these changed in the same direction, used these with the sign of the change in the swap stock and cumulated the values for the given month. Similar results are obtained if we only consider government securities, without bank forint funds.
Source: MNB, own calculations.

In October 2008, during the weakening of the forint exchange rate, the composition effect significantly contributed to the opening of the on-balance sheet foreign currency position, and the composition effect of the domestic private sector moved closely with the spot + swap strategy (forward sale of forints) of non-residents. This means that the domestic private sector contributed to the stabilisation of the forint exchange rate through the transformation of the currency structure of its loans and deposits, while the spot market forint sales of non-resident participants weakened the exchange rate with low implied yield spreads. The volume effect partly co-moved with the forint assets + swap strategy of non-residents and partly with the spot + swap strategy. Thus, the volume effect is partly attributed to the fact that foreign currency based lending was partly financed by internal forint savings. Following outbreak of the crisis, the correlation between the government securities+swap strategy of non-residents and the volume effect strengthened; the net swap demand of non-residents also declined with the sale (or maturity) of government securities by non-residents, while the on-balance sheet foreign currency position also began to close in parallel with the balance sheet adjustment of the banking system.

4 The domestic FX swap markets during the crisis

4.1 INTRODUCTION

This chapter of the study focuses on the effect of the global financial crisis emerging in the autumn of 2008 on the functioning of the domestic FX swap market, particularly on turnover and implied forint yields. In the framework thereof, we first briefly outline the main aspects of the individual stages of the financial crisis on a global scale and also outline the most important impacts on the domestic financial markets. We do not wish to provide an in-depth chronology of the crisis and wish only to analyse the aspects that are necessary for the understanding of the trends on the domestic FX swap market. Since the impact of the radical change affecting the domestic financial markets passed through in a pronounced form to the domestic markets in the period following the Lehman bankruptcy, we will focus on changes occurring from September 2008 in relation to the turnover and price data of the FX swap market; the developments in the pre-Lehman period are described only where these are deemed to be important for comparison purposes, in the context of the analysis.

In our analysis, we have broken down the entire examined period into the following stages:

1. Period before the emergence of subprime crisis, before July 2007 ("golden age")

2. Emergence of subprime crisis, end of July 2007 – 15 September 2008

3. Lehman bankruptcy, 15 September 2008 – 31 December 2008

4. Stabilisation of developed financial markets, 1 January 2009 – early April 2009

5. Recovery on the financial markets, from early April 2009

4.2 GLOBAL FOREIGN CURRENCY LIQUIDITY PROBLEMS AND DECLINING INTERBANK CONFIDENCE

During the period preceding the emergence of the subprime crisis in July 2007 (stage 1), investors were able to cheaply obtain the necessary foreign currency funds in practically unlimited amounts, and thus the Hungarian banking system was not confronted with liquidity constraints in the process of swapping its HUF liquidity with foreign currency on the domestic FX swap markets. In the second stage of the reviewed period, following the emergence of the subprime crisis, liquidity disruptions on the developed interbank markets were evident: this was clearly indicated by the 50-100 basis point surge in the LIBOR-OIS spread, effectively reflecting the interbank market turmoil (Chart 17). In this period, the dollar market was clearly struggling with the largest liquidity problems; the Swiss franc and euro markets only experienced minor difficulties at that time.

This, in itself, however, did not result in quantity constraints for acquiring the necessary foreign currency liquidity; at this stage of the crisis, investors were still able to access almost unlimited foreign currency funds with a higher premium.

The financial markets dried up in reaction to the lack of confidence following the Lehman bankruptcy. The earlier picture fundamentally changed in the third period we analysed, the period following the bankruptcy of Lehman in September 2008. The premia of interbank yields surged radically by several hundred basis points on the markets of all major currencies, and the markets essentially dried up. As a result of the growing lack of confidence among financial

Chart 17
The 3-month LIBOR–OIS spread in dollar, euro, pound and franc
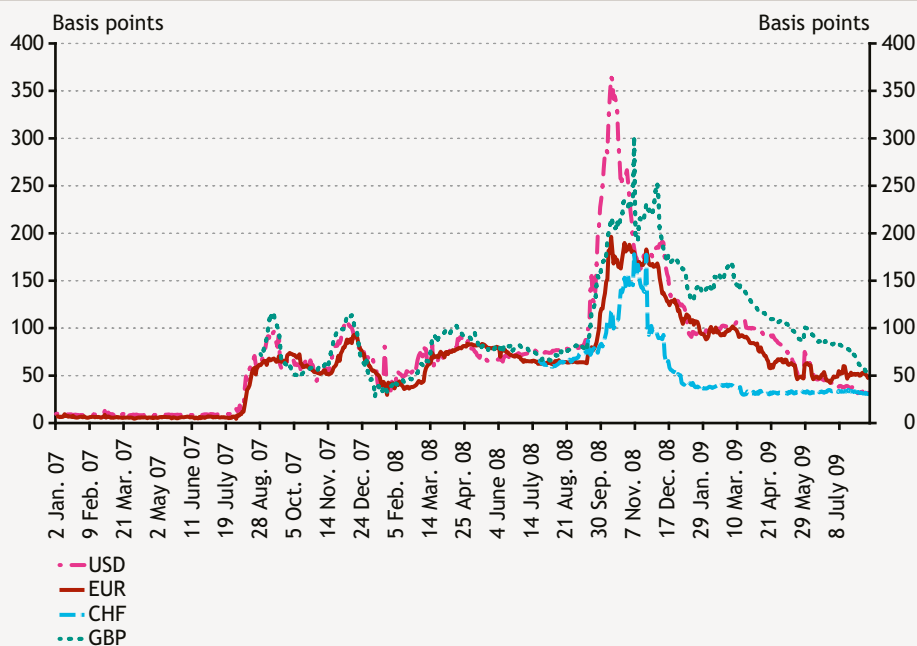
Source: Thomson Reuters.

institutions, banks radically reduced their interbank credit limits, institutions with a foreign currency liquidity surplus invested their surplus liquidity either in the deposit instruments of the central bank or the safest American and German government securities. This posed multiple risks for the banks of emerging countries. First, financial institutions were unable to roll over their maturing foreign currency debts on the interbank markets, or only at considerable costs. Second, there was a realistic risk that the global banks which experienced major difficulties on the developed markets would not roll over (or cancel before maturity) their foreign currency loans provided to subsidiaries operating in emerging countries.

The government and central bank reactions to the deepening of the crisis improved the liquidity of the global financial markets only with a delay and on a gradual basis. Central banks and governments attempted to manage the radical deterioration of the interbank market with a series of complex measures: a radical reduction in base rates, implementation of programs targeting the capitalisation of banks, launching of asset purchase programs, introduction of liquidity providing instruments with longer maturity, the set-up of FX swap lines between the major central banks and the expansion of government guarantee schemes aimed at reducing the uncertainty characterising the banking sector and enabling participants to acquire the foreign currency liquidity necessary for the operation of the system. As a result of the measures, consolidation of the market began, the interbank market premia gradually declined from the end of 2008 (stage 4) and the liquidity position of financial institutions improved significantly. Nevertheless, the strong intervention by the central banks had several consequences. From our point of view, the most important one is that the developed interbank markets played a reduced role in the reallocation process of FX liquidity; financial institutions primarily acquired their necessary foreign currency funds directly from the central banks. As a result, the operation of resident financial institutions was disrupted in countries where the local central banks were unable to provide FX liquidity to the resident banks; these could continue to obtain the necessary funds on the developed interbank markets only at a high cost and with short maturity.

The other important consequence of the central bank measures was that the lack of funds in the system as a whole gradually decreased as a result of the rapid interest rate cuts, the increasingly expanded quantitative easing programs, and the declining demand for loans attributable to the real economic downturn. Furthermore, there was growing liquidity from the spring of 2009. Initially these funds were only invested in the safest government securities, resulting in a radical decline in the yields of American and German bonds. From April 2009 (stage 5), however, international investor sentiment began to improve radically: by this stage, the markets commonly shared the view that the financial intermediary system

had very likely avoided a collapse and the real economic downturn would soon bottom out. In addition, the better-than-expected agreements concluded at the G-20 summit and the introduction of a more flexible crisis management policy announced by international organisations provided a major boost to market sentiment. In reaction to the upturn in risk tolerance resulting from the above developments, the direction of capital flow again reversed and a larger amount of capital began to flow in the direction of more risky market instruments. This substantially reduced the premium of interbank market yields vis-à-vis government securities, which thereby declined in the summer of 2009 to a level measured before the Lehman bankruptcy.

4.3 EFFECT OF THE CRISIS ON FOREIGN CURRENCY LIQUIDITY FLOWING INTO DOMESTIC INSTRUMENTS

Prior to the emergence of the financial crisis, Hungary was also a beneficiary of international capital flows. On the one hand, owing to ample accessible liquidity, domestic participants could access foreign currency liquidity at a low premium, leading to a rapid increase in debt in both the private and the government sector.

On the other hand, Hungary became an important target country for carry trade activity, due to the high risk tolerance of international investors and the high yields on the Hungarian forint instruments. During stage 2 of the reviewed period, it seemed that the financial crisis emerging in the developed countries would only marginally affect foreign investments in domestic instruments. At this stage, the drying up of foreign funds was not yet foreseeable. This view was evidenced by the strengthening of the forint's exchange rate and the continuing growth of the government securities portfolio of non-residents, although certain warning signs already surfaced in this period (e.g. the government securities "mini crisis" in March 2008, rise in Hungary's default premium).

In the period following the Lehman bankruptcy (stage 3), the disappearance of market liquidity severely affected Hungary. Due to the high external debt of the private and government sector and high reliance on international financing, investors rated Hungary in the group of most vulnerable emerging countries. As a result of the indebtedness, the radical decline in global risk appetite exhausted the external funds of both the government and the private sector, significantly contributing to the country's need to turn to international organisations. During the period of the stabilisation of the international markets (stage 4), Hungary's position essentially did not improve: the government securities portfolio of non-residents declined, the forint hit a new low, and yields and volatility were on the rise. In stage 5, beginning in April 2009, an improvement was perceivable on the domestic markets as well, and the period of consolidation has continued up to the date of completing this study.

4.4 CHANGES IN THE FORINT EXCHANGE RATE AND RELATED EXPECTATIONS

During the period when the financial crisis (stage 3) deepened, trends on the domestic FX swap markets were significantly affected by several factors related to the disappearance of foreign currency liquidity. In particular, these include the weakening of the forint exchange rate, the rapid change in expectations relating to the exchange rate, the surge in outflowing stock relating to margin calls, and the direct exchange rate effect arising in connection with the rollover of FX swap transactions.

From September 2008, expectations relating to the forint exchange rate changed significantly: following the earlier, moderately asymmetric expectations, in the short term the market expected rapid weakening of the exchange rate, followed by a slower weakening linked to the positive change in market sentiment (stage 5). During the period following the Lehman bankruptcy, the forint exchange rate underwent a major change within a short period of time: while the domestic currency experienced relatively rapid appreciation in 2008 H1, the forint exchange rate weakened by nearly 15 per cent in a single month starting from the middle of September, as a result of the emerging crisis. The changes affecting international investor sentiment rapidly transformed expectations relating to the forint exchange rate; the skewness of the estimated distribution of the exchange rate expected in one month radically increased (Chart 18), indicating that investors expected further weakening with higher probability than a strengthening of the exchange rate.

Although the exchange rate of the forint stabilised from October 2008 until the end of the year, expectations of weakening continued to rise. This expected depreciation of the forint exchange rate occurred in the first months of 2009: in two

Chart 18
The forint exchange rate and skewness of the estimated distribution
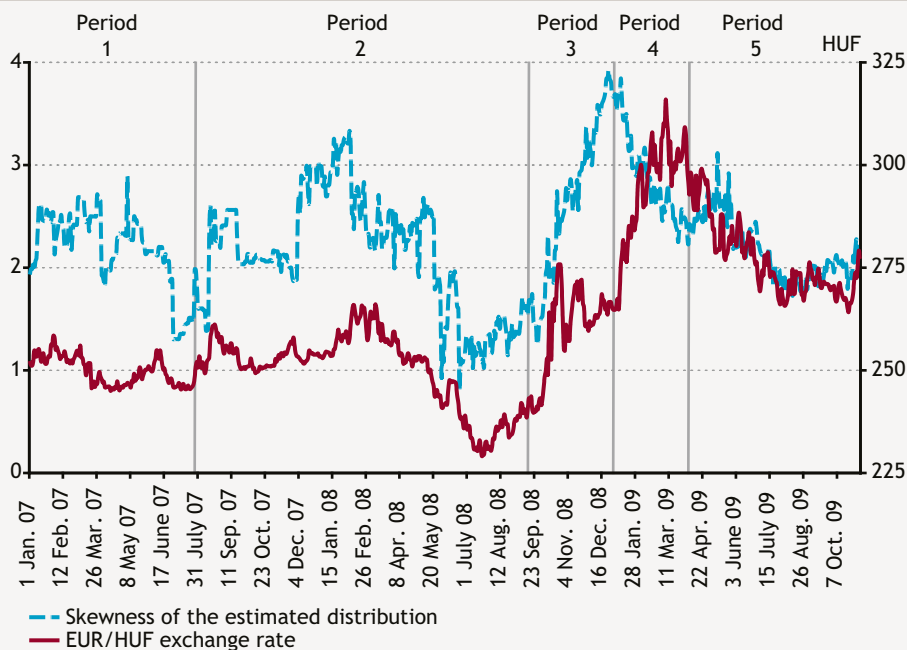
Source: Bloomberg.

months, the national currency weakened by an additional 20 per cent, reaching a low of roughly 317 against the euro. Although by March 2009 the skewness of estimated distribution lessened from the record levels recorded at the end of the year, the indicator remained higher than the long-term average, indicating that investors expected further weakening of the forint exchange rate. From April 2009, in reaction to the shift in international investor sentiment, the forint exchange rate experienced a relatively rapid adjustment: it strengthened by approximately 8-10 per cent against the euro in three months, and then fluctuated around the 270 level reached in the middle of summer, with relatively high volatility. The skewness of the expected exchange rate distribution also stabilised around the long-term average level.

Each month, the Reuters surveys indicated a weakening exchange rate path for the short term (3-6 month maturities), followed by strengthening over a 1-year period reaching the level recorded on the date of the survey. The co-movement of the skewness of the estimated distribution and the swap stock of non-residents – particularly observed from the middle of September until the end of October – may suggest that during this period the expectations of non-residents relating to the depreciation of the forint exchange rate played an important role in the rise of the net swap stock, concurrently with the difficulties underlying access to foreign currency liquidity.[45]

4.5 TURNOVER ON THE DOMESTIC FX SWAP MARKET

In the period preceding the financial crisis, the majority of financial analysts assumed that the FX swap market could not dry up, as the transactions' counterparty risks are lower than that of unhedged interbank placements. Beyond the relatively stable exchange rate and interest rate expectations, this assumption was based on the premise that the financial markets offer easy access to cheap and ample liquidity in both the domestic and foreign currency. The situation emerging after the Lehman bankruptcy, however, was new in several respects: foreign currency liquidity was available on the interbank markets only in a much more limited quantity and at a much higher price (see Chapter 4.1.); due to the radical upsurge in risk aversion, expectations relating to the forint exchange rate and interbank forint yields significantly changed

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[45] See Chapter 1.3.3.1.

Chart 19
Distribution of total euro and dollar swap market turnover at banking group and non-group level in HUF billion
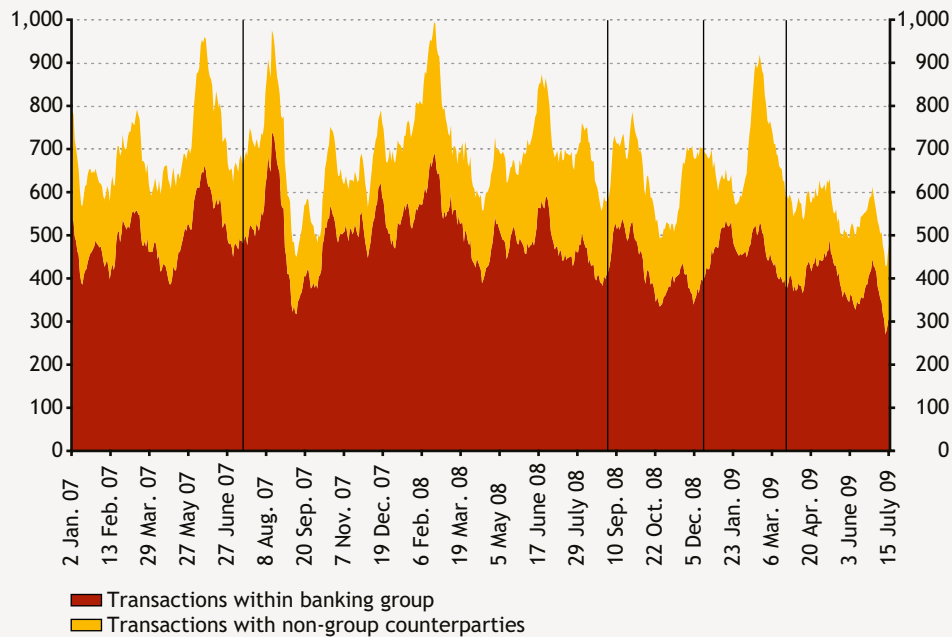
Source: MNB.

and became much more volatile. This had a direct effect on the domestic FX swap markets. With growing uncertainty, there were signs of the drying up of the market: foreign currency liquidity became much more expensive, the limits of market participants vis-à-vis each other contracted, turnover became extremely volatile and the maturity of transactions shortened significantly. It is also clear, however, that these market disruptions affected specific market participants to varying degrees. We analyse these trends below in greater detail, focusing in particular on the changes occurring in the most severe period of the crisis, during the six months following the Lehman bankruptcy, in comparison to trends observed in the previous period.

**The total average turnover of the domestic FX swap market did not decline permanently to an enormous degree during the period when the crisis was spreading, but market liquidity declined significantly on a few trading days and access to foreign currency liquidity became extremely limited.** Although we witnessed a larger decline in total market turnover in the period following the Lehman bankruptcy, a similar decrease had occurred in other periods as well (Chart 19). Thus, this decline is not considered to be extraordinary, but we should note that market turnover remained below the long-term average for a relatively long time during the October period. It is also clear that the decline was temporary and from the middle of November, the 10-day moving average of total daily turnover rose to approximately the previous average. It is nevertheless important to note that the shortening of the maturity of transactions partly contributed to the relatively moderate decline in turnover.

Daily (previously volatile) turnover data also clearly show that the trading days on which the turnover of the domestic FX swap market plunged to 30-40 per cent of the long-term average were in October, during the most critical days of the crisis. Beyond the above, anecdotal information at the time and data provided by financial institutions also clearly imply that the crisis affected the specific market segments and different market participants to various degrees. The market structure underwent major changes in a relatively short period of time: due to lacking foreign currency liquidity and the substantial contraction of interbank limits, major changes occurred in the counterparties of certain market participants, the concentration of certain market segments, the maturity and pricing of concluded transactions and the turnover share of participants adopting different strategies. In the following section, we analyse the market segments where these changes were concentrated and their form.

In parallel with the deepening of the crisis, the role of transactions at the banking group level increased; following the temporary uncertainties of October, parent banks were able and willing to take up the position of the external

Chart 20
Distribution of total euro and dollar swap market turnover at the banking group and non-group level in per cent
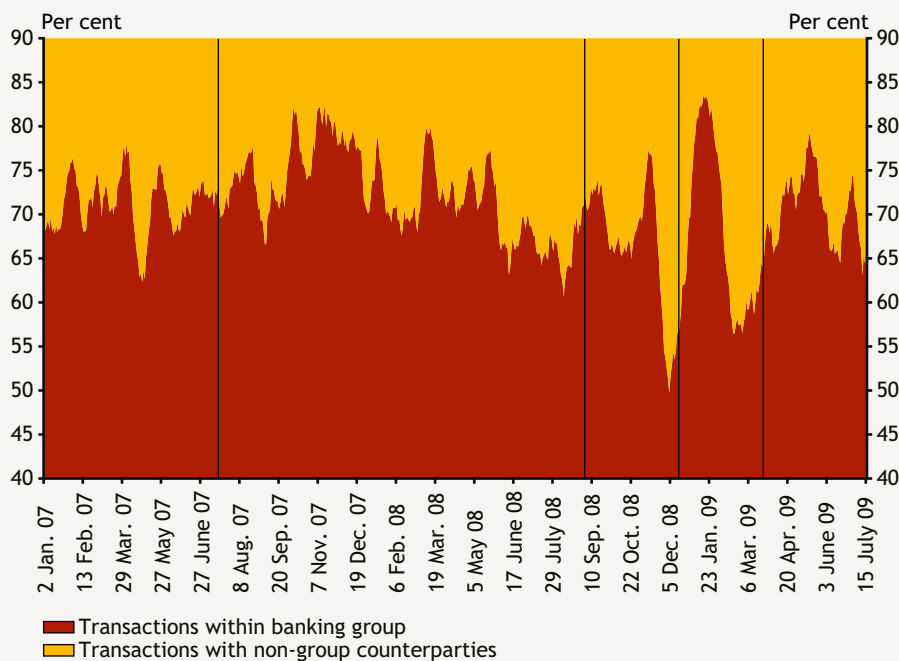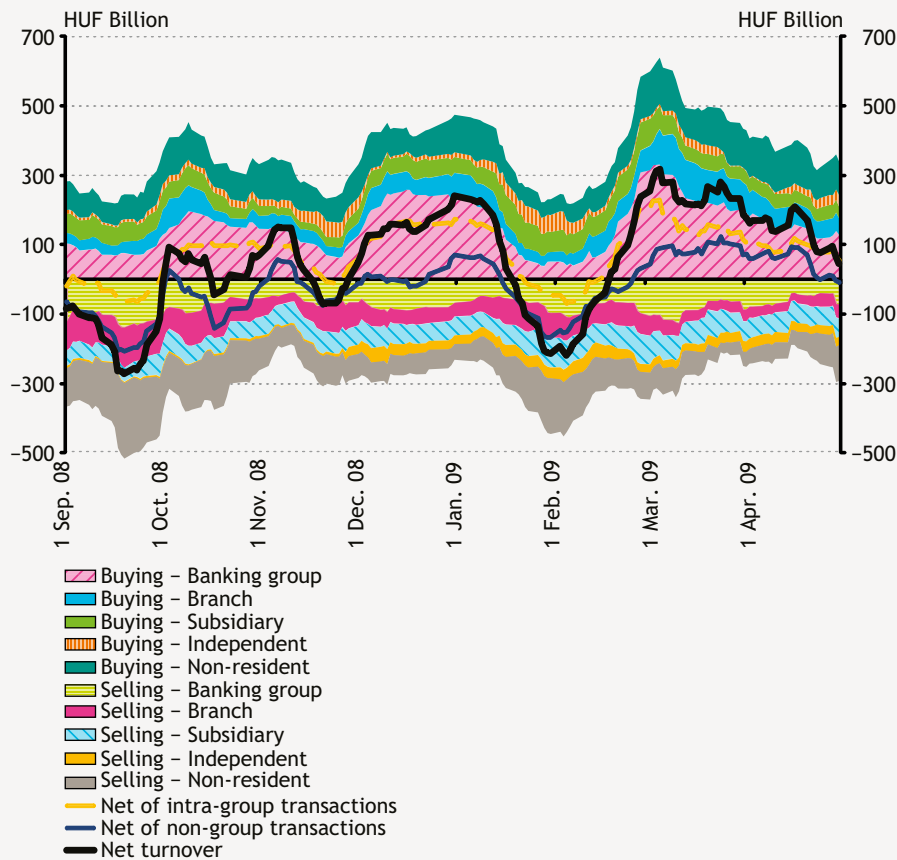

Source: MNB.

counterparties leaving the markets. Although we observed that the downturn in total market turnover was not extraordinary, the change is much larger in relation to the ratio of transactions concluded at banking group and non-group level (Chart 20). At the time of the downturn in October 2008, turnover at the banking group and non-group level declined by nearly the same rate, but the adjustment occurring by the end of the year was clearly attributed to the parent banks' replacement of the previous external participants. Owing to the above development, there was a period in December when half of total market turnover was made up by transactions at the banking group level.[46] This change is even greater if we examine the role of parent banks in providing foreign currency liquidity to their domestic subsidiaries: the share of parent banks in the turnover of transactions providing foreign currency liquidity for domestic banks increased from an average of 30-35 per cent in the previous period to 50 per cent. This all supports anecdotal information that domestic banks were able to access foreign currency liquidity from external counterparties only with significantly tightening limits and/or high premia, and thus a growing number of such banks resorted to transactions within their own banking group.

The role of parent banks changed during the different stages of the crisis; in the period of temporary improvement, turnover was once again concentrated on transactions at the non-group level, and with the weakening of the forint, the role of parent banks again gained relevance. After the first wave of panic caused by the Lehman bankruptcy subsided, international investor sentiment improved moderately, Hungary secured the funds necessary for financing through the IMF package, and there was a certain amount of consolidation on the domestic swap market, as well. Turnover was on the rise, and in parallel, the ratio of transactions concluded with non-group counterparties surged to historical highs. In parallel with the renewed rise in the inflow of funds from external counterparties, the absolute turnover of transactions concluded at the banking group level declined. In parallel with the weakening of the forint and the renewed worsening of investor sentiment, the ratio of parent banks in total turnover again increased in February and March 2009 (Chart 20). In contrast to October, this was less related to the decline in the absolute turnover of transactions concluded with external counterparties and much more to the surge in the turnover of transactions concluded at the banking group level. Although turnover rose above the long-term market average during this period, it is important to note that this is chiefly attributable to the fact that domestic banks managed to roll over their existing portfolios through the conclusion of transactions with

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[46] Between 1 January 2007 and 30 July 2009, the average value of the proportion of transactions at the banking group level to total turnover amounted to 29 per cent.

Chart 21
Turnover of the total domestic FX swap market, in a breakdown of foreign currency buying and selling sides[47]
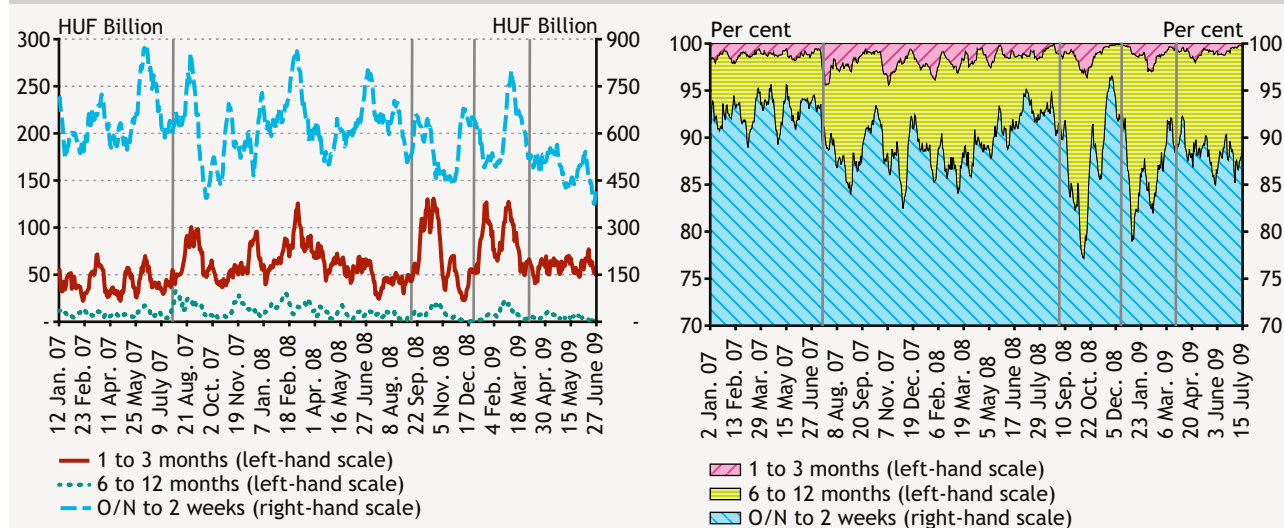

Source: MNB.

maturities that were significantly shorter than in the past. These are in line with the maturity of portfolio data to be analysed later, where dynamic extension commenced somewhat later, in the middle of March 2009 (in relation to banks with parent banks).

The domestic banking system took up a net foreign currency lender position on the domestic FX swap market immediately after the Lehman bankruptcy, but from the middle of October, with the exception of shorter, transitional periods, it acted as a net foreign currency buyer. (Foreign currency buying and selling refers to the spot leg of FX swaps.) As a result of the drying up of the developed interbank markets in September 2008, the domestic banking system took up a net foreign currency seller position on the domestic FX swap market (Chart 21): in particular, the forint sales/foreign currency purchases of external non-group counterparties took an upturn, but the domestic banking system also sold foreign currency in the framework of transactions at the banking group level. Similar conditions arose once again for a prolonged period in the whole of the analysed period in February 2009; in this case, too, the domestic banking system sold foreign currency in net terms with transactions both at the banking group and non-group level. With the exception of these two periods of several weeks, domestic banks acted as net foreign currency buyers in the analysed period. It is clear, however, that this is chiefly attributable to transactions at the banking group level, as transactions at the non-group level resulted in net foreign currency selling overall for most of the period ending in March 2009. Thus, some of the foreign currency liquidity acquired from the parent banks left the domestic banking system and served as a source of the forint sales of non-resident counterparties on the FX swap market.

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[47] All data indicate a 10-day moving average. The individual categories in the chart show the volume of foreign currency buying and selling transactions concluded by the entire domestic banking system vis-à-vis the given partner groups. The term "Banking group" indicates transactions concluded within the banking group; the categories "Subsidiary", "Branch" and "Independent" contain transactions concluded with domestic banks of the appropriate type, while "Non-resident" indicates the turnover of transactions concluded with non-group non-resident counterparties.

Chart 22.a and 22.b
Breakdown of euro and dollar swap market turnover in HUF billion and in proportion of total turnover[48]

1 to 3 months (left-hand scale)
6 to 12 months (left-hand scale)
O/N to 2 weeks (right-hand scale)

1 to 3 months (left-hand scale)
6 to 12 months (left-hand scale)
O/N to 2 weeks (right-hand scale)

Source: MNB.

The ratio of non-resident counterparties within non-group transactions declined substantially. If we only examine the role of non-group counterparties, it is clear that the decline in turnover in October was chiefly attributable to the decline in transactions concluded with non-resident counterparties. As a result, the ratio of non-resident counterparties within non-group transactions fell significantly to below 50 per cent from the average 68 per cent measured earlier, and save for a few minor rebounds, it remained well below the level of the earlier average over the entire analysed time horizon. On the basis of the foregoing, we may conclude that while the turnover of transactions concluded with domestic counterparties increased moderately over the reviewed time horizon, turnover concluded with non-residents declined in terms of both the ratio and absolute value amidst much more intense volatility. As noted above, the parent banks took over the place of the non-resident counterparties exiting the market in the most severe period of the crisis, but as foreign currency liquidity became accessible again (provided by external counterparties) on the market or from other (e.g. central banks) sources, the parent banks limited their activity.

In the period when the crisis was spreading, the maturity of the concluded transactions shortened considerably; in certain periods, longer-term transactions with several months maturity were excluded from the market. On the basis of anecdotal information at the time (see Kállai and Kőszeghy, 2009), one could assume that the maturity of domestic FX swap market transactions shortened significantly in the period following the Lehman bankruptcy; the necessary foreign currency liquidity was accessible only in the framework of transactions with short maturity (overnight, tomnext, possibly 1 week) due to the shortage of liquidity and the sharp rise in lacking confidence among the banks. Our data supplied by banks only partially support this assumption. In the first half of October, the turnover of transactions with 1-month to 3-month maturity (Chart 22.a) took an upturn; the ratio of these transactions increased and similar growth was measured in relation to FX swap transactions with a maturity of 6-12 months. Since the turnover of transactions with a shorter maturity (with maturity of less than 2 weeks) did not change significantly, their ratio decreased to a historical low of 75 per cent of total turnover (Chart 22.b). The above trend reversed at the end of October and transactions with longer maturities were increasingly excluded from the market; from the middle of November, there were several weeks when there were almost no transactions with a maturity of over 180 days on the market and the turnover of 1- to 3-month transactions also declined significantly. Similar trends were seen in the first months of 2009 as well: with the temporary improvement in market sentiment, transactions with longer maturity regained ground, followed by renewed concentration on transactions with shorter maturity in reaction to the re-emergence of problems in February. The longer-term, 3- and 6-month FX swap tenders introduced by the MNB in March 2009 presumably contributed to halting the decline in the average maturity of transactions by the end of March, and a moderate increase has been observed since then.

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[48] Chart 22.a: market turnover, Chart 22.b: relative. For better visibility, the scaling of Chart 22.b begins at 70 per cent.

In parallel with the upturn in the activity of parent banks, we observed a substantial decline in the average maturity of transactions. If we separately examine the breakdown of turnover at the banking group and non-group level on the basis of maturity, significantly larger changes can be observed in connection with the latter. In the period following the Lehman bankruptcy, in relation to transactions concluded with external counterparties, only transactions with the longest, 6- to 12-month maturity disappeared from the market; in the analysis of turnover weighted with maturity, however, the ratio of transactions with medium term, 1- to 3-month maturity did not decrease significantly. With respect to transactions at the banking group level, however, transactions with the shortest maturity were clearly favoured: on a nominal basis, 85 per cent of transactions concluded in November 2008 were shorter than 14 days, and the ratio of transactions with a maturity of less than two weeks reached a record level with respect to turnover weighted with maturity. As a result of the above, in combination with the rise in the ratio of transactions at the banking group level, the average maturity of total market turnover shortened significantly. Parent banks are likely to have adopted a strategy which enabled them to provide funds to their subsidiaries on days when they were unable to acquire necessary liquidity from external participants, but the shorter maturity allowed them to quickly withdraw the provided liquidity under certain circumstances (e.g. improvement of market conditions or – in a worse case – the deterioration of their own liquidity position). This motivation contributed significantly to the decline in the maturity of turnover at a rate not witnessed in the past. We may assume, however, that in the absence of financing provided by the parent banks, domestic banks could have accessed foreign currency liquidity under even worse conditions (with shorter maturity or higher yields).

4.6 HOW DID THIS AFFECT MARKET YIELDS?

Although the turmoil on the domestic FX swap market can be clearly identified in the decline in market turnover and changes in concentration, the most pronounced changes clearly materialised in price indicators. Notwithstanding that the FX swap transaction is basically regarded as a hedged transaction, the implied forint yields established on the domestic market fell short of the forint yields of interbank unhedged transactions by several hundred basis points in the most critical days of the crisis.[49] This study does not aim at identifying the factors determining the yields of FX swap transactions; we only focus on the description of the main trends. Furthermore, we do not analyse the effect of central bank measures on FX swap yields; this may comprise the object of future research.

The departure of implied forint yields in transactions with short maturity meant that the implied forint yield of FX swap transactions dropped well below the base rate. In practice, this meant that forint funds were accessible on the FX swap market cheaper than the short-term interbank yields adopted by the central bank as an operational target, which considerably worsened the efficiency of the interest rate channel. From the perspective of the other side, this means that domestic banks could access necessary foreign currency liquidity on the domestic FX swap market only through the payment of a high (several hundred basis point) premium compared to the prevailing foreign currency yields. We observed similar developments in relation to FX swap transactions with longer, 1- to 12-month maturity.

It is worthwhile, however, to examine the difference between the individual market segments. In the following, we explore the differences in the pricing of FX swap transactions concluded by the given market participants during the most severe period of the crisis, namely in the few months following the Lehman bankruptcy. We also attempt to analyse the above in terms of maturity, currency and the direction of the transaction (i.e. whether the market participant acquired foreign currency or HUF liquidity in the spot leg of the transaction).

With the deepening of the crisis, a substantial difference soon emerged in the implied yield levels of forint and foreign currency purchase transactions. By comparing changes in the implied forint yield (Chart 23.a) of transactions involving a foreign currency purchase in the spot leg (from the point of view of domestic banks) with changes in the yields of transactions involving HUF purchases (Chart 23.b), it is clear that before September 2008, the implied forint yields typically fluctuated within the interest rate corridor determined by the central bank's overnight forint deposit and loan interest rates. In reaction to the deepening crisis, these rapidly decreased and within a short time, a difference of even several hundred basis points evolved between the level of the base rate and the implied forint yield of FX swap market

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[49] We calculated the implied forint yields from the swap points of actual transactions. For the given days, we applied the daily averages weighted with the volume of transactions. For the calculation of implied forint yields, we applied foreign yields of the appropriate maturity. For the purpose of more effective illustration, all charts in Chapter 4.6 show the 5-day moving average of implied forint yields weighted with daily turnover.

Chart 23.a and 23.b

Implied forint yields on the FX swap market relating to transactions involving foreign currency purchases and HUF purchases
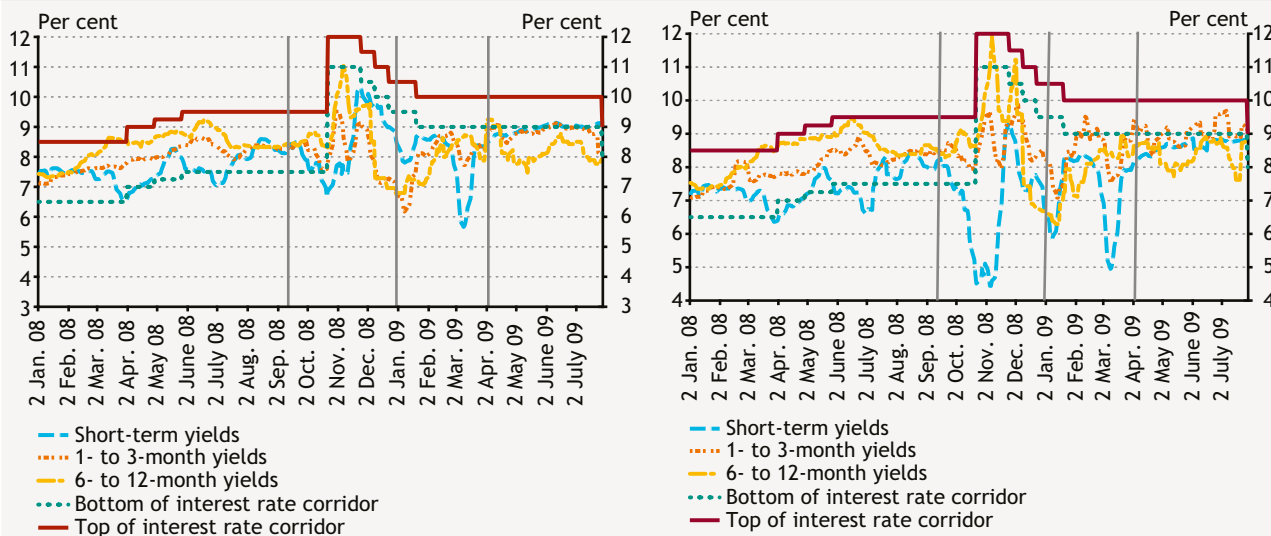
Source: MNB.

transactions. The departure of market yields varied according to maturities and directions. The largest "gap" developed in connection with short-term transactions involving HUF purchases:[50] due to the higher risks, market participants with foreign currency liquidity provided foreign currency liquidity only with very high foreign currency yields, exploiting the contraction/freezing of the alternative markets. With conversion to forint yields, this meant that from the middle of October 2008, participants providing foreign currency in exchange for HUF liquidity could do so with implied forint yields approximating an average of 5 per cent.

We may observe, particularly in relation to yields with the shortest maturities, that these did not follow the 300-basis point interest rate increase of October, or only minimally. Concurrently with the increase in the interest rate, the central bank reduced the width of the interest rate corridor from the previous ±100 basis points to ±50 basis points, which would have also warranted the rise in implied forint yields.[51] A major increase in implied forint yields was observed only in the second week of November; the short implied forint yields relatively closely approximated the interest rate corridor again for a short period, exceeding the 9-10 per cent level. This trend, however, did not last long; by the end of the year, in reaction to falling interest rates and the renewed rise in market risks, the forint yields of short-term FX swap transactions linked to HUF purchases again dropped significantly to 5-6 per cent.

With regard to short yields, one can observe that the implied forint yield of transactions providing foreign currency liquidity were more closely adjusted to the base rate than in the case of opposite transactions, where the domestic banks acquired HUF liquidity. This may be attributable to the fact that, for example, the O/N FX swap standing facility introduced by the MNB enabled domestic banks to acquire foreign currency liquidity, and thus, this may have theoretically more effectively limited changes of the implied yields of market transactions with the same direction.

The differences between the two sides (foreign currency purchases and HUF purchases) are much smaller in relation to transactions with longer maturity, although this is rather virtual, due to the substantial decline in the ratio of transactions with longer maturity (see above). Predominantly short-term transactions were concluded in the periods characterised by the highest tensions, and thus longer maturities only minimally affected the average calculated from total maturities. This trend may be ascribed to the fact that the banks were not willing to undertake expensive foreign currency

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[50] One possible explanation of the difference between ask and bid yields is that domestic banks act as market makers on the forint/foreign currency swap market. See Csávás et al. (2006).

[51] As a result of the narrowing of the interest rate corridor, the overnight deposits rolled over at the central bank were available with a smaller difference in comparison to the base rate.

Chart 24.a and 24.b
FX swap market implied forint yields for the whole banking system and only for local branches of foreign bank

- Euro sale transactions
- Euro purchase transactions
- USD sale transactions
- USD purchase transactions
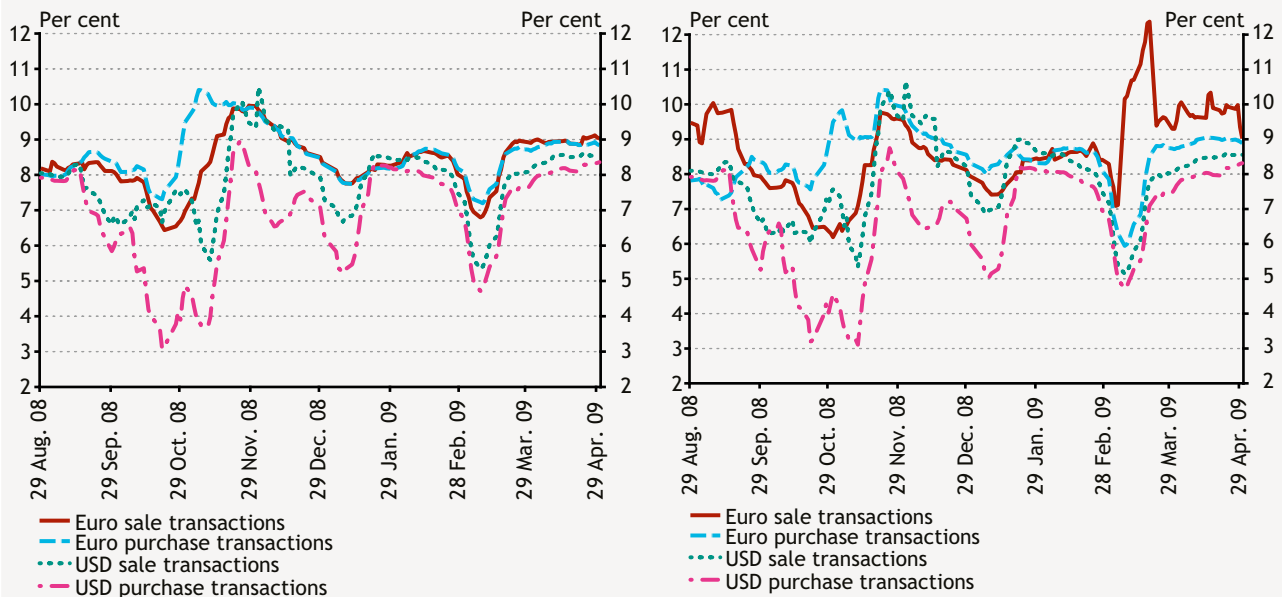
Source: MNB.

liquidity with a long maturity. In relation to transactions with longer maturities, in the period following early April 2009, the implied forint yields returned to the interest rate corridor much slower than in the case of short-term transactions. This was particularly the case in relation to transactions involving HUF purchases. This may also have been due to the fact that the FX swap instruments with longer maturity (3 and 6 months) introduced by the MNB were obviously also available in the foreign currency liquidity providing direction.

Major differences can also be observed in the breakdown of currencies. In relation to dollar transactions, upon analysing either the purchase or the sale side, the implied forint yields most frequently significantly fell short of the yields on transactions concluded against the euro (Chart 24.a). This may be attributable to the fact that the larger liquidity problems arose on the international dollar 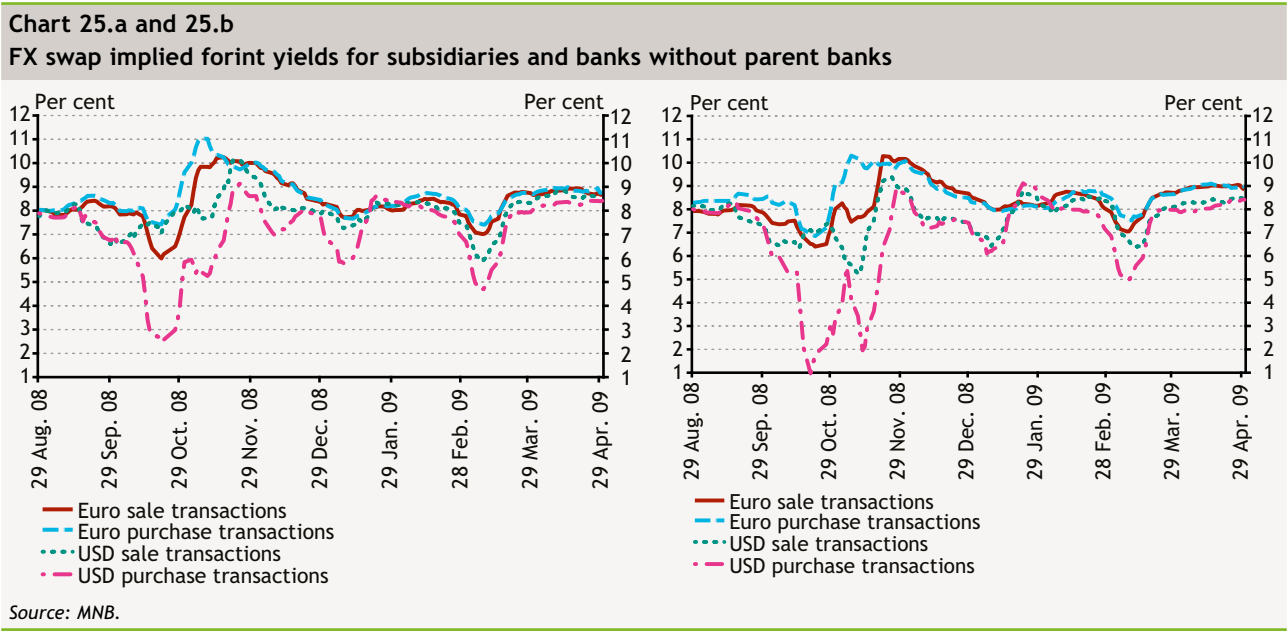market and less so on the euro interbank markets. At the same time, the fact that the instruments of the MNB were available to market participants in the forint/euro pair may also have played a role (we did not analyse the yields of transactions in Swiss francs due to their low share within turnover).

If we do not analyse the whole banking system, but only examine the transactions of domestic credit institutions operating as branches, we can observe similar dynamics in the implied forint yields, in view of the fact that banks of this type account for most of the turnover. But there are also certain differences. In October 2008, branches accessed euro with an implied forint yield of approximately 100 basis points less, i.e. with a higher implied euro yield, than other banks. This is somewhat surprising, as a difference between the branches and the market average does not arise in connection with dollar transactions of the same direction. This may be attributable to the fact that the branches concluded fewer transactions in euro in this period.

The other largest variation from the market average occurred in March 2009, when transactions were concluded with considerably high implied forint yields and the foreign currency liquidity was provided to their counterparties. This may be related to the fact that consolidation was already in progress at the global level at the time, and thus the predominantly non-resident counterparties were only willing to pay a relatively low foreign currency yield when wishing to access foreign currency liquidity.

The dynamics observed in the change of spreads relating to subsidiaries are similar to those of the whole market. The most pronounced difference is observed in connection with dollar sale transactions: at the end of October and early November, the yield on transactions concluded by subsidiaries was most closely adjusted to the central bank interest rate increase, and a new, substantial departure from the trend did not occur in November.

Chart 25.a and 25.b
FX swap implied forint yields for subsidiaries and banks without parent banks

Euro sale transactions
Euro purchase transactions
USD sale transactions
USD purchase transactions

Source: MNB.

In relation to domestic credit institutions without a parent bank, yields on dollar sale transactions varied in the largest degree from the market average. The lowest implied forint yields were observed in this segment in October-November 2008. In relation to dollar purchase transactions, the implied yields were approximately 100 basis points lower than the total bank average mostly in December and January, which may imply that banks without parent banks struggled most with the difficulties in accessing foreign currency liquidity.

5 The effect of counterparty limits and the exchange rate on the swap stock and HUF liquidity

5.1 CONTRACTION OF COUNTERPARTY LIMITS ON THE CURRENCY SWAP MARKET DURING THE CRISIS

According to anecdotal information, in the period of the crisis following the Lehman bankruptcy, non-resident banks significantly reduced the counterparty limits vis-à-vis the domestic banking system, and the limits of domestic banks vis-à-vis each other also contracted. By contraction of the limit, first we mean the decrease in the nominal value of the counterparty limit, and second, that existing transactions also increasingly utilise the unchanged limits. The contraction of the limit significantly aggravated access to foreign currency liquidity in the form of currency swaps and contributed to the emergence of FX swap market turmoil. The limits became effective as a result of the combined effect of several factors which are discussed below.

As a result of the general *deterioration of risk tolerance,* non-resident investors intended to assume lower exposure to all risky instruments. Counterparty risk particularly shifted to the foreground after the Lehman bankruptcy and spilled over to the FX swap markets. In relation to the domestic FX swap market, the general contraction of limits was also aggravated by the fact that the major international credit rating agencies *downgraded* the *credit rating* of both the Hungarian State and domestic banks on several occasions. The worse credit rating may have in itself contributed to the reduction of counterparty limits, and the expected future loss on the same FX swap concluded earlier also increased, whereby the same transaction put a larger burden on the limits.

There is an FX swap exposure of the whole domestic banking system vis-à-vis non-residents, where the non-resident buys foreign currency and sells forints in the forward leg of the transaction, i.e. it takes up a short forint position. As a result of the *weakening* of the *forint exchange rate* against the euro and other currencies, the market value of forward transactions increased or became positive, from a non-resident point of view. Therefore, the counterparty limits, set by non-residents vis-à-vis domestic banks, were increasingly burdened by the rise in the level of prevailing credit risk exposure underlying FX swaps *(as discussed in Chapter 1.2).* Thus, this effect would have led to the exposure arising from the FX swap stock to approximate the level determined by the limits, even without reduction of the limits.

In parallel with the weakening of the exchange rate, *its volatility* also *jumped*. The level of future potential exposure arising from FX swaps mostly depends on the path taken by the forint exchange rate until the maturity of the transaction. Thus, as a consequence of the rising volatility, the burden of the same FX swap on counterparty limits was significantly larger than earlier.

The contraction of limits may have been partly attributed to the fact that *domestic banks* are *heterogeneous* with respect to the form of ownership. Banks operating as branches on the domestic market roll over a significantly smaller net FX swap stock than domestic subsidiaries or credit institutions without a parent bank (see Chapter 6). Since the branches are legally not distinguished from the founding credit institution (MNB, 2008b), the FX swap transactions concluded by the branches with non-residents are also included in the counterparty limit of the parent bank, thus the limits applied to them may be significantly wider than in relation to the other domestic banks.

Domestic banks reacted differently to the contraction of limits.

– We noted above that in the period following the Lehman bankruptcy, the ratio of transactions concluded with parent banks substantially increased within both turnover and the stock. Furthermore, the FX swap market instruments introduced by the MNB enabled banks also without a parent bank to supplement transactions missing due to limit-related problems.

– The banks were also able to react to the effectivity of limits with the reduction of the maturity of newly concluded FX swap transactions. Among two FX swap transactions with the same nominal value, the one with the longer maturity puts a larger burden on the counterparty limits. This is attributable to the fact that with longer maturities, the potential loss on the transaction may be greater. As noted above, the average maturity of the turnover of transactions concluded with non-group counterparties declined in certain periods. In addition to limit-related problems, the shortening maturity of transactions may also have been generally attributed to a declining risk tolerance.

We noted above that the margin call also moderates limit problems, as the collateralisation of the transaction offsets most of the counterparty risk. But the banks most severely affected by the contraction of the limits could access the foreign currency necessary for margining (in the absence of other funds) only through the conclusion of new FX swaps (see chapter on margining). The new FX swaps were also linked to counterparty risks, and thus the favourable effect of margining may have been offset by the fact that the necessary collateral could only be accessed through new transactions.

Anecdotal information on the contraction of counterparty limits emerged from the second week of October 2008 (see, for example, Brückner, 2009). However, there is no information available as to which banks were most affected by the contraction of limits and to what extent this was a general trend. Nevertheless, the contraction of counterparty limits between domestic banks was clearly reflected by the fact that banks participated in the so-called bilateral FX swap tenders introduced by the MNB mostly in the period between October and mid-November of 2008. In the course of these transactions, domestic banks turned to the MNB as an "intermediary", thereby managing to avoid counterparty risks vis-à-vis each other. We have no such direct observations relating to the decrease of counterparty limits applied by non-resident banks vis-à-vis domestic banks; we discuss the changes possibly implying the above in the chapter dealing with turnover concentration.

5.2 ROLE OF CURRENCY SWAP MARGINING

Similarly to international practice, the majority of domestic banks rolling over larger swap stocks need to provide collateral to their counterparties with certain frequency, in accordance with the ISDA master agreement, due to the counterparty risk of the currency swaps. Upon the significant depreciation of the exchange rate, banks are required to increase the foreign currency amount of the deposit requirement due to the forward leg of the swap transaction (foreign currency deposit and foreign currency collateral). The banks can meet additional *foreign currency liquidity* requirements most commonly through the use of their HUF liquidity and the conclusion of new currency swap transactions. Beyond the factors described above, the *margin call effect* may have contributed to the rise in the currency swap stock.

We estimate below the level of the effect arising from the margining of the currency swap stock of the domestic banking system vis-à-vis non-residents (Annex 15). In addition to currency swap stock data, our estimates also rely on information received from the major domestic banks, relating to margining practices.

In the course of quantifying the *margin call effect,* we take as a starting point the product of the market value of the swap transactions (i.e. the difference between the current and the original forward exchange rate upon conclusion) and the volume. For the forward exchange rates, however, it is necessary to determine the amount of the current swap points on all dates and for all maturities. For the purpose of simplifying quantification, we will use spot exchange rates instead of forward ones. We therefore do not take into account changes in the yield spread, as the effect is likely to be significantly smaller than that arising from changes in the exchange rate. We will also disregard the calculation of present value, as the majority of transactions have short maturities. These assumptions may result in higher-than-actual fluctuations in relation to transactions with longer maturity.

We determined the value of the margin call relating to the total net swap stock on the basis of the following formula:

$$MC_t = \sum_{i=0}^{N_t} \frac{S_t - S_{0,i}}{S_t} \cdot VOL_i$$

where $S_{0,i}$ is the spot exchange rate of specific transactions upon conclusion, S_t is the current exchange rate, N_t is the number of outstanding transactions on the given date. VOL_i is the volume of transactions expressed in foreign currency. We use a volume with a positive sign in relation to transactions acquiring foreign currency liquidity in the spot leg and with a negative sign in relation to transactions of an opposite direction. We aggregate the results for each currency at the exchange rate valid on 31 May 2009.

Prior to performing the estimation, we asked the major domestic banks about margining techniques. Several of these banks did not apply margining to their currency swap transactions either before or after the crisis, therefore we disregarded the transactions of 4 large banks.

In the course of estimation, we took into account that a collateralisation requirement is commonly not set out in transactions concluded between domestic banks and parent banks. We also assumed that margining applies to all maturities, including overnight transactions, although anecdotal information suggests that banks did not conclude margin call agreements for transactions with the shortest maturity after the onset of the crisis either.

It is also important to note that most banks do not apply daily margining, but require additional collateral only upon extreme shifts or volatility of the exchange rate. The estimate is based on the implicit assumption that the banks and their swap counterparties top up the margin account on a daily basis, according to changes in the exchange rate. In other words, calculations conforming to market practices would result in a less "continuous" (but rather discrete) path.

Owing to the above factors, the results obtained should be interpreted as how much the amount of the margin call requirement caused by the movement of the foreign exchange rate would have been alone, if the banks we analysed had applied the practice of daily margining to the total non-group forint/foreign currency swap stock.[52]

The margin call moved within a narrow band until the beginning of 2008 (Chart 26). The low value of the margin call recorded before 2008 is due to several factors. First, the net swap stock was at a significantly lower level in the years before 2008 and 2009, and changes in the exchange rate were also typically more subdued. Second, the previously low margin call is also attributable to the fact that the average maturity of transactions was shorter in the past; the level of the necessary margin is lower in relation to short transactions, as the banks are returned the amount of the margin upon maturity of the transactions.

From the spring of 2008 until mid-2008, in parallel with the strengthening of the forint, the cumulated margin call was declining, with a negative value, i.e. under the above assumptions, in this period non-resident banks deposited margins at domestic banks. After the summer of 2008, however, the net cumulated margin moved on a steep rise, and turned from negative to positive at the end of September and early October 2008. Thus, our estimates suggest that the domestic banking system needed to access additional foreign currency liquidity for margining from early October, during a period when FX swap market tensions peaked.

In September – October 2008, the estimated value of the margin call rose to approximately HUF 500 billion at the banking sector level, in reaction to the weakening of the exchange rate. Assuming that banks acquired foreign currency liquidity necessary for collaterals entirely through new currency swaps, the contribution of margining to the increase of the total swap stock is estimated to be nearly two billion euros in this period. By the spring of 2009, with the strengthening of the exchange rate, the margin call effect also diminished.

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[52] First, the applied calculation overestimates the actual liquidity requirement (see Annex 15), and second, it underestimates it, as we projected it onto the net swap stock and netting can in certain cases conceal certain effects to a significant degree. Foreign currency originating from the additional margin cannot necessarily be used for the fulfilment of a margin call requirement of an opposite direction.

Chart 26

Cumulated margin call estimated from the net non-group forint/foreign currency swap stock, caused by exchange rate changes, and the net stock weighted exchange rate index
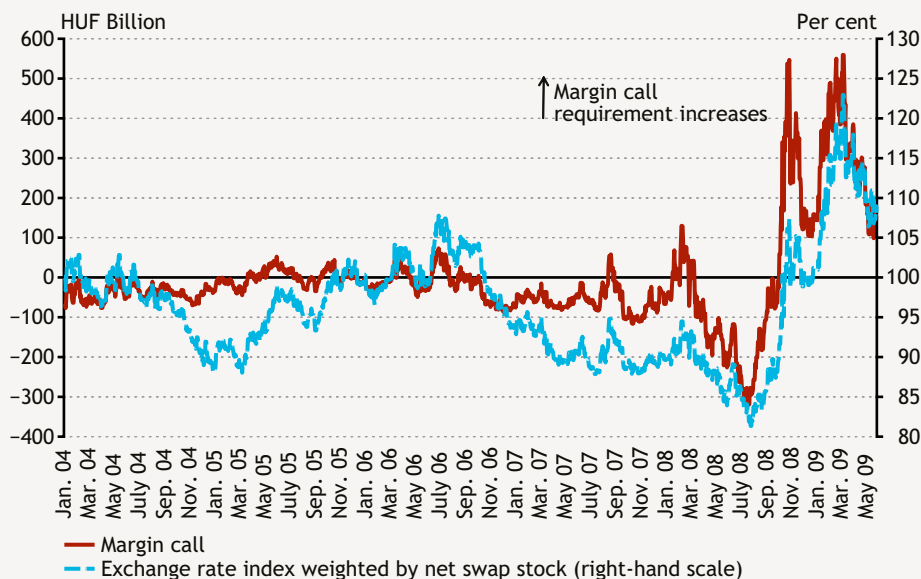
Note: Estimated margin call in forint/euro, dollar and Swiss franc pairs, not including 4 domestic large banks, applied only to non-parent bank transactions, assuming daily margining. In relation to the time series of the net swap stock weighted exchange rate, 1 January 2004 = 100.
Source: MNB, own calculations.

The significance of margining is further reflected by the fact that on the basis of data available for individual transactions, domestic banks which claimed to have applied margining managed to increase their stock vis-à-vis non-residents by the largest amount. In relation to 3 such banks, the net swaps concluded with non-resident counterparties substantially exceeded the historical high recorded earlier, prior to the Lehman bankruptcy.[53] This may imply that the contraction of the counterparty limits affected banks conducting margining to a lesser extent, that is, owing to margining, they were able to conclude new transactions which did not put a burden on their counterparty limits, or only to a limited degree. Second, the swap stock of banks choosing margining increases as a result of collateralisation (if the foreign currency collateral is provided through a forint funds + swap strategy).

5.3 MARKET CONCENTRATION

On the basis of anecdotal information from market participants in the autumn of 2008, it seemed clear that in addition to the marked change in expectations, as described above, the contraction of the counterparty limits between certain participants had a major effect on trends on the domestic FX swap market. However, we have no accessible data relating to changes in counterparty limits, and thus we attempt to understand the changes affecting the limit system of banks with the combined analysis of changes in market concentration and turnover. In the course of examining concentration, we focus on non-group market turnover because in our opinion, the omission of transactions at the banking group level enables a clearer understanding of the effects of changing limits between counterparties on market turnover.

The change in concentration[54] alone is inadequate to clearly identify the direction and volume of changes affecting the limits between counterparties. *First,* it is possible that in certain market segments, the contraction of counterparty limits materialises in a rise in concentration: certain participants are simply excluded from the markets (because, for example, they are unable to provide further foreign currency liquidity to domestic banks), and thus the domestic financial institutions need to acquire the necessary foreign currency from fewer market participants who, however, permit

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[53] We analysed the net swap stock in a domestic bank – non-resident bank relationship, by examining approximately 500 bank pairs, not including transactions at the banking group level.

[54] We measure market concentration below with the use of the Herfindahl index. On the basis of turnover data, we calculated the share of domestic and non-resident banks in daily turnover. We merged non-resident banks belonging to the same banking group. We only analyse the turnover of domestic banks conducted with non-group non-residents. We use the Herfindahl index standardised for the interval between 0 and 1 for the ratios.

sufficiently large limits. *Second,* the contraction of counterparty limits may also materialise through a decline in market concentration: while domestic banks were able to swap their HUF liquidity to foreign currency with relatively fewer participants in the past, as a result of narrowing limits, they are forced to acquire the same quantity in smaller amounts, from more sources. The rise in concentration may primarily occur if certain groups of counterparties significantly narrow their limit systems to various degrees, while concentration will essentially decline if the contraction of counterparty limits occurs at nearly the same rate on the whole of the market. *In addition,* it is theoretically possible that the concentration of market turnover does not change in parallel with the contraction of the limit system: first, because the narrower limits do not constitute an effective limit on the entire market, and second, reallocations among certain participants and the participation of other external participants (e.g. the use of the central bank's bilateral tenders) moderates the use of the limit system, and third, the funds raised in the course of margin calls[55] also reduce the use of limits.

With the exception of a few minimal upturns, market concentration basically stagnated at an unchanged, relatively low level during the entire period under review (Chart 27.a.). We can presume a contraction of the limit system from the number of counterparties concluding transactions on the domestic market: while the domestic banking system concluded daily transactions with an average of 55 non-group counterparties in the period preceding the Lehman bankruptcy, this figure decline significantly in October 2008, sinking to a low of 40 (Chart 27.b). The average transaction volume, however, did not change substantially: while the domestic banking system concluded FX swap transactions with non-group counterparties in the approximate amount of HUF 9.7 billion on an average day in the "golden age" of 2007, this value moderately decreased to HUF 9 billion in 2008 Q4.[56] On the basis of the foregoing, only the (temporary) decline of the number of non-group counterparties active on the market suggests a substantial contraction of the limit system. It is important to emphasise that neither a decline in turnover, nor a fall in the number of counterparties was observed in the few weeks following the Lehman bankruptcy; this occurred in the first weeks of October which confirms anecdotal information that the drastic decline in interbank counterparty limits was characteristic only from October.

A larger variation is observed in our concentration indicators by analysing the foreign currency and HUF purchases of domestic banks through FX swap transactions. Although the turnover of both types of transactions declined – temporarily – by a relatively high degree and in nearly identical proportions in October 2008, concentration increased by a much higher rate in relation to HUF purchase transactions concluded by domestic banks in the spot leg than in the

Chart 27.a and 27.b

Non-group FX swap turnover and market concentration, the number of non-group counterparties and turnover conducted with them
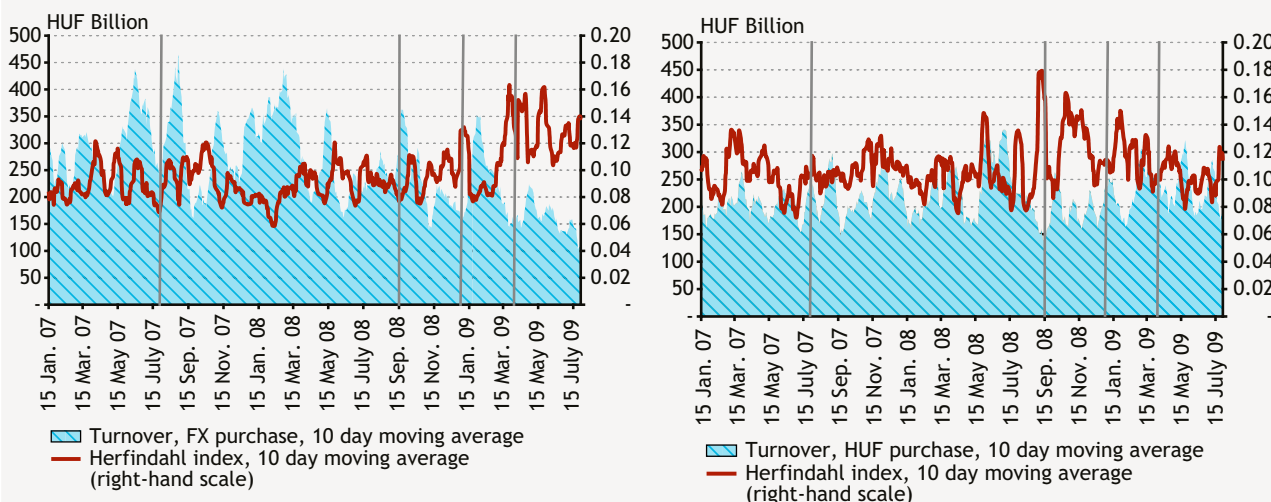

Source: MNB.

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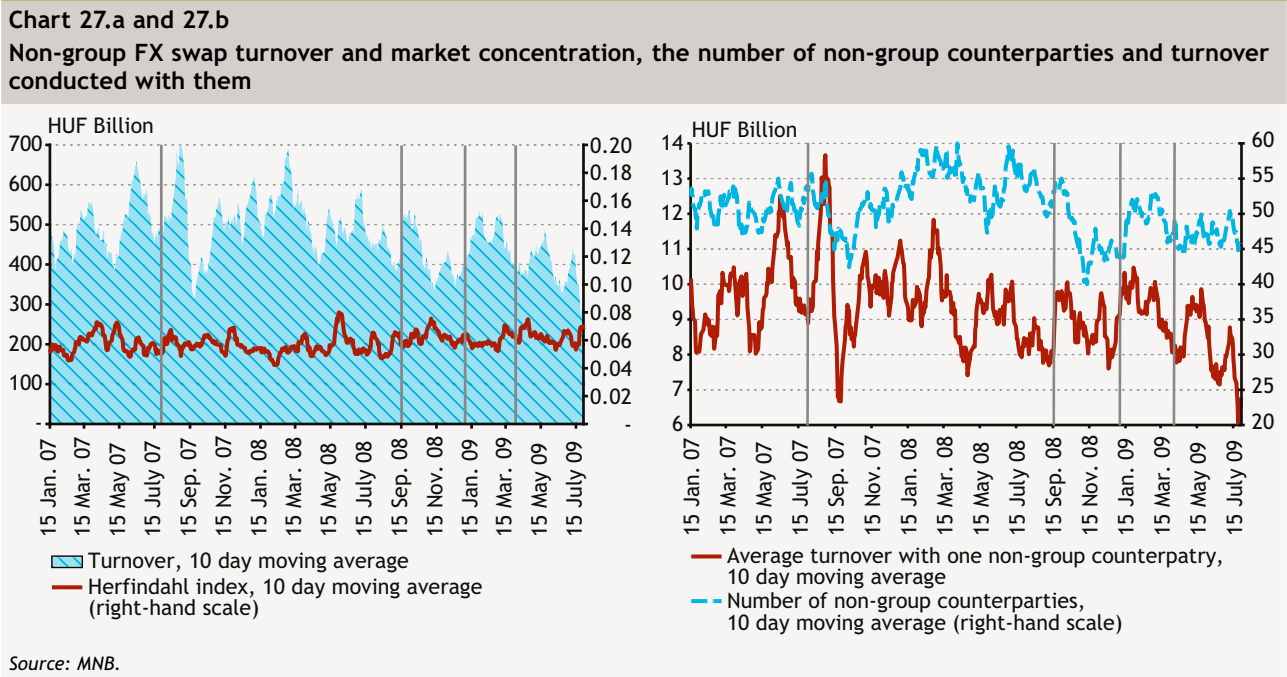
[55] See Chapter 1.2. for more details.

[56] We should note, however, that the weakening of the exchange rate distorts this picture. A larger difference would arise if we were to disregard this fact.

Chart 28.a and 28.b

Market concentration relating to the foreign currency purchase and HUF purchase transactions of domestic banks concluded with non-group counterparties

Turnover, FX purchase, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Turnover, HUF purchase, 10 day moving average
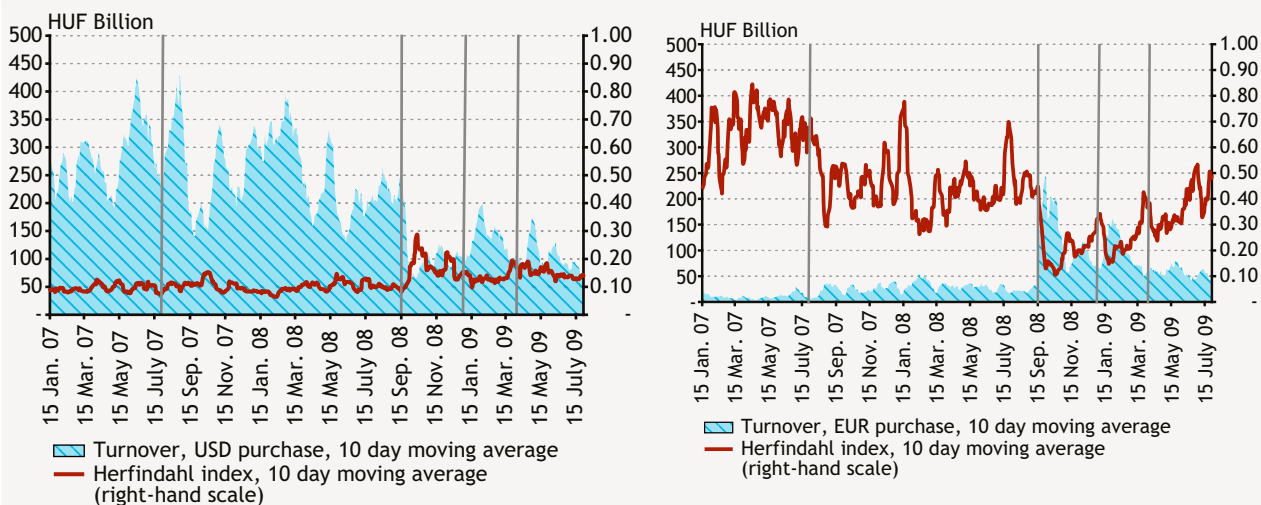Herfindahl index, 10 day moving average (right-hand scale)

Source: MNB.

case of foreign currency purchases (Chart 28.a. and 28.b.). We can observe an opposite trend in connection with the problems arising in February-March of 2009: the concentration of HUF purchases approximated the long-term average level, but market concentration increased relatively strongly in relation to transactions linked to foreign currency purchases. The trends also varied with respect to turnover: while HUF purchases did not change substantially, the foreign currency purchases of domestic banks declined significantly once again after the temporary upturn recorded in January 2009. This decline continued in the period of market stabilisation as well. This decline, however, was more attributable to demand-related causes, as the decrease in the foreign currency liquidity requirement of domestic banks may have been the reason, in contrast to the period in early 2009, when the renewed contraction of market supply is likely to have determined the limit.

We also observe significantly different trends when analysing the concentration of the turnover of transactions concluded in dollars and euros. The turnover of dollar transactions – which had played a dominant role up to September 2008 – declined radically to one quarter of its earlier value, and the previously low market concentration increased significantly (Chart 29.a.). This is clearly attributable to one of the first negative effects of the Lehman bankruptcy: there was a severe dollar shortage in the international financial system. This resulted in rapid transformation of the domestic FX swap market: the turnover of euro transactions – which had played a marginal role in the past – multiplied in value and market concentration decreased to a relatively low level compared to the exceptionally high value recorded in the past. Thus, the euro basically took over the role of the dollar; in this period, the domestic banks used the accessed euro liquidity to acquire Swiss franc liquidity on the international markets which served as the basis for foreign currency lending. However, as the crisis increasingly spread to the European banking system, the volume of euro funds accessible to domestic banks also declined radically. Thus, the decline in turnover occurring in October 2008 is attributable to the fact that the euro liquidity accessible to domestic banks decreased significantly and dollar liquidity remained at a low level. As the global dollar shortage eased, the ratio of dollar transactions again rose in domestic FX swap turnover, although it failed to reach the earlier level, and concentration stabilised at a moderately higher level.

Our concentration indicator also suggests that turnover shifted from non-residents to resident counterparties in the most severe period of the crisis, implying that non-residents cut back the counterparty limits vis-à-vis domestic participants more strongly than resident banks. While we observed a decline in turnover and an upturn in concentration in both (resident and non-resident) segments up to October 2008, the trends were different in the final two months of the year. Turnover concluded with non-group domestic counterparties increased and the market concentration of the segment declined (Chart 30.a.), while turnover conducted with non-residents decreased more strongly and concentration further increased (Chart 30.b.). By the end of 2008, however, the turnover of transactions concluded with non-residents fell to

Chart 29.a and 29.b

Market concentration relating to the USD purchase and EUR purchase transactions of domestic banks concluded with non-group counterparties

Turnover, USD purchase, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Turnover, EUR purchase, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Source: MNB.

Chart 30.a and 30.b

Market concentration of domestic banks' transactions concluded with domestic and foreign non-group counterparties

Turnover, domestic counterparties, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Turnover, foreign counterparties, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)
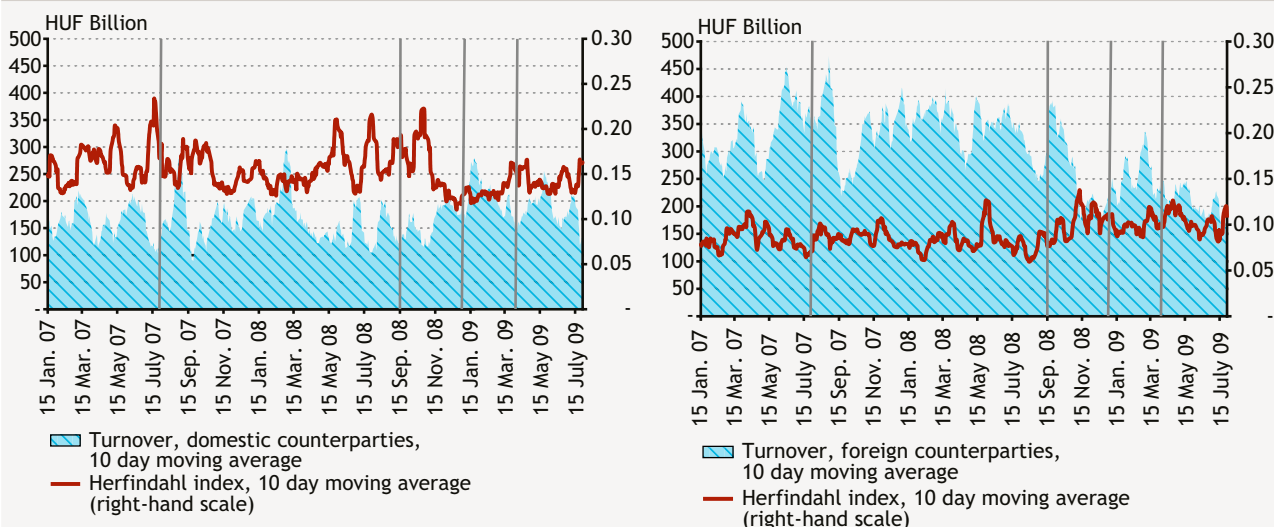
Source: MNB.

half of the previous long-term average which, in parallel with the rise in concentration, supports the assumption that several non-resident banks suspended the application of FX swap transactions with Hungarian counterparties.

In the course of analysing non-group market turnover, it may be interesting to examine whether there are any differences between changes affecting the turnover of banks with parent banks and independent domestic financial institutions. In relation to financial institutions with parent banks, concentration basically stagnated at an unchanged level, while turnover declined by a relatively higher rate (Chart 31.a). Since this heterogeneous group includes financial institutions with widely varying strategies and stable backgrounds, changes in the average turnover and concentration in the group only allows us to draw a few specific conclusions.

Chart 31.a and 31.b
FX swap market turnover of domestic financial institutions with and without parent banks conducted with external counterparties

Turnover of financial institutions with parent banks, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Turnover of financial institutions without parent banks, 10 day moving average
Herfindahl index, 10 day moving average (right-hand scale)

Source: MNB.
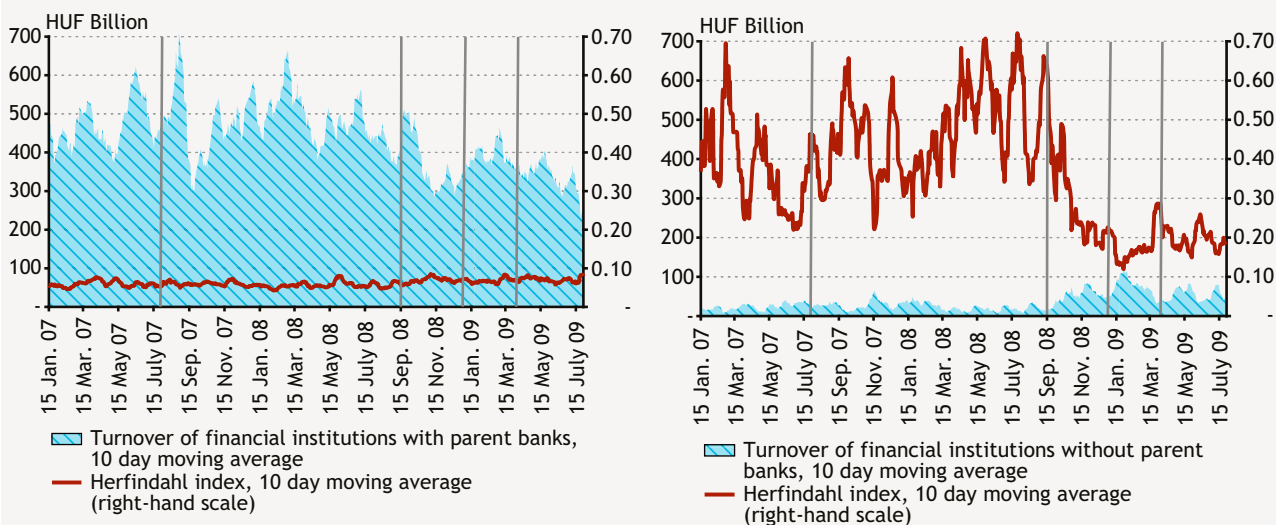
We can identify interesting trends, however, when analysing financial institutions without parent banks: in the period following the Lehman bankruptcy, the turnover of concluded FX swap transactions doubled from the previously low level, and this dynamic growth continued in stage four of the analysed period as well. Market concentration declined radically in parallel with the above: while the banks classified in the above group concluded FX swap transactions with an average of 3-5 counterparties in the past, they needed to satisfy the increased liquidity requirement from a significantly larger number of counterparties (Chart 31.b.).
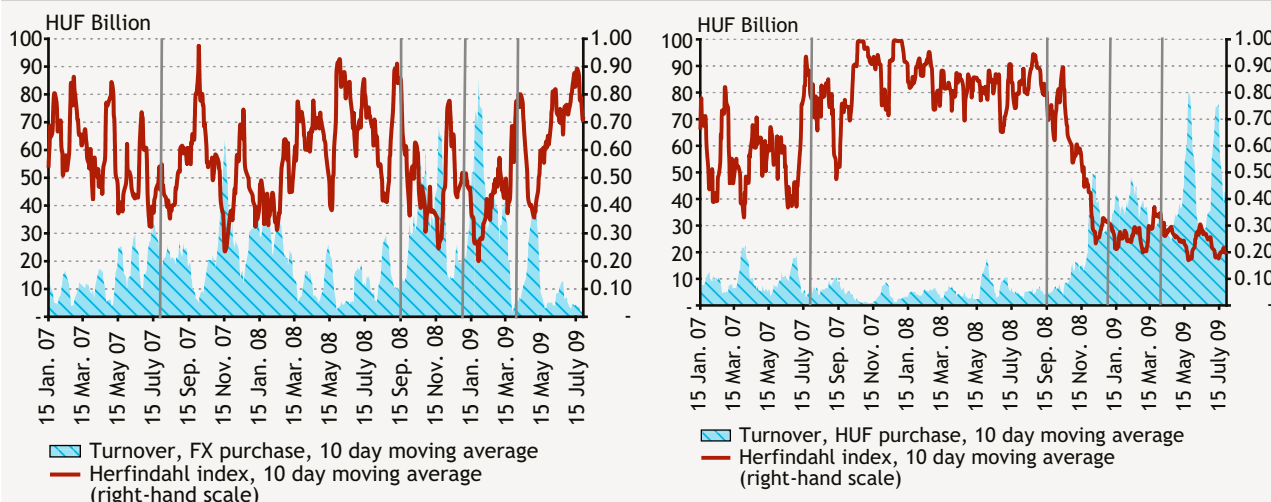
It is worthwhile to provide a further breakdown of the turnover of domestic financial institutions without parent banks and separately analyse the foreign currency and HUF purchase transactions of domestic banks (in the spot leg). In the former case, we can observe that compared to the past the overall rising turnover became much more volatile in the period of the deepening crisis, co-moving closely with the substantial changes affecting the country's assessment; domestic financial institutions purchased large quantities of foreign currency in the few weeks following the Lehman bankruptcy, which was followed by a major downturn when the crisis also hit Hungary in the first half of October. An upturn was again witnessed amidst briefly improving sentiment resulting from the conclusion of the IMF package, followed by a substantial decline in the FX swap market foreign currency purchases of domestic financial institutions without parent banks to below the long-term average by December 2008 (Chart 32.a.). Changes in market concentration showed similar volatility in this period, moving in a direction opposite to turnover: it significantly declined in more favourable market sentiment and surged under worsening market conditions. The fluctuation of turnover and market concentration continued in the first four months of 2009. Such volatile movement, however, was not witnessed in connection with HUF purchase transactions: with declining concentration, the rise in turnover increased several fold from the middle of November from the previously low level and remained on this level in the subsequent months (Chart 32.b.).

The strengthening of the margin call effect[57] may have contributed to the upturn in the turnover of foreign currency purchases in relation to banks without a parent bank; as a result of the weakening forint, domestic subsidiaries needed to acquire a substantial amount of foreign currency funds for margining, which they predominantly ensured through the conclusion of FX swap transactions, during a period when a major shortage in foreign currency liquidity emerged on the international markets. This is likely to have contributed to the significant decline in market concentration; due to the contraction of the limit system, domestic subsidiaries were only able to acquire the necessary funds from a much larger number of counterparties (Chart 32.b.).

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[57] See Chapter 5.2. for more details.

Chart 32.a and 32.b
Foreign currency and HUF purchase transactions of domestic financial institutions without parent banks

Turnover, FX purchase, 10 day moving average
Herfindahl index, 10 day moving average
(right-hand scale)

Turnover, HUF purchase, 10 day moving average
Herfindahl index, 10 day moving average
(right-hand scale)

Source: MNB.

Beyond the above, we examined the trends characterising market turnover in terms of whether any differences emerged in relation to branches and domestic banks. Market concentration moved within a relatively narrow band in both groups, and only a minimal rise was measured in both cases in the months following the Lehman bankruptcy. Trends in turnover, however, revealed larger differences: while the turnover of branches basically stagnated around the long-term average in the analysed period of the crisis, the turnover of domestic banks fell well below the average value in 2008 Q4, which is mainly due to the nearly 50 per cent decline in foreign currency purchase transactions.

In summary, our analyses suggest that the contraction of the counterparty limits tended to be coupled with a rise in concentration. This may imply that non-resident banks were characterised more by heterogeneity than homogeneity in relation to the contraction of the limits, i.e. the degree of limit contraction probably varied. In addition to the development of concentration indicators, the decline in the number of counterparties is another aspect which provides the most support for the anecdotal information relating to the contraction of limits.

5.4 THE EFFECT OF EXCHANGE RATE CHANGES THROUGH CURRENCY SWAPS ON THE HUF LIQUIDITY OF BANKS

The rollover of currency swaps and changes in the HUF exchange rate not only affect the value of the margin call and the value of the balance sheet position expressed in forints, as noted above, but also the *HUF liquidity* of domestic banks. If the spot exchange rate effective upon maturity of the FX swaps providing foreign currency liquidity is weaker than the forward exchange rate priced in the maturing currency swaps, the rollover involves a HUF liquidity requirement[58] (hereinafter this will be defined as the *rollover effect)*. This occurs if the HUF amount received in the forward leg is lower than the HUF amount payable in the spot leg of the new transaction in exchange for the same foreign currency amount. The opposite occurs in relation to transactions of an opposite direction; the given bank records a HUF liquidity surplus. We estimate below the effect of exchange rate changes on the HUF liquidity of banks.

In relation to the rollover effect, it is important to emphasise that it arises only on the level of individual banks and not at the banking system level *(direct rollover effect).* As a result of the rollover of currency swaps vis-à-vis non-residents, the liquidity requirement arising at a given bank may arise as a HUF liquidity surplus at another domestic bank. Non-residents, for example, may deposit surplus HUF liquidity originating from a rolled over transaction as a HUF deposit at another domestic bank. It is also possible, however, that the HUF liquidity arising at non-residents is rechanneled to the initial bank; in this case, the rollover effect does not arise at the individual bank level either. The HUF liquidity of the

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[58] In such case, the combined amount of account money and cash on the asset side of the bank is defined as HUF liquidity.

entire banking system is only affected by the rollover of FX swaps concluded with the MNB (the liquidity of the banking system can only be modified as a result of changes in the balance sheet of the MNB).

The rollover effect possibly arising at the individual level increases the liquidity requirement of banks only on a temporary basis. If domestic banks use the currency swaps for the financing of longer-term foreign currency *based* loans, upon maturity of the loans, the amount repayable in forints increases in proportion to the weakening of the exchange rate. In other words, the related HUF liquidity requirements and surpluses arise as distributed over time, due to the varying maturities of the loans and swaps used for hedging.

We quantified the rollover effect as follows. We first estimated the volume of rolled over currency swaps per bank (for the total of HUF/EUR, HUF/USD and HUF/CHF transactions). We determined the above as the minimum of the volume maturing on the given date and the volume concluded of the same direction on the given date. We then took the ratio of the rolled over amount, calculated for the entire banking system, relative to the total amount maturing on the given date, and thereby received a value between 0 and 1 *(rollover ratio)*. We multiplied the difference between the *forward* exchange rate of maturing transactions and the spot exchange rate of new transactions with the volume of transactions expressed in foreign currency and then took the product of this value with the rollover ratio.[59] We performed the calculations for transactions in both directions and netted the amounts.[60]

Since the rollover effect only arises at the level of individual banks, the HUF liquidity requirement aggregated for the banking system may not be interpreted as expressing the quantity by which the HUF liquidity of the entire banking system increased due to the weakening of the exchange rate. It should rather be interpreted as expressing the maximum quantity by which the HUF liquidity requirement would have increased for domestic banks rolling over FX swaps in the adverse case that HUF liquidity is rechanneled from such banks to banks which do not conclude FX swaps. It is therefore important to follow the direction of changes in the time series we estimated and not their precise quantity.

With perfect functioning of the interbank money market (depo market), when a liquidity surplus or deficit arises at the individual level, banks can easily redistribute liquidity between each other. If, however, frictions arise on the interbank market, HUF liquidity tensions may arise at an individual level, and the indicator estimated by us can help to determine the periods in which the rollover of the FX swaps may have contributed most to the aggravation of HUF liquidity tensions.

The cumulated HUF liquidity requirement declined at a moderate rate in the period extending from early 2004 until the spring of 2008, and this decline accelerated until October 2008 (Chart 33). The negative cumulated liquidity requirement is also attributable to the substantial strengthening of the exchange rate in comparison to the priced forward exchange rates. Following the crisis in October 2008, however, the time series rose steeply in parallel with the weakening of the exchange rate. This was related to two factors: first, the volume of the swap stock was larger than in previous years, and second, the exchange rate also weakened more strongly. Thus, the sensitivity of the cumulated net HUF liquidity requirement to the exchange rate also increased in parallel with the change in the volume of the swap stock.

The direct HUF liquidity requirement declined by approximately HUF 450 billion between January 2004 and October 2008. It is important to note that between the summer and mid-October of 2008, despite the significant weakening of the HUF exchange rate, the estimated HUF liquidity requirement did not increase; in fact, it continued to decline at a moderate rate. This is attributed to the fact that the forward exchange rate of the majority of transactions maturing between July and October was moderately weaker than the average spot exchange rate characterising the period from the middle of summer until October, because the majority of the maturing transactions were concluded prior to the strengthening of the forint at the beginning of the summer of 2008.

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[59] Multiplication with the foreign currency amount is necessary, as the difference between the forward and spot exchange rate reflects the liquidity effect of a currency swap transaction for 1 unit of foreign currency.

[60] The rollover effect is substantively similar but not identical to the exchange rate effect described above. First, we derived the rollover effect from the currency swap stock and not from the on-balance sheet position. Second, the exchange rate effect calculated from the on-balance sheet position may also arise if the maturing currency swap transactions are not rolled over on a given date, but there is a major change in the exchange rate, while the rollover effect in this case equals zero.

Chart 33

Direct net HUF liquidity requirement (cumulated since early 2004) arising from the rollover effect and the exchange rate weighted with net currency swap stock
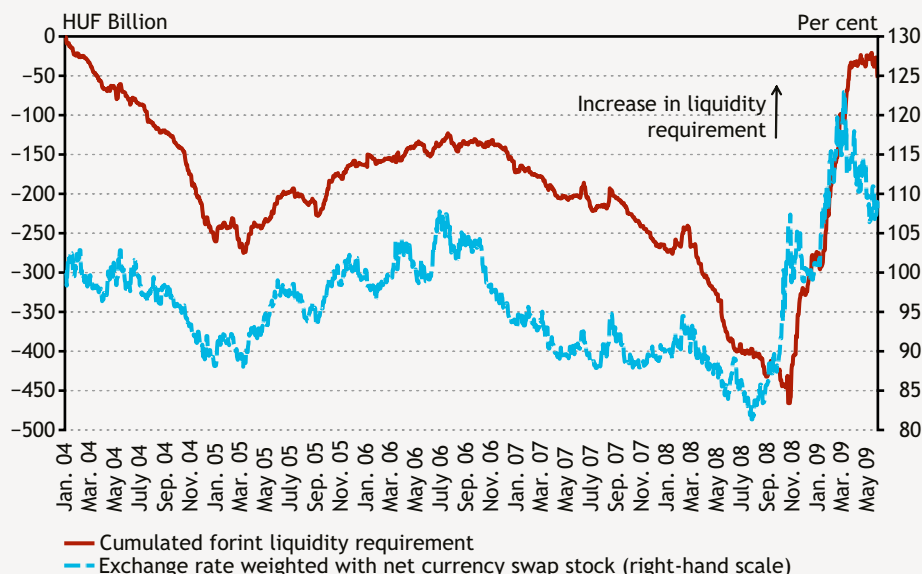
Note: The calculations apply to the net HUF/foreign currency swap stock.
Source: MNB, own calculations.

The HUF liquidity requirement rose steeply by approximately HUF 400 billion from mid-October 2008 until April 2009. The substantial increase was simultaneous with the emergence of turmoil on the interbank money markets; the volume of overnight transactions rolled over by domestic banks at the MNB significantly and permanently increased from the middle of October, and in parallel, the volume of interbank unhedged loan transactions also declined substantially. Although the turmoil on the money markets was principally caused by the contraction of interbank limits, the rise in the liquidity requirement arising jointly from the rollover of FX swaps and the weakening of the exchange rate may have intensified the strains on the money market. The instruments introduced by the MNB in the autumn of 2008, aiming to mitigate tensions on the HUF interbank market, managed to offset the individual bank liquidity problems in the subsequent period (introduction of loan instruments with longer maturity, expansion of eligible collateral, reduction of required reserve rate, see MNB, 2009b).

In summary, the effect of the fluctuations of the HUF exchange rate – through the swap stock – on HUF liquidity is likely to have been substantial on an individual level. At the sector level, this materialised as a HUF liquidity distribution problem; during the crisis, due to frictions on the forint interbank market, the liquidity requirements and surpluses arising on an individual level were not matched on the market.

6 Changes in the structure and characteristics of the currency swap stock resulting from the crisis

In the above sections we discussed the factors underlying the expansion of the HUF/foreign currency net swap stock which originated from the financial intermediation of the banking system.[61] In addition to the level of the net swap stock, it is also important to analyse its structure and the impact of the crisis on it, if we wish to trace aspects of expansion and the crisis relating to financial stability.

A breakdown of the gross stock, and the net stock derived from it, is also possible on the basis of the type of domestic credit institutions, the type of counterparties, remaining maturity and currency. For this purpose, it is important to consider changes in the gross stocks (separately for transactions acquiring foreign currency liquidity and providing foreign currency liquidity in the spot leg) and the net stocks resulting from changes therein. In relation to the above, greater emphasis should be placed on the analysis of the changes of the stock which indicates the stock of outstanding transactions of domestic banks acquiring *foreign currency liquidity* in the spot leg. Based on the direction of the on-balance sheet position, the sum of the above significantly exceeds the stock of transactions of the opposite direction.

Among the types of domestic banks, it is important to distinguish credit institutions (in foreign strategic ownership) which are active mainly on the money market, currently typically operating as branches (hereinafter 'money market' banks), domestic banks not in foreign strategic ownership[62] and banks in foreign strategic ownership. The distinction is based on the fact that banks which are active on the money market commonly conduct custodian and treasury transactions, while subsidiaries in foreign strategic ownership also provide lending, thus major differences may presumably arise in the swap market behaviour of the two bank types. The distinction based on the ownership background is motivated by the fact that the reliance of banks with foreign parent banks on the swap market and its characteristics may vary from the reliance of banks without a foreign strategic ownership, owing to the interests and commitments of the foreign parent banks. The breakdown based on bank types enables the analysis of heterogeneity among the banks.

The breakdown of the swap stock based on counterparty types also contains aspects relating to financial stability. Within the group of foreign counterparties, it is important to distinguish members within the given banking group and non-group market participants, because the rise in the share of intra-group transactions may reduce the financial stability related risks arising from problems on the currency swap market for two basic reasons. First, it may reduce the rollover risk due to the higher commitments of the parent banks. Second, the major domestic credit institutions are generally owned by foreign strategic investors, most of which are credit institutions based in the euro area. And these credit institutions can access the (foreign currency) liquidity providing instruments of the ECB. Moreover, the rise in the ratio of parent bank transactions may also imply difficulties in acquiring foreign currency liquidity through the swap market: it is possible that a given bank can conclude HUF/foreign currency swap transactions with market participants only under unfavourable conditions.

The average remaining maturity of the gross swap stock and its changes based on maturity should be tracked in terms of the assessment of rollover risks. A decline in the average remaining maturity suggests an increase of rollover risks, as the

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[61] See Chapter 3.
[62] The group of banks with a background of foreign strategic ownership basically include the subsidiaries of foreign banks.

average remaining maturity of hedged assets in the balance sheet of the banking system is significantly longer. Thus, different conditions may apply upon rollover of transactions than at the beginning of hedging or the re-pricing of hedged assets. It is particularly important to analyse the maturity of transaction types, where the domestic banking system acquires foreign currency liquidity in the spot leg. If the average remaining maturity of such types of transactions (weighted with stock) is longer than the maturity of transactions of an opposite direction, this means that the foreign currency payments need to be made later in time in the forward legs than the foreign currency liquidity (revenue) arising from forward legs of an opposite direction.
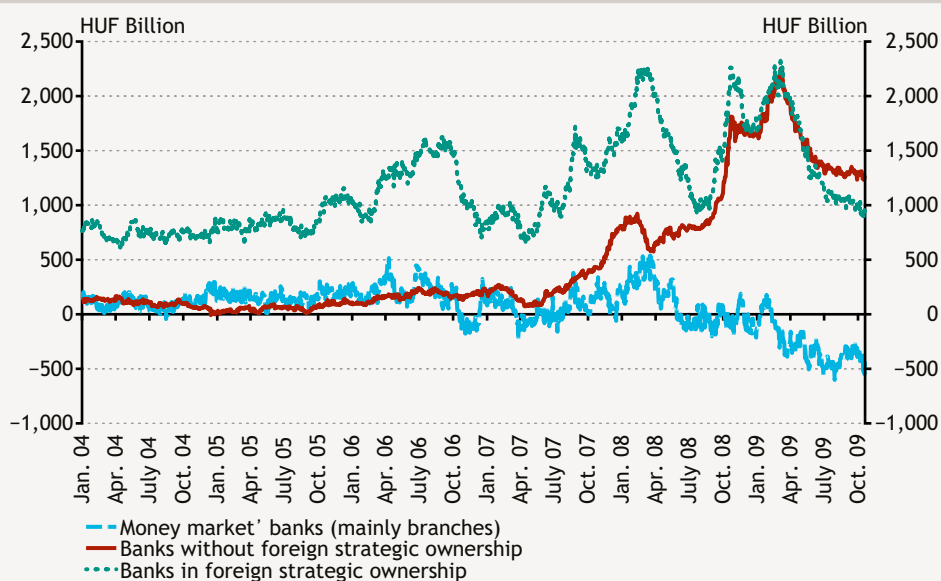
Analysis of the foreign currency structure provides information on the foreign currency pair segment in which the domestic banking system carries major exposure, that is, the fluctuation of the exchange rate of which major foreign currency may keenly affect the liquidity position of domestic banks.

We analysed the changes in the structure of the swap stock in recent years in accordance with the above criteria.

On the basis of the breakdown of the type of domestic credit institutions, we may establish that prior to the subprime crisis emerging in July 2007, the net swap stock was determined by banks in foreign strategic ownership; from the end of 2007, the swap stock of banks without foreign strategic ownership ("domestic banks") also rose significantly. The liquidity problems of these banks played a key role in this trend: they accessed direct external foreign currency funds on the market with a substantially higher premium and shorter maturities than in the past, while their cross-border foreign currency placements rose steeply as a result of expansion pursued in the region. In relation to 'money market' banks, the net swap stock concluded with non-resident counterparties reached a lower (nominal) level, sinking to a negative domain following the crisis of October 2008. This means that the 'money market' banks provided foreign currency liquidity to their non-resident counterparties after the crisis (Chart 34).

With respect to the breakdown of the net HUF/foreign currency swap stock of 'money market' banks and branches according to domestic and non-resident counterparty types, another interesting observation may be made: between 2004 and September 2008, they typically rechanneled foreign currency liquidity from non-resident counterparties to domestic credit institutions. Following the subprime crisis in July 2007, the intensity of their above activity moderately strengthened, followed by a decline after the crisis of October 2008, i.e. with the strengthening of global (primarily dollar and Swiss franc) foreign currency liquidity problems (Chart 35).

Chart 34
The net HUF/foreign currency swap stock of non-residents by type of domestic credit institution

Money market' banks (mainly branches)
Banks without foreign strategic ownership
Banks in foreign strategic ownership

Source: MNB.

Chart 35

Breakdown of the HUF/foreign currency swap stock of 'money market' banks by type of counterparty
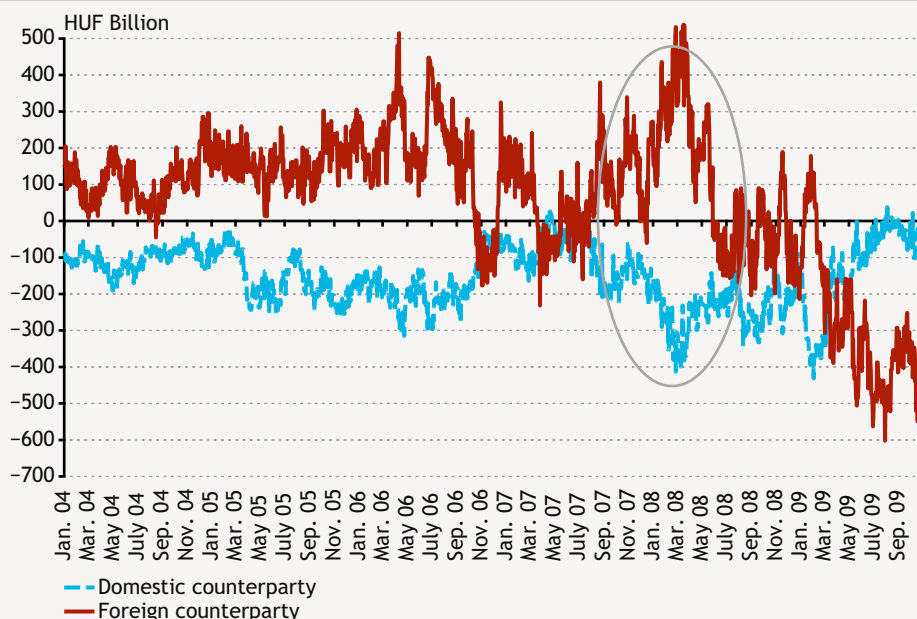
Source: MNB.

The swap counterparties of the domestic banking system are typically non-resident participants. They typically do not conclude HUF/foreign currency swap transactions with the household and corporate sector, or only in small volumes. The transactions concluded between domestic credit institutions do not appear within the net swap stock, and their volume within the gross stock is significantly lower than the HUF/foreign currency swap stock concluded with non-residents. In relation to the net swap stock of the entire credit institution system, most of the swap stock constitutes exposure to non-group non-resident participants (Chart 36). Between the second half of 2006 and the end of 2007, the net

Chart 36

Change and breakdown of the HUF/foreign currency swap stock of the credit institution sector by type of counterparty
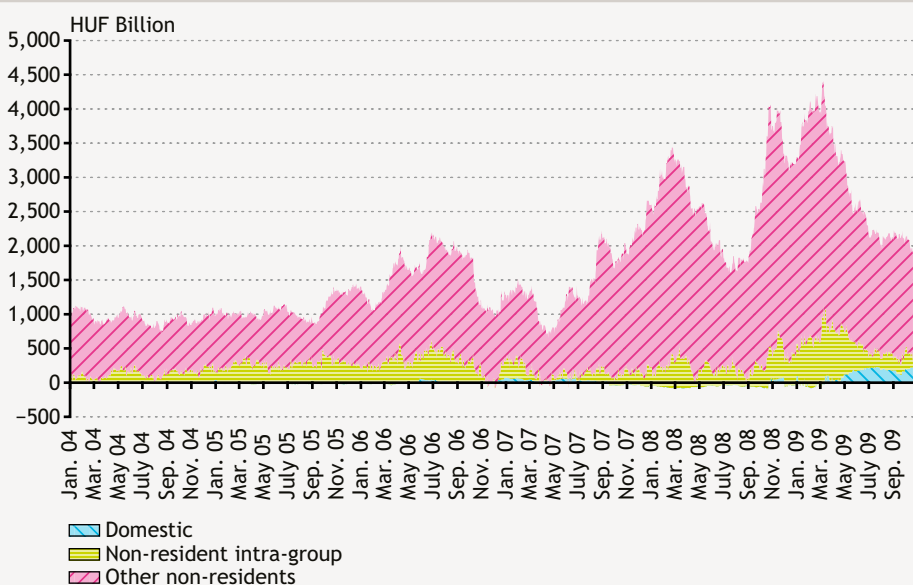
Note: The domestic category increases from the spring of 2009, primarily due to the use of MNB swap tenders. Transactions are calculated at the current exchange rate of the foreign currency amount in the forward leg.
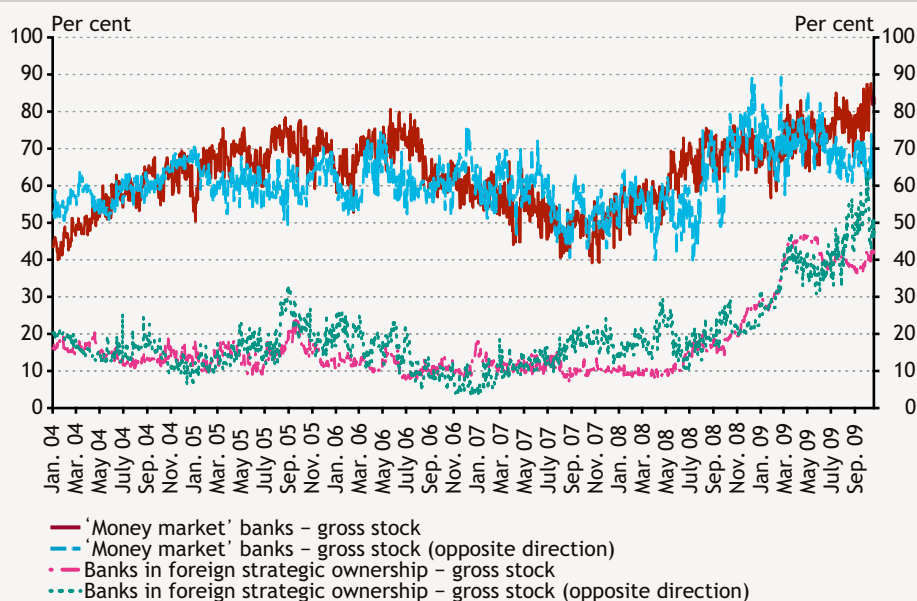Source: MNB.

stock of intra-group transactions sunk to a significantly lower level, while the net stock gradually increased. Thus, in this period, changes in the composition of exposure based on counterparty types increased the financial stability and rollover risks at the banking system level. From the second half of 2008, and particularly from September, after the emergence of the crisis a renewed increase in the weight of transactions concluded with parent banks within the total stock was observed. This partly reflected the strong commitment of the parent banks and partly the fact that the banks attempted to reduce their swap market exposure.

With respect to the gross swap stock of foreign owned credit institutions, the ratio of transactions within non-resident groups increased gradually to 40% by 2005 Q3, and then declined gradually to approximately 20% until 2008 Q2. Following the emergence of the turmoil on the FX swap market in September and October 2008, the figure even reached 45% by March 2009 (Annex 11).

The breakdown of the swap stock based on counterparty type varies according to the type of bank. The ratio of transactions within non-resident banking groups was always high, above the 40-50% range in relation to 'money market' banks, and by September 2009 it even reached 80%, following a clear and gradual rise after the subprime crisis of 2007. The high ratio of intra-group transactions may also be attributed to non-resident customer demand. In relation to subsidiaries with foreign strategic ownership, the value rose from roughly 10 per cent in the spring of 2008 to 40-50 per cent by the summer-autumn of 2009 (Chart 37).

The average remaining maturity of gross stocks was relatively short until August 2006, amounting to only 0.5 years. Moreover, in parallel with the above, the average remaining maturity of the stock of the opposite direction moderately exceeded this figure (Annex 12). Thereafter, the average remaining maturity of the gross and net stock gradually increased until June 2007, a shortening of maturity was observed in June-August 2007, i.e. the onset of subprime crisis. The domestic banking system increased maturity in two waves until the end of summer 2008; this was chiefly attributable to the rise in the maturity and stock of banks without foreign strategic ownership. Shortening of the maturity began before the Lehman bankruptcy and continued until the second half of October; thereafter domestic banks aimed at increasing maturity. One source for the above was the downsizing of the maturing transactions of the swap stock, which automatically resulted in a rise in the average maturity. The other source, particularly from early 2009, was related to cross-currency swap transactions with longer maturity, concluded primarily with non-resident group members, and secondarily with other non-resident counterparties (Chart 38). This may be interpreted as a reversal, as the average remaining maturity of transactions concluded with parent banks and group members gradually declined from 1.3 years to 0.5 years from the spring of 2007,

Chart 37
Ratio of intra-group transactions in the gross non-resident HUF/foreign currency swap stock by bank type

Source: MNB.

Chart 38
Average remaining maturity of the gross HUF/foreign currency swap stock by counterparty type

Year

- Non-resident intra-group
- Other non-residents
- Non-residents (together)
- Domestic
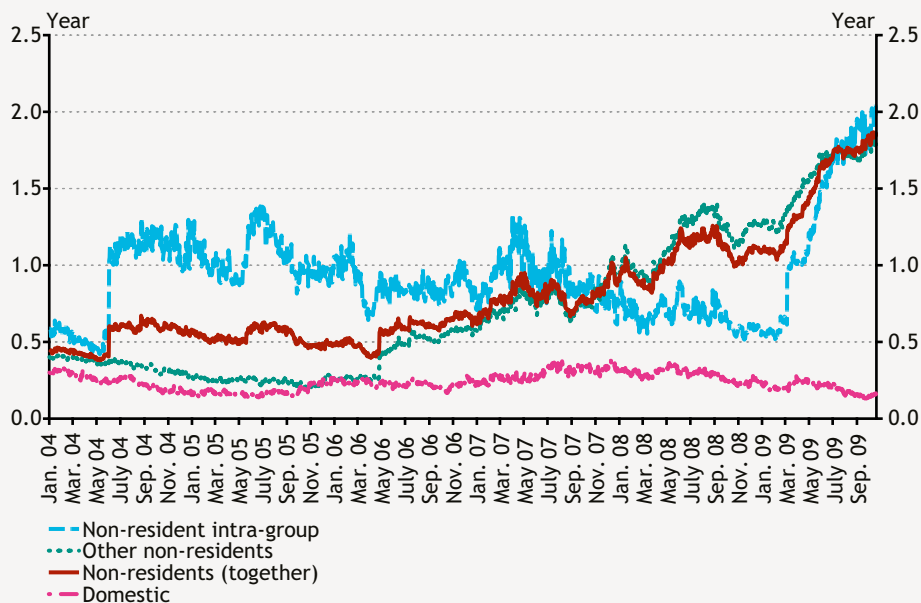
Source: MNB.

and then subsequently rose to 2 years from January until September 2009. The dynamics of the maturity of total transactions concluded with non-residents, however, was determined by transactions concluded with non-group members for most of the period, as these represented a significantly larger weight within the total stock of the banking system.

The average remaining maturity increased from early 2009 in relation to all types of banks (Chart 39). In relation to banks not in foreign strategic ownership, the increase in the average remaining maturity commenced even before the subprime crisis, during regional expansion. Following the emergence of the subprime crisis, the reliance of these banks on swap markets also rose in parallel with the deterioration of conditions for raising foreign currency funds directly from

Chart 39
Average remaining maturity of the gross HUF/foreign currency swap stock by domestic bank type

Year

- Banks without foreign strategic ownership
- Banks in foreign strategic ownership
- 'Money market' banks (branches)
- Total
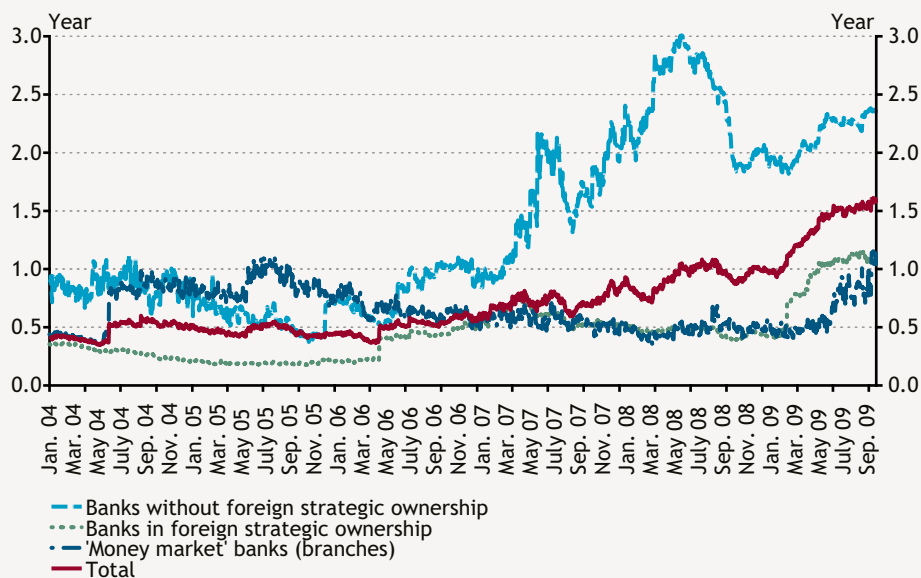
Source: MNB.

the market. The risks arising from the above trend, however, were mitigated by the fact that transactions with increasingly long maturities were concluded until the spring of 2008. Thereafter, rollover risks rose as the swap transactions were concluded with gradually shortening maturity until the crisis. In the group of 'money market' banks in foreign strategic ownership, the average remaining maturity reached an extremely low 0.5 years even after the emergence of the crisis, until March 2009, and only began to rise from March.

With regard to the foreign currency structure of the HUF/foreign currency gross and net swap stock, major changes were observed after the crisis. Transactions concluded against the dollar played a determining role until early 2006. Turnover and liquidity in the dollar segment was also higher on the international market, thus the hedging of the on-balance sheet foreign currency position was also performed earlier through the dollar segment (Chart 40). In addition to liquidity management, the dollar segment may also have played an important role in yield spread speculation: this is also reflected by the change in the foreign currency structure of the gross swap stock (Chart 41). This also explains that turnover in the HUF/USD segment was significantly higher in comparison to the other segments. Within the two gross stocks, the dollar segment always played a determining role until the crisis, while within the net swap stock – which is relevant for the hedging of exchange rate risks – the dominance of the dollar was gradually substituted with a more even distribution of the Swiss franc, the euro and the dollar in parallel with the rise in Swiss franc denominated lending. From the emergence of the crisis in October 2008, with the intensification of dollar liquidity problems, the dollar segment declined radically within the gross and net stock, and the Swiss franc segment declined moderately, while the euro segment experienced a substantial rise. From the summer of 2009, Swiss franc and euro transactions make up half of the net stock, respectively, and the ratio of the dollar segment has basically diminished to zero. The euro segment currently appears to be dominant within the gross stock. This may be attributed to the fact that, first, the MNB directly intervened in this market segment for the purpose of stimulating the swap market, and second, domestic banks practically abolished Swiss franc based lending after the events of October 2008.

With regard to the average remaining maturity by currency, first the maturity of Swiss franc transactions began to rise from the spring of 2006, that is, approximately from the recovery of the stock in Swiss francs. From early 2007, however, maturity stagnates between 1.5 and 1.8 years; it declined substantially from the period preceding the Lehman bankruptcy, from July 2008 until October (Annex 13). The remaining maturity of the dollar segment increased only later, from 2007,
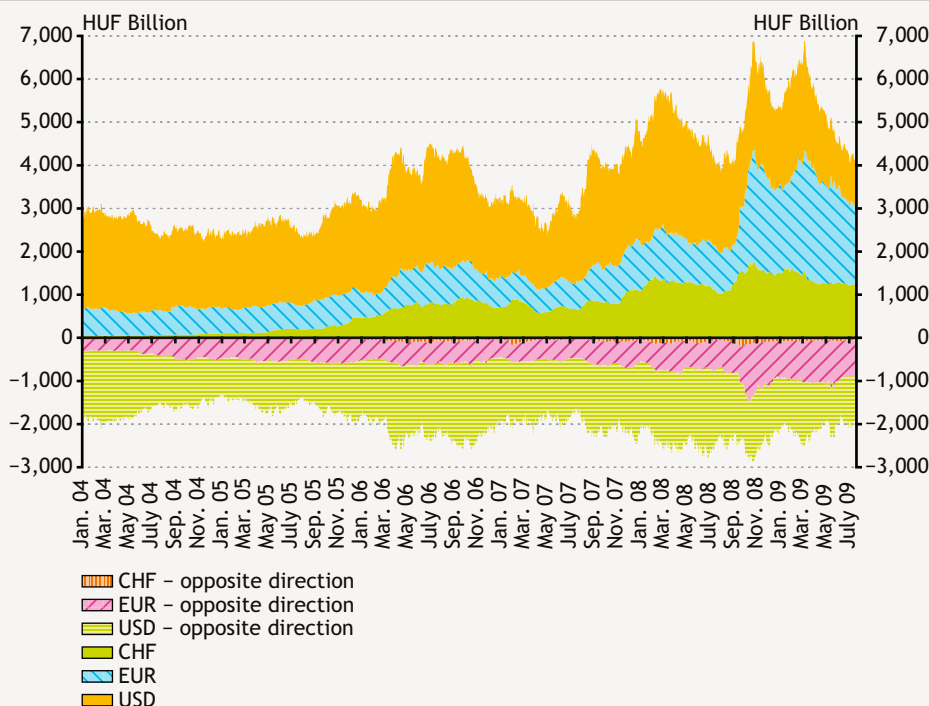
Chart 40
Distribution of the HUF/foreign currency net swap stock in the domestic credit institution sector by currency
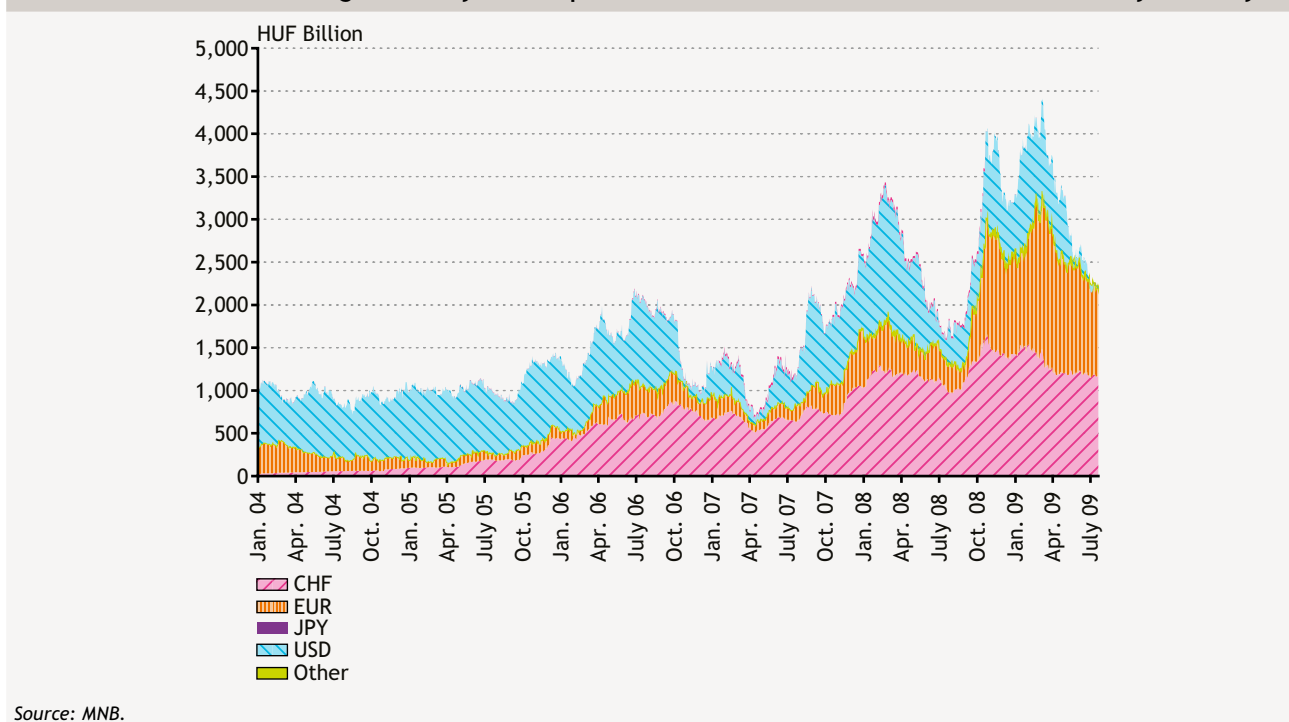
Source: MNB.

Chart 41
Distribution of the HUF/foreign currency gross swap stock in the domestic credit institution sector by currency

Note: In relation to domestic banks, for illustration purposes, we indicated the stock of transactions providing foreign currency liquidity in the spot leg with a negative sign (on a reversed scale), including domestic transactions.
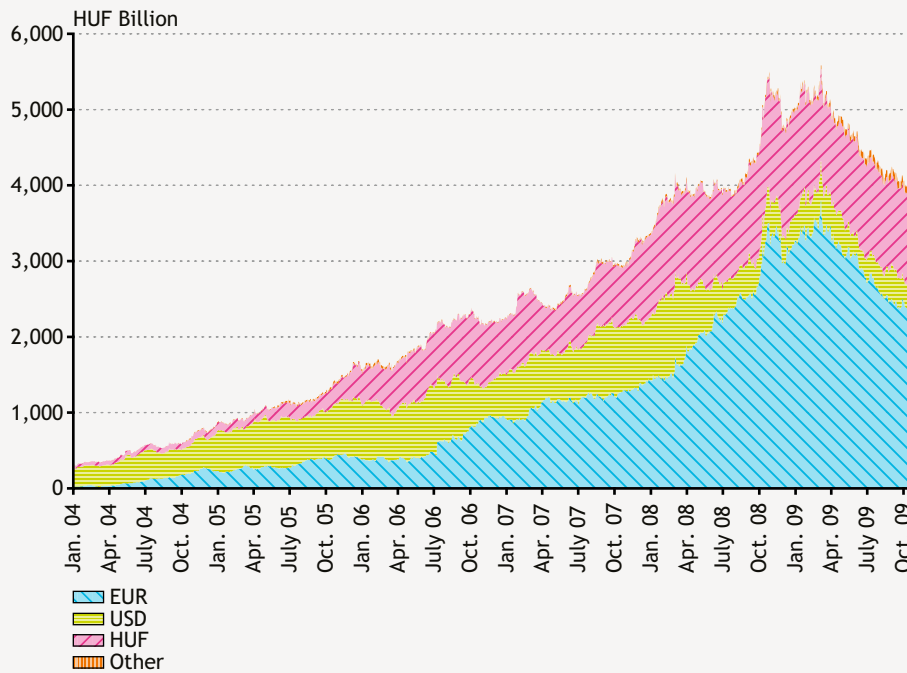Source: MNB.

on a gradual and higher level. The average remaining maturity of this segment during the emergence of the crisis in 2008 decreased only after the decline in the maturity of Swiss franc and euro transactions. A sudden, substantial shortening occurred on 15 September 2008 in relation to the euro segment. Maturity increased in all segments following the crisis, particularly in relation to the euro.

The domestic banking system, however, also carried an on-balance sheet cross-rate exposure, as the banking system was a net euro borrower and net Swiss franc lender in the balance sheet (in connection with the rise in Swiss franc lending). Moreover, in addition to the Swiss franc, HUF/USD and HUF/EUR transactions played a dominant role in the foreign currency structure of HUF/foreign currency swaps (Chart 42). And these transactions needed to be concluded further with USD/CHF and EUR/CHF transactions in order to offset the exchange rate exposure arising against the Swiss franc. Thus, in recent years there was a substantial rise in the volume of transactions by which domestic banks acquire Swiss franc liquidity in the spot leg. The EUR/CHF transactions are dominant in relation to the above; this is attributable to the fact that in relation to the euro, this is not only necessary for further concluding the net stock of transactions concluded against the forint, but also to hedge the on-balance sheet exposure to the CHF/EUR cross-rate. By contrast, the dollar segment was dominant from the beginning of the analysed period until early 2006; at the time the on-balance sheet CHF/EUR position was still at a negligible level and the dollar also dominated within the HUF/foreign currency swap stock.

The breakdown of the stock against the Swiss franc by counterparty type suggests that the stock and weight of intra-group transactions significantly increased from the end of 2007 until July 2009. If we only consider the stock of banks in foreign strategic ownership, the ratio of intra-group transactions in the stock against the Swiss franc rose from roughly 15% to 60%, while the figure rose from approximately 10% to roughly 76% within the EUR/CHF segment (Chart 43). First, this may imply that following the emergence of the subprime crisis in October 2007, the parent banks gradually increased their commitments to their subsidiaries in this segment. Second, as the increase in the ratio of intra-group transactions accelerated primarily in the period following the Lehman bankruptcy and in parallel with the strengthening of global Swiss franc liquidity problems, this may also suggest that in the absence of commitments by the parent banks, the domestic

Chart 42

The net currency swap stock against the Swiss franc by currency

HUF Billion

Source: MNB.

Chart 43

The CHF/EUR net currency swap stock by remaining maturity

HUF Billion | Per cent

- Over 1 year
- Between 3 months and 1 year
- Between 2 and 3 months
- Between 1 and 2 months
- Between 1 week and 1 month
- Within 1 week
- Ratio of intra-group transactions - in case of banks in foreign strategic ownership (right-hand scale)
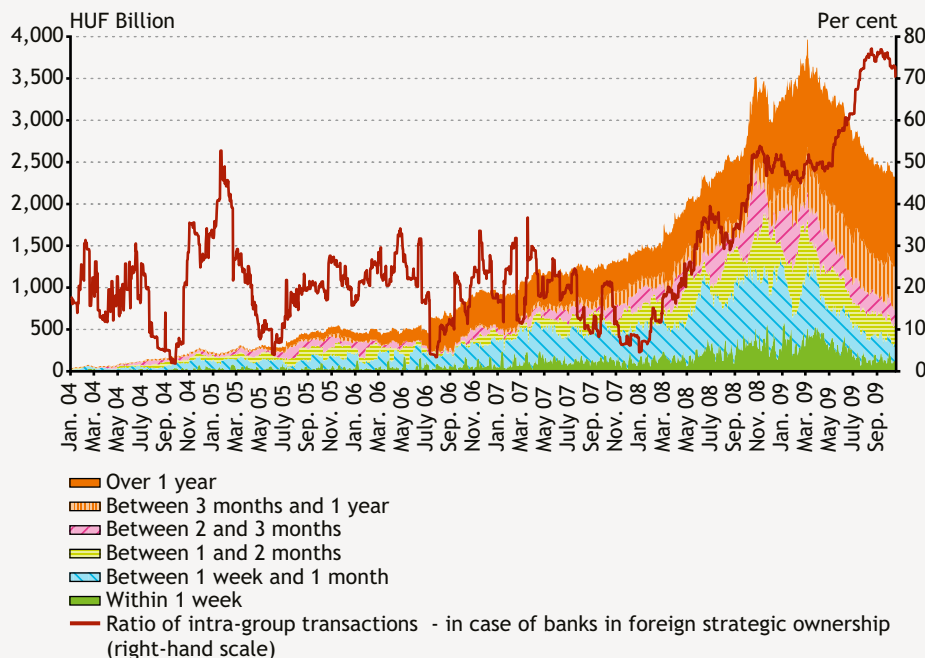
Note: Stock data indicates the breakdown of the swap stock of the entire credit institution sector, while the ratio only relates to banks with foreign strategic ownership.
Source: MNB.

subsidiaries would not have accessed Swiss franc liquidity or only at a very unfavourable price. In the meantime, the ratio of transactions with maturity of over one year gradually increased within the CHF/EUR segment.

7 Summary

The FX swap transaction may be understood as borrowing in one currency, with concurrent depositing in the other currency, where the receivable arising in one currency serves as collateral for the liability outstanding in the other currency. Owing to the structure of the FX swap transaction, it enables the swap of liquid assets (cash, account money) in different currencies through the spot leg and concurrently the cover of the resulting change in the foreign currency position through the forward leg. As a result, the transaction enables liquidity in the necessary denomination without the changing of the original foreign currency position – it is therefore applicable on a wide scale.

The currency of a financing instrument may be modified with the use of a currency swap transaction; accordingly, the transaction is suitable for hedging the on-balance sheet foreign currency position arising from the foreign currency lending of the domestic banking system with forint funds. Hedging with short-term FX swap transactions, however, is linked to liquidity and rollover risks. Beyond the financing of foreign currency lending, the transaction may also be used to produce a synthetic forward position, the purchase and hedging of HUF government securities and yield spread speculation. As an important macroeconomic difference between spot + swap and HUF government securities+swap strategies, while the former only results in the taking up of an exchange rate risk,[63] the latter results in the production of a synthetic financing instrument.

Beyond the wide ranging applicability of the transaction, the rise in the currency swap stock of the domestic credit institution system is also attributable to macroeconomic factors. In recent years the external borrowing requirement reached a high level up to the period preceding the crisis; debt generating items played a dominant role in the financing thereof, leading to a significant rise of the net external debt of the country, and in parallel, the reliance of the banking system on foreign funds. The rise in net external debt obviously contributed to the opening of exposure to the forint exchange rate. Much of this exposure was borne by the domestic private sector, accompanied by the taking up of an unhedged foreign currency position in the household and small enterprise sector. The exchange rate position of the domestic private sector was to a large extent taken up through the balance sheet of the banking system which contributed to the opening up of the on-balance sheet foreign currency position.

The fact that the non-resident sector took up a shrinking share of the exchange rate exposure resulting from increasing external debt would not have necessarily led to the rapid increase of the swap stock of the domestic banking system, as this could have happened entirely through the direct foreign currency cross-border loans provided to the domestic banking system. The latter development is related to several factors: conditions for raising direct external market funds deteriorated since the emergence of the subprime crisis which resulted in the rise of market premia and the contraction of access to foreign funds particularly in the case of banks without a non-resident parent bank. In addition, for most of the period, the production of foreign currency funds with swap transactions proved to be an overall cheaper method of financing, partly as a result of the higher ratio of sight deposits. The rise in the swap stock of the non-resident sector may have been necessitated by the fact that it adopted different strategies (spot+swap, government securities+swap) to exploit the high liquidity and flexibility of the market through the use of FX swap transactions.

On the basis of the decomposition of the on-balance sheet foreign currency position of the domestic banking system, we may conclude that its expansion is principally attributed to the volume effect, that is, it increased in reaction to items that also affected the balance sheet total. The foreign currency loans provided to the domestic private sector contributed to the combined increase of the balance sheet total and the on-balance sheet foreign currency position. The composition effect, i.e. the modification of the foreign currency *structure* of loans and deposits by bank customers, was moderate in

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[63] Or jointly with other strategies: results in its hedging.

terms of the whole period in comparison to the volume effect; it only affected the dynamics of the swap stock within the period up to the crisis. The composition effect materialised on the deposit side of households and on both the loan and deposit side of companies, as a result of the multi-currency loans.

In October 2008, during the weakening of the forint exchange rate, the *composition effect* contributed significantly to the opening of the on-balance sheet foreign currency position, and the composition effect of the domestic private sector moved closely with the spot+swap strategy (forward sale of forints) of non-residents. This means that the domestic private sector contributed to the stabilisation of the forint exchange rate through the transformation of the currency structure of its loans and deposits, while the spot market forint sales of non-resident participants weakened the exchange rate. The volume effect partly co-moved with the forint government securities+swap strategy of non-residents and partly with the spot+swap strategy. Thus, the volume effect is partly attributed to the fact that some of the funds of foreign currency based lending were provided by internal forint savings at the level of the domestic banking system. Following the emergence of the crisis, the correlation between the government securities+swap strategy of non-residents and the volume effect strengthened; the net swap demand of non-residents also declined with the sale of government securities by non-residents and their maturity, while the on-balance sheet foreign currency position also began to close in the framework of the balance sheet adjustment of the banking system.

Directly after the emergence of the global financial crisis in the autumn of 2008, the conditions for acquiring foreign currency liquidity worsened substantially, counterparty limits for domestic banks contracted and the volatility of the HUF exchange rate rose. These factors produced a major effect on the implied forint yields and the level and structure of swap market turnover. The total average turnover of the domestic FX swap market did not decline by an enormous rate in the expansive period of the crisis, but market liquidity declined significantly for a few days and access to foreign currency liquidity became extremely limited. The fact that the decline in turnover was not of an extraordinary level was partly due to the active role played by parent banks and partly to the shortening maturities. On the basis of turnover data, it can be established that during the weakening of the HUF exchange rate and the market turmoil, the ratio of transactions concluded with parent banks and group members increased significantly. Implied forint yields moved significantly away from the bottom of the interest rate corridor, meaning that foreign currency liquidity was available at a high premium in comparison to international interbank yields. Following multiple departures, the implied forint yields returned to the interest rate corridor in the long term in April 2009.

The rise in the concentration of market turnover may imply the contraction of counterparty limits. In addition, the decline in the number of counterparties is most reliable as data supporting anecdotal information relating to the contraction of limits. In the contraction of the limits, the non-resident, non-group counterparties were more characterised by heterogeneity than homogeneity. In addition to shortening maturities and raising the ratio of transactions concluded with parent banks, domestic banks reacted to contracting limits with the conclusion of collateralisation agreements (margining, CSA annex). Margining reduced the burden on the limits, and at the same time, we estimate that it substantially increased the swap requirement of certain domestic banks as a result of the significant weakening and fluctuation of the HUF exchange rate. In addition to contracting the limits, the weakening of the HUF exchange rate also significantly affected the liquidity position of individual banks through the rollover of FX swaps; from October 2008, the aggregate value of individual, direct forint liquidity requirements increased substantially. This effect arises at the level of individual banks, and not at the sector level, and thus it primarily represents a major risk if the interbank forint market does not function free of frictions.

The turbulence following the Lehman bankruptcy contributed to changes in both the level and structure of the currency swap stock. In relation to banks without foreign strategic ownership, the rise in the net swap stock was considerable even after the subprime crisis in 2007, as the conditions for raising external foreign currency funds on the market deteriorated significantly, and the conversion of the forint liquidity arising from domestic forint deposits with currency swaps enabled the production of synthetic foreign currency funds. From mid-September to the end of October 2008, the net swap stock increased significantly, with the opening of the on-balance sheet foreign currency position resulting from the composition effect and margining, and concurrently with the major weakening of the HUF exchange rate, and it then declined as a trend from the end of the year, in parallel with the on-balance sheet adjustment of the banking system. The average remaining maturity of the gross swap stock began to shorten directly after the Lehman bankruptcy, at the time of global dollar liquidity problems, followed by a rise from early 2009, principally owing to the increasing maturity of transactions

concluded with parent banks. Domestic subsidiary banks managed to increase maturity primarily through cross-currency swap transactions concluded with intra-group counterparties, but non-group counterparties also concluded transactions with longer maturity with domestic banks. The combined effect of the above factors led to the decline of exposure to swap market turmoil and risks to financial stability.

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Annexes

ANNEX 1: CASH FLOWS AND MARKET VALUE OF THE FX SWAP AND FORWARD TRANSACTION UPON MATURITY

The table below illustrates the cash flows of forward forint purchases:

Table 1

Cash flows of the forward transaction in original currency

(forward forint purchase)

	Deal date	Maturity
FOREIGN CURRENCY	0	−1
FORINT	0	F

$$\text{Where } F = S_{0,HUF/EUR} \cdot \frac{1 + r_{HUF}}{1 + r_{DEV}}$$

where r_{HUF} and r_{DEV} are the forint and foreign currency yields at the given maturity.

Table 2

Market value of the forward transaction in forints at maturity

(forward forint purchase)

	Deal date	Maturity
FOREIGN CURRENCY	0	$-S_T$
FORINT	0	F
Total		$F-S_T$

On the basis of the above table, the market value of the forward transaction depends on the relationship between the spot exchange rate of the forint at maturity (S_T) and the forward exchange rate (F). If the exchange rate weakens by a extent larger than the value determined by the interest rate spread $(r_{HUF} - r_{DEV})$ $(F < S_T)$, the transaction produces a loss, otherwise it is profitable. This is why the forward transaction is adequate for assuming an exchange rate position.

The FX swap transaction differs from the forward transaction in that a sale-purchase of currencies is transacted in relation to the former: it consists of a spot transaction and a forward transaction. The table below shows the FX swap transaction in terms of the counterparty buying foreign currency in the spot leg:

Table 3

Cash flows of the FX swap transaction in the original currency

(currency purchase in the spot leg, forint purchase in the forward leg)

	Deal date	Maturity
FOREIGN CURRENCY	+1	−1
FORINT	$-S_0$	F

To determine the market value of the total FX swap transaction at maturity, it is necessary to consider total cash flow, that is, the future value of the spot leg's cash flows, in addition to the value of the forward leg expressed in forints. This is shown in Table 2 of Chapter 1.1.

The market value of the FX swap transaction depends on the foreign exchange rate at maturity only in relation to the foreign currency interest rate and – contrary to forward transactions – not in relation to total capital. Thus, the FX swap transaction basically in itself constitutes a closed position in the sense that it only contains the exchange rate risk linked to the foreign currency interest rate.

If the forward leg of the FX swap transactions commonly (would) applies(y) not only to the original foreign currency amount, but also the interest bearing foreign currency amount, the exchange rate risk linked to the foreign currency interest rate is (would be) eliminated (Table 5-6).

Table 4

Cash flows of the modified FX swap transaction in the original currency

(currency purchase in the spot leg, forint purchase in the forward leg)

	Deal date	Maturity
FOREIGN CURRENCY	+1	$-(1+r_{DEV})$
FORINT	$-S_0$	$+S_0 \cdot (1+r_{HUF})$

Table 5

Market value of the modified FX swap transaction at maturity in forints

(future value calculation)

	Deal date	Maturity	Total
FOREIGN CURRENCY	$+1 \cdot (1+r_{DEV}) \cdot S_T$	$-S_T \cdot (1+r_{DEV})$	0
FORINT	$-S_0 \cdot (1+r_{HUF})$	$+S_0 \cdot (1+r_{HUF})$	0
Total	$(1+r_{DEV}) \cdot (S_T-F)$	$(1+r_{DEV}) \cdot (F-S_T)$	0

ANNEX 2: PRODUCTION OF A SYNTHETIC FORWARD POSITION THROUGH FX SWAP TRANSACTIONS, MARKET VALUE OF THE FORWARD AND SYNTHETIC FORWARD POSITION

A synthetic forward position may also be produced through the use of an FX swap transaction and a spot foreign currency market transaction of a direction opposite to the spot leg. This is shown by the table below:

Table 1

Cash flows of a synthetically produced forward position in the original currency

(forward forint purchase)

		Deal date	Maturity
FX SWAP	FOREIGN CURRENCY	+1	−1
	FORINT	$-S_0$	F
SPOT	FOREIGN CURRENCY	−1	
	FORINT	$+S_0$	
TOTAL	FOREIGN CURRENCY	0	−1
	FORINT	0	F

If we consider the future value of the cash flows indicated in the above table relating to the date of maturity, the result is a market value corresponding to the forward transaction.

Table 2
Market value of a synthetically produced forward position at maturity in forints
(forward forint purchase)

		Deal date	Maturity	Total
FX SWAP	FOREIGN CURRENCY	$+1 \cdot (1+r_{DEV}) \cdot S_T$	$-S_T$	$r_{DEV} \cdot S_T$
	FORINT	$-S_0 \cdot (1+r_{HUF}) = -F \cdot (1+r_{DEV})$	F	$-r_{DEV} \cdot F$
SPOT	FOREIGN CURRENCY	$-1 \cdot (1+r_{DEV}) \cdot S_T$	0	$-(1+r_{DEV}) \cdot S_T$
	FORINT	$+S_0 \cdot (1+r_{HUF}) = +F \cdot (1+r_{DEV})$	0	$+F \cdot (1+r_{DEV})$
TOTAL		0	$F{-}S_T$	$F{-}S_T$

On the basis of the above table, the market value of the synthetic forward position depends on the relationship between the spot exchange rate of the forint at maturity (S_T) and the forward exchange rate. If the exchange rate weakens by a rate larger than the value determined by the interest rate spread $(r_{HUF} - r_{DEV})$ $(F < S_T)$, the transaction produces a loss, otherwise it is profitable. This is why the FX swap transaction can also be applied to assuming an exchange rate position.

The market evaluation of the forward transaction and the synthetic forward position (mark-to-market) is conducted – also in relation to margin call agreements – not only at maturity, but also during the lifetime of the transaction.

Table 3
Current market value of the forward transaction and the synthetically produced forward position in forints, on date t during the lifetime of the transaction
(forward forint purchase)

	Deal date	Maturity	Total
FOREIGN CURRENCY	0	$-S_t \cdot \dfrac{1}{1+r_{DEV}^{tT}} = -F_{tT} \cdot \dfrac{1}{1+r_{HUF}^{tT}}$	$-F_{tT} \cdot \dfrac{1}{1+r_{HUF}^{tT}}$
FORINT	0	$+F_{OT} \cdot \dfrac{1}{1+r_{HUF}^{tT}}$	$+F_{OT} \cdot \dfrac{1}{1+r_{HUF}^{tT}}$
TOTAL	0	$+(F_{0T} - F_{tT}) \cdot \dfrac{1}{1+r_{HUF}^{tT}}$	$+(F_{0T} - F_{tT}) \cdot \dfrac{1}{1+r_{HUF}^{tT}}$

On the basis of the above table, we can establish that the market value of the transaction during maturity (on date *t*) generally depends on the direction and degree of the change in the forward exchange rate relating to the date of maturity *(T)*.

Because the present value of euro due at maturity is:

$$ -S_t \cdot \frac{1}{1+r_{DEV}^{tT}} = -F_{tT} \cdot \frac{1}{1+r_{HUF}^{tT}} $$

where S_t is the spot foreign exchange rate valid on date *t*, r_{DEV}^{tT} is the foreign currency yield calculated for the period between date *t* and *T*, F_{tT} is the forward exchange rate relating to date *T* on date t, and r_{HUF}^{tT} is the forint yield relating to the period between date *t* and *T*.

In consideration of the present value of forint revenue due at maturity, as well, the market value of the transaction:

$$ +(F_{0T} - F_{tT}) \cdot \frac{1}{1+r_{HUF}^{tT}} $$

where F_{0T} is the forward exchange rate determined upon conclusion of the transaction, relating to date *T*. Thus, if the forward exchange rate of the forint relating to date *T* strengthens $(F_{tT}{<}F_{0T})$, the transaction has a positive net present value. Otherwise it has a negative net present value: if it exceeds a limit value, additional collateral needs to be provided to the counterparty in accordance with the margin call agreements (or rather, the credit support annex).

ANNEX 3: ROLLOVER OF THE FX SWAP TRANSACTION

Table 1
Cash flows of the FX swap transaction's rollover in the original currency
(currency purchase in the spot leg, forint purchase in the forward leg)

		Deal date	Rollover	Maturity
1. FX swap	Foreign currency	+1	−1	
	Forint	$-S_0$	$+F_{01}$	
2. FX swap	Foreign currency		+1	−1
	Forint		$-S_1$	$+F_{1T}$

In the table, S_0 and S_1 is the foreign exchange rate valid upon rollover, F_{01} is the forward exchange rate upon conclusion, relating to the maturity date of the first FX swap transaction, F_{1T} is the forward exchange rate priced in the transaction concluded upon rollover.

$$F_{01} = S_0 \cdot \frac{1 + r_{HUF}^{01}}{1 + r_{DEV}^{01}}$$

$$F_{1T} = S_1 \cdot \frac{1 + r_{HUF}^{1T}}{1 + r_{DEV}^{1T}}$$

where r_{HUF}^{01} and r_{HUF}^{1T} are the forint yields calculated for the corresponding periods, and r_{DEV}^{01} and r_{DEV}^{1T} are the foreign currency yields calculated for the appropriate periods.

Table 2
Market value at maturity of the cash flows of the FX swap transaction's rollover in forints
(future value calculation)

		Deal date	Rollover	Maturity	Total
1. FX swap	Foreign currency	$+S_T \cdot (1+r_{DEV}^{01}) \cdot (1+r_{DEV}^{1T,F})$	$-S_T \cdot (1+r_{DEV}^{1T})$		$+r_{DEV}^{01} \cdot S_T \cdot (1+r_{DEV}^{1T})$
	Forint	$-S_0 \cdot (1+r_{HUF}^{01}) \cdot (1+r_{HUF}^{1T,F})$ $= -F_{0T} \cdot (1+r_{DEV}^{01}) \cdot (1+r_{DEV}^{1T,F})$ $= -F_{01} \cdot (1+r_{DEV}^{01}) \cdot (1+r_{HUF}^{1T,F})$	$+S_0 \cdot \dfrac{1+r_{HUF}^{01}}{1+r_{DEV}^{01}} \cdot (1+r_{HUF}^{1T})$ $= +F_{01} \cdot (1+r_{HUF}^{1T})$		$-r_{DEV}^{01} \cdot F_{01} \cdot (1+r_{HUF}^{1T})$
2. FX swap	Foreign currency		$+S_T \cdot (1+r_{DEV}^{1T})$	$-S_T$	$+r_{DEV}^{1T} \cdot S_T$
	Forint		$-S_1 \cdot (1+r_{HUF}^{1T})$	$+S_1 \cdot \dfrac{1+r_{HUF}^{1T}}{1+r_{DEV}^{1T}}$	$-r_{DEV}^{1T} \cdot F_{1T}$
Total		$+(S_T - F_{0T}) \cdot (1+r_{DEV}^{01}) \cdot (1+r_{DEV}^{1T,F})$	$+(F_{01} - S_1) \cdot (1+r_{HUF}^{1T})$	$+F_{1T} - S_T$	$\approx +r_{DEV}^{01} \cdot \left[S_T \cdot (1+r_{DEV}^{1T}) - F_{01} \cdot (1+r_{HUF}^{1T})\right]$ $+ r_{DEV}^{1T} \cdot \left[S_T - F_{1T}\right]$

Exchange rate risk on FX interest

Note: In the table, we assume that $r_{HUF}^{1T,F} = r_{HUF}^{1T}$ and $r_{DEV}^{1T,F} = r_{DEV}^{1T}$. $r_{HUF}^{1T,F}$ and $r_{DEV}^{1T,F}$ is the forward yield priced at the conclusion of the first transaction, relating to the second time period.

$F_{0T} = S_0 \cdot \dfrac{(1+r_{HUF}^{01}) \cdot (1+r_{HUF}^{1T,F})}{(1+r_{DEV}^{01}) \cdot (1+r_{DEV}^{1T,F})}$

It is clear from the above table that upon the rollover of the FX swap, the exchange rate risk linked to the principal is eliminated, but owing to the structure of the scheme, the exchange rate risk linked to the foreign currency interest rate cannot be neutralised. Although at rollover and maturity, the resultant of the cash flows, converted to forints, is not

necessarily zero (if the priced forward exchange rate and the spot exchange rate at maturity are different); but with interest accrued on the cash flows, the whole of the transaction closes at zero, with the exception of exchange rate risk linked to the foreign currency interest rate.

If, namely, in accordance with the assumption made in Table 2, the yields move in accordance with the earlier forward yields upon rollover and/or the foreign currency amount received in the spot leg at conclusion is lent for a duration of one period and rolled over, the funds necessary for securing the forint amount are provided through the rollover of deposits of one period, then the value of the transaction at maturity is:

$$\approx +r_{DEV}^{01} \cdot \left[S_T \cdot (1 + r_{DEV}^{1T}) - F_{01} \cdot (1 + r_{HUF}^{1T}) \right] + r_{DEV}^{1T} \cdot \left[S_T - F_{1T} \right]$$

| Exchange rate risk on FX interest of period 1 | Exchange rate risk on FX interest of period 2 |

Upon launching of the series of transactions, this poses a risk because S_T is not known either at the conclusion of the first or the second transaction. (Within the formula, r_{DEV}^{01} and F_{01} are known at the conclusion of the first transaction, the other items are known only upon conclusion of the new transaction).

The foreign currency received initially, however, may also be lent for a duration of two periods, with a foreign currency yield corresponding to the prevailing yield curve, the paid forint amount may be secured with forint funds with a necessary duration of two periods.[64] In the second period, however, the current spot yield (r_{HUF}^{1T}) does not necessarily correspond to the forward yield ($r_{HUF}^{1T,F}$). If we also take this into account, the result of the transaction may be defined with a more complex formula:

$$r_{DEV}^{01} \cdot \left[S_T \cdot (1 + r_{DEV}^{1T,F}) - F_{01} \cdot (1 + r_{HUF}^{1T,F}) \right] + r_{DEV}^{1T} \cdot \left[S_T - F_{1T} \right] + S_T \cdot (r_{DEV}^{1T,F} - r_{DEV}^{1T}) + F_{01} \cdot (r_{HUF}^{1T} - r_{HUF}^{1T,F})$$

| Exchange rate risk on FX interest | FX interest rate risk | HUF interest rate risk |

Thus, the rollover of FX swap transactions is linked to interest rate risk and exchange rate risk related to the foreign currency interest rate at the launch of the transaction; at launch, namely, the future direction of foreign currency interest rates, forint interest rates and the spot foreign exchange rate is not known. (At launch, only r_{DEV}^{01}, $r_{DEV}^{1T,F}$, r_{HUF}^{01}, $r_{HUF}^{1T,F}$, F_{01} is known; S_T is known only at maturity and the other variables only from the conclusion of the second transaction).

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[64] From a theoretical point of view this comparison needs to be taken as a basis. The future value of a given cash flow, relating to a given date, is determined on the basis of the yield curve valid on the date of the cash flow, for the period between the date of the cash flow and the date of market valuation.

ANNEX 4: CASH FLOWS OF FOREIGN CURRENCY LENDING WITH SHORT-TERM FORINT FUNDS, WITH VARIABLE INTEREST RATES, AND ITS HEDGING WITH FX SWAP TRANSACTIONS FROM THE POINT OF VIEW OF THE BANK (IN ORIGINAL CURRENCY)

| Transaction | | Currency | Lending | Rollover of FX swap | Maturity of loan |
			Date of deal		Date of maturity
Foreign currency loan	Principal	FX	−1		+1
	Interest	FX		$+1 \cdot r_{DEV}^{01}$	$+1 \cdot r_{DEV}^{1T}$
1. HUF deposit	Principal	HUF	$+1 \cdot S_0$	$-1 \cdot S_0$	
	Interest	HUF		$-1 \cdot S_0 \cdot r_{HUF}^{01}$	
2. HUF deposit	Principal	HUF		$+1 \cdot S_0$	$-1 \cdot S_0$
	Interest	HUF			$-1 \cdot S_0 \cdot r_{HUF}^{1T}$
1. Spot leg of FX swap		HUF	$-1 \cdot S_0$		
		FX	+1		
1. Forward leg of FX swap		HUF		$+1 \cdot F_{01}$	
		FX		−1	
2. Spot leg of FX swap		HUF		$-1 \cdot S_1$	
		FX		+1	
2. Forward leg of FX swap		HUF			$+1 \cdot F_{1T}$
		FX			−1
Total cash flow	Principal	HUF	0	$\approx S_0 - S_1$	$\approx S_1 - S_0$
		FX	0		
	Interest	HUF	−	$\approx (r_{HUF}^{01} - r_{DEV}^{01} - r_{HUF}^{01}) \cdot S_0 = -r_{DEV}^{01} \cdot S_0$	$\approx (r_{HUF}^{1T} - r_{DEV}^{1T}) \cdot S_1 + r_{HUF}^{1T} \cdot S_0$
		FX	−	$+ r_{DEV}^{01}$	$+ r_{DEV}^{1T}$

Note: In the table we assume that upon maturity, the foreign currency loan is a loan repayable in a lump sum, with periodically variable interest.

The above table implies that the transaction is considered to be hedged in terms of exchange rate risk for the principal, as the forint liquidity requirement (surplus) arising in the first period arises as a forint liquidity surplus (deficit) in the second period.

Upon rollover, the forint liquidity amounts to $S_0–S_1$, if the exchange rate weakens (i.e. $S_1 > S_0$), a forint liquidity surplus arises approximately in the same amount $(S_1–S_0)$.

Upon rollover, resultant of cash flows in forints:

$$F_{01} - S_1 - S_0 \cdot r_{HUF}^{01} = S_0 \cdot \frac{1 + r_{HUF}^{01}}{1 + r_{DEV}^{01}} - S_1 - S_0 \cdot r_{HUF}^{01} \approx S_0 \cdot (1 + r_{HUF}^{01} - r_{DEV}^{01}) - S_1 - S_0 \cdot r_{HUF}^{01} = \underbrace{(S_0 - S_1)}_{\substack{\text{Change in principal caused by FX rate – in HUF}}} - \underbrace{r_{DEV}^{01} \cdot S_0}_{\substack{\text{FX interest in HUF}}}$$
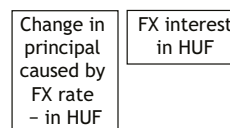
In parallel with the above, the principal payable in foreign currency has an opposite sign and a corresponding amount, thus, only foreign currency interest is payable in foreign currency.

At maturity, resultant of cash flows in forints:

$$F_{1T} - S_0 - S_1 \cdot r_{HUF}^{1T} = S_1 \cdot \frac{1 + r_{HUF}^{1T}}{1 + r_{DEV}^{1T}} - S_0 - S_1 \cdot r_{HUF}^{1T} \approx S_1 \cdot (1 + r_{HUF}^{1T} - r_{DEV}^{1T}) - S_0 - S_1 \cdot r_{HUF}^{1T} =$$

$$= \underbrace{(S_0 - S_1) - r_{DEV}^{1T} \cdot S_0}_{\substack{\text{Change in} \\ \text{principal} \\ \text{caused by} \\ \text{FX rate} \\ \text{– in HUF}}} \underbrace{- r_{HUF}^{1T} \cdot (S_1 - S_0)}_{\substack{\text{FX interest} \\ \text{in HUF}}}$$

Cash flows in foreign currency basically offset each other; at maturity, only interest due on the given period is payable in foreign currency.

Thus, if the foreign currency or foreign currency based loans have variable interest rates, and these are financed with short-term funds similar to FX swaps, the series of transactions does not contain a yield spread risk: whatever has a positive sign in one period as a cash flow has a negative sign at maturity (and vice versa). (If the foreign currency loan has a fixed interest rate and the forint deposit has long-term maturity, the interest rate spread risk is not eliminated.)

It is also noteworthy that the exchange rate risk linked to the foreign currency interest is not eliminated (in the first period: $\approx r_{DEV}^{01} \cdot S_T - r_{DEV}^{01} \cdot S_0$, in the second period: $\approx r_{DEV}^{1T} \cdot S_T - r_{DEV}^{1T} \cdot S_0$).

ANNEX 5: FOREIGN CURRENCY BASED LENDING WITH SHORT-TERM FORINT FUNDS THROUGH SHORT-TERM FX SWAP TRANSACTIONS (INDICATION OF ONLY PRINCIPAL)

FOREIGN CURRENCY BASED LENDING
0. point in time

	ASSETS	LIABILITIES	
1. Forint deposit	$+HUF_0$	$+HUF_0$	
2a. Spot leg of FX-swap transaction	$-HUF_0$ $+DEV_0$		2a. Spot leg of FX swap transaction
3. Spot transaction	$-DEV_0$ $+HUF_0$		3. Spot transaction
4. Granting and disbursement of foreign currency based loan	$+DEV_0^{receivables}$ $-HUF_0$	$+HUF_0$ $-HUF_0$	
SUM – ON-BALANCE SHEET	$+DEV_0^{receivables}$	$+HUF_0$	
SUM – OFF-BALANCE SHEET	$+HUF_{01}$	$+DEV_0$	
2b. Forward leg of FX swap transaction	$+HUF_{01}$	$+DEV_0$	2b. Forward leg of FX swap transaction
	ASSETS	LIABILITIES	

1. Spot counterparty · 1. Swap counterparty

ON-BALANCE / OFF-BALANCE

ROLLOVER OF FX SWAP TRANSACTION
1. point in time

	ASSETS	LIABILITIES	
Starting point	$+DEV_0^{receivables}$	$+HUF_0$	
5. Forward leg of FX swap transaction	$+HUF_{01}$ $-DEV_0$		5. Forward leg of FX swap transaction
6a. Spot leg of new FX swap transaction	$+DEV_0$ $-HUF_1$		6a. Spot leg of new FX swap transaction
7. Redemption of forint deposit	$-HUF_0$	$-HUF_0$	
8. New forint deposit	$+HUF_0$	$+HUF_0$	
SUM – ON-BALANCE SHEET	$+DEV_0^{receivables}$ $+HUF_{01} - HUF_1$	$+HUF_0$	
SUM – OFF-BALANCE SHEET	$+HUF_{1T}$	$+DEV_0$	
Starting point	$+HUF_{01}$	$+DEV_0$	
5. Forward leg of FX swap transaction	$-HUF_{01}$	$-DEV_0$	5. Forward leg of FX swap transaction
6b. Forward leg of new FX swap	$+HUF_{1T}$	$+DEV_0$	6b. Forward leg of new FX swap
	ASSETS	LIABILITIES	

1. Spot counterparty · 2. Swap counterparty

ON-BALANCE / OFF-BALANCE

REDEMPTION OF FOREIGN CURRENCY BASED LOAN
T. point in time

	ASSETS	LIABILITIES	
Starting point	$+DEV_0^{receivables}$ $+HUF_{01} - HUF_1$	$+HUF_0$	
9. Redemption and repayment of foreign currency based loan in forint	$-DEV_0^{receivables}$ $+HUF_T$		
10. Spot transaction	$+DEV_0$ $-HUF_T$		10. Spot transaction
11. Forward leg of new FX swap transaction	$-DEV_0$ $+HUF_{1T}$		11. Forward leg of new FX swap transaction
12. Redemption of forint deposit	$-HUF_0$	$-HUF_0$	
SUM – ON-BALANCE SHEET	$+HUF_{01} - HUF_0$ $+HUF_{1T} - HUF_1$	0	
SUM – OFF-BALANCE SHEET	0	0	
Starting point	$+HUF_{1T}$	$+DEV_0$	
11. Forward leg of new FX swap transaction	$-HUF_{1T}$	$-DEV_0$	11. Forward leg of new FX swap transaction
	ASSETS	LIABILITIES	

2. Spot counterparty · 2. Swap counterparty

ON-BALANCE / OFF-BALANCE

ANNEX 6: RISKS AND CHARACTERISTICS OF HEDGING FOREIGN CURRENCY AND FOREIGN CURRENCY BASED LENDING WITH SHORT-TERM FX SWAP TRANSACTIONS – DETAILED DESCRIPTION

In relation to hedging with FX swaps with short maturity, upon disbursement of foreign currency based loans and repayment, the same procedures are applied as in the case of the FX swap and the foreign currency based loan having the same maturity. The difference is related to the fact that FX swap transactions with shorter maturity need to be renewed upon maturity (see Annex 5).

Upon rollover, among sub-balance sheet items, the forward leg of the previously concluded FX swap transaction is eliminated (forint receivables and foreign currency liabilities decrease). At the same time, the forward leg of the transaction concluded for its rollover increases the amount of off-balance sheet forint receivables and foreign currency liabilities (Annex 5, items 5 - 6b). Thus, overall, the amount of off-balance sheet foreign currency liabilities remains at the same level.[65] The off-balance sheet forint receivables change depending on the difference between the forward exchange rates priced in the previous and newly concluded swap transactions. This is basically determined by two factors: changes in the interest rate spread relating to the maturity (period) of the two transactions and the spot forint exchange rate. Definition of the amounts contained in the chart:

$$HUF_{01} = S_0 \cdot \frac{1+r_{HUF}^{01}}{1+r_{DEV}^{01}} \cdot DEV_0 \approx S_0 \cdot (1+r_{HUF}^{01}-r_{DEV}^{01}) \cdot DEV_0$$

$$HUF_{1T} = S_1 \cdot \frac{1+r_{HUF}^{1T}}{1+r_{DEV}^{1T}} \cdot DEV_0 \approx S_1 \cdot (1+r_{HUF}^{1T}-r_{DEV}^{1T}) \cdot DEV_0$$

Definition of changes (upon rollover) in the amount of off-balance sheet forint receivables with a formula:

$$HUF_{1T} - HUF_{01} \approx (\underbrace{S_1 - S_0}_{\text{Fx. rate change}} + \underbrace{(r_{HUF}^{1T}-r_{DEV}^{1T}) \cdot S_1 - (r_{HUF}^{01}-r_{DEV}^{01}) \cdot S_0}_{\text{Yield spread change}}) \cdot DEV_0$$

Where HUF_{01} is the forint amount of the first FX swap transaction's forward leg which is determined upon disbursement of the foreign currency loan (at date **0**) and matures at the end of the first period. HUF_{1T} is the forint amount of the second FX swap transaction's forward leg which is determined upon the rollover of the first transaction and matures at date T (upon maturity of the loan).

In parallel, the forward leg of the first FX swap transaction also appears as an **on-balance sheet item** at maturity: by settling its maturing forint debt, the swap counterparty increases the bank's forint account (liquid assets), while the bank decreases its foreign currency account (liquid assets) by fulfilling its obligations arising from the swap transaction. The bank secures the foreign currency liquidity necessary for the latter through the spot leg of the new swap transaction which first contributes to the increase in the foreign currency account, and second, to the decrease in the forint account. As a result of the cash flows of the two FX swap transactions, the on-balance sheet foreign currency assets do not change. Changes in the stock of on-balance sheet forint assets basically depend on the direction and degree of difference between the forint amount payable in the forward leg and the forint amount received in the spot leg of the new transaction. And this is determined by the direction and degree of difference between the forward exchange rate determined at conclusion of the first transaction (F_{01}) and the spot exchange rate (S_1) applied at maturity.

$$HUF_{01} - HUF_1 = (F_{01} - S_1) \cdot DEV_0 \approx (\underbrace{S_0 - S_1}_{\substack{\text{Exchange rate} \\ \text{change}}} + \underbrace{(r_{HUF}^{01} - r_{DEV}^{01}) \cdot S_0}_{\text{Yield spread}}) \cdot DEV_0$$

However, the interest rate spread contained in this amount offsets the difference between interest received on the foreign currency loan and paid on the forint deposits in this period.[66] These items also appear in the balance sheet. Thus, overall, the balance sheet is modified in accordance with changes to the exchange rate.

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[65] In some of the transactions concluded by market participants, the nominal amount paid in foreign currency is equal in the spot and forward leg, and the amount of foreign currency received in the spot leg in the new transactions corresponds to the amount of foreign currency payable in the forward leg of the previously concluded transactions. In this case, the priced yield spread is expressed as the differences between the payable and received forint amounts. However, there is also a different practice: in certain cases, the amounts payable in forints and not in foreign currency match. In such case, the amount of the priced yield spread can be derived from difference in the foreign currency amounts.

[66] Since foreign currency loans typically have variable interest rates, and forint deposits – based on our simplifying assumptions – have maturities identical to those of FX swap transactions, these interest rates basically eliminate each other.

By simultaneously examining changes in on-balance sheet and off-balance sheet forint assets and receivables, their combined amount (at least in terms of principal) does not change in reaction to changes in the exchange rate. If the exchange rate weakens, the on-balance sheet liquid (forint) assets decrease by an amount with which the off-balance sheet forint receivables increase upon rollover. The exchange rate risk is thus eliminated. Only changes in the yield spread may contribute to the modification of the combined amount of on-balance sheet and off-balance sheet forint assets upon rollover (and this change, too, appears among off-balance sheet items):

$$HUF_{1T} - HUF_{01} + HUF_{01} - HUF_1 - (r_{HUF}^{01} - r_{DEV}^{01}) \cdot S_0 \cdot DEV_0 \approx \underbrace{(r_{HUF}^{1T} - r_{DEV}^{1T}) \cdot S_1 - (r_{HUF}^{01} - r_{DEV}^{01}) \cdot S_0) \cdot DEV_0}$$

Change in yield spread

However, it is important to note that although **the total open foreign exchange position of the bank basically remains closed upon rollover as well, the direct forint liquidity requirement and surplus changes as a result of foreign exchange rate fluctuations.**[67] The change appearing in the balance sheet as a result of exchange rate fluctuation actually affects the forint account, i.e. it appears as a forint liquidity requirement or surplus. In parallel with the above, the change of off-balance sheet forint receivables in the same amount, but in an opposite direction, does not affect forint liquidity upon rollover. This means that upon the weakening of the exchange rate *(S_0–S_1<0)*, the forint liquidity requirement increases upon rollover, otherwise a forint liquidity surplus arises as a result of the series of transactions.[68]

First, this effect arises only on a direct, individual level: the liquidity requirement arising at a given bank arises as a forint liquidity surplus at another or the same domestic bank. A given bank, namely, either concludes the transaction with another domestic bank, or the liquidity surplus arising on the side of the non-resident swap counterparty is rechanneled to the domestic banking system in the form of a non-resident or domestic deposit.

Second, as an "offset" of the possibly arising forint liquidity requirement, later, upon maturity of the loan, the change caused by the weakening exchange rate linked to this period arises as a forint liquidity surplus, as the amount repayable in forints increases proportionately.[69] In other words, the hedging of the foreign exchange rate risk of the foreign currency based loan is ensured during the entire maturity; although the related forint liquidity requirements and surpluses arise as distributed over time (in case of hedging with FX swaps), their amount closes to approximately zero over the entire maturity.

In parallel with the above, if the forint fund has a short maturity, the forint deposit must be paid and it needs to be rolled over (Annex 5, items 7-8). This, however, does not significantly affect the hedging of the exchange rate risk.

At **maturity** of the foreign currency based loan, the forward leg of the second swap transaction is cancelled from among the off-balance sheet items upon settlement (Annex 5, item 11), and it simultaneously appears among on-balance sheet items. Thus, at maturity, the amount of off-balance sheet items decreases by the amount of the loan, while the on-balance sheet foreign currency account decreases and the forint account increases. The bank secures the foreign currency amount due at maturity of the transaction by converting the forint liquidity arising from the repayment of the loan (item 9) to foreign currency on the spot foreign currency market with a spot transaction (item 10).[70] This spot transaction decreases the forint account and increases the foreign currency account. And in parallel with repayment of the loan, the on-balance sheet foreign currency receivable is also cancelled from the balance sheet. Payment of the forint deposit can be financed with the forint revenue due upon maturity of the second FX swap (item 12).[71] The balance sheet total also decreases with repayment of the foreign currency loan and payment of the forint deposit.

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[67] In such case, the combined amount of account money and cash on the asset side of the bank is defined as forint liquidity.

[68] See Annex 4 for more details.

[69] See Annex 4 for more details.

[70] Or it converts on the spot market the forint amount received from the customer to foreign currency through a transaction concluded with another bank for the customer and this foreign currency amount is used for repayment.

[71] See Annex 4.

If we take into account not only transactions at maturity, but the whole series of transactions (illustrated in the chart), the off-balance sheet items do not change, while the change in the balance sheet resulting from the hedging of the principal and its effect on profit may be defined as follows:

$$HUF_{01} - HUF_0 + HUF_{1T} - HUF_1 \approx \underbrace{(r_{HUF}^{01} - r_{DEV}^{01}) \cdot S_0}_{\substack{\text{Yield spread} \\ \text{for period 1}}} + \underbrace{(r_{HUF}^{1T} - r_{DEV}^{1T}) \cdot S_1}_{\substack{\text{Yield spread} \\ \text{for period 2}}}$$

This amount, however, roughly compensates the interest rate spread that originates in certain periods from the difference between received foreign currency interest and paid forint interest: although the exchange rate risk linked to the foreign currency interest is not eliminated, but its level is considered low compared to the risk on the principal.[72] (The yield spread related to the FX swaps is generally determined at the exchange rate valid at conclusion, while the foreign currency interest is payable at the exchange rate valid at maturity.)

Such compensation is regarded to be complete if the interest rate (repricing) period of forint deposits and foreign currency based loans with variable interest rates corresponds to the maturity of FX swaps used (rolled over) for hedging. In the opposite case, the hedging of foreign currency based loans with FX swaps is also linked to interest rate (spread) risk: the difference between the interest rate priced in foreign currency based loans with a longer interest rate period or with a fixed interest rate and the interest rate of forint deposits may vary from the yield spread resulting from the rollover of FX swap transactions with shorter maturity. Upon disbursement of the loan, the forward interest rate spread priced for the given period does not necessarily correspond to the actual yield spread subsequently applied, priced in the new FX swap transaction. This means that the entire series of transactions contains an interest rate spread risk.

ANNEX 7: DETAILED DESCRIPTION OF YIELD SPREAD SPECULATION WITH FX SWAPS

Upon simultaneous application of opposite direction FX swap transactions with different maturities, the net swap stock and on-balance sheet position of the given bank (practically) remains at an unchanged level under this strategy; in this case, the bank is not hedging the exchange rate risk either, but satisfies customer demand and carries out speculation on the yield spread. Its gross swap stock, however, simultaneously increases in relation to the transactions in both directions. The given daily swap turnover simultaneously also increases; it is, therefore, possible that upon a major rise in turnover, the swap stock basically remains at an unchanged level.

This strategy may be appropriate for yield spread speculation because the yield spread priced in the FX swap transaction with a longer maturity may vary from the yield spreads (and the amount thereof) priced in rolled over (shorter-term) transactions of an opposite direction. Thus, if a bank expects the yield spread to decrease by a larger rate in comparison to the one priced in the current yield curves, thereby in the FX swap transactions, it is worth concluding transactions providing forint liquidity (forint loan) with longer maturities in the spot leg and transactions acquiring (borrowing a forint loan) forint liquidity with shorter maturities in the spot leg. Chart 1 illustrates this case.

On the basis of the chart below, the effect on the profit of the bank may be approximated with the following formula:[73]

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[72] The yield spread in the FX swaps is generally determined at the exchange rate valid upon conclusion, while the foreign currency interest is payable at the exchange rate valid at maturity. See Annex 3 and 4 for more details and information.

[73] We do not include interest paid or received (at maturity) on the liquidity deficit or surplus arising upon rollover. We calculated the yields contained in the formula in a **non**-annualised form and assuming a linear calculation of interest.

The first member:

$$HUF_{0T} - HUF_{01} = (S_0 \cdot \frac{1 + r_{HUF}^{0T}}{1 + r_{DEV}^{0T}} - S_0 \cdot \frac{1 + r_{HUF}^{01}}{1 + r_{DEV}^{01}}) \cdot DEV_0 \approx S_0 \cdot DEV_0 \cdot (r_{HUF}^{0T} - r_{DEV}^{0T} - r_{HUF}^{01} + r_{DEV}^{01})$$
$$\approx S_0 \cdot DEV_0 \cdot (r_{HUF}^{1T,F} - r_{DEV}^{1T,F})$$

The second member:

$$HUF_1 - HUF_{1T} = (S_1 - S_1 \cdot \frac{1 + r_{HUF}^{1T}}{1 + r_{DEV}^{1T}}) \cdot DEV_0 \approx -S_1 \cdot DEV_0 \cdot (r_{HUF}^{1T} - r_{DEV}^{1T})$$

Thus, the first member indicates the forward yield spread relating to the second period (for the period extending from date 1 to date *T)*, while the second member indicates the actual yield spread relating to the same period. If the forward yield spread is higher than the actual one, the strategy is profitable.

Chart 1
Simultaneous use of long-term and short-term FX swap transactions: speculation on falling yield spread

CONCLUSION OF FX SWAPS
0. point in time

	ASSETS	LIABILITIES	
1a. Spot leg of longer term FX swap	$-HUF_0$ $+DEV_0$		O N - B A L A N C E
2a. Spot leg of shorter term FX swap	$-DEV_0$ $+HUF_0$		
SUM – ON-BALANCE SHEET	**0**	**0**	
SUM – OFF-BALANCE SHEET	$\mathbf{+HUF_{0T}+DEV_0}$ ⟷	$\mathbf{+HUF_{01}+DEV_0}$	O F F - B A L A N C E
1b. Forward leg of longer term FX swap	$+HUF_{0T}$	$+DEV_0$	
2b. Forward leg of shorter term FX swap	$+DEV_0$	$+HUF_{01}$	
	ASSETS	LIABILITIES	

ROLLOVER OF SHORTER TERM FX SWAP
1. point in time

	ASSETS	LIABILITIES	
Starting point	0	0	O N - B A L A N C E
3. Forward leg of shorter term FX swap	$-HUF_{01}$ $+DEV_0$		
4a. Spot leg of new shorter term FX swap	$-DEV_0$ $+HUF_1$		
SUM – ON-BALANCE SHEET	$\mathbf{+HUF_1 - HUF_{01}}$	**0**	
SUM – OFF-BALANCE SHEET	$\mathbf{+HUF_{0T}+DEV_0}$	$\mathbf{+HUF_{1T}+DEV_0}$	O F F - B A L A N C E
Starting point	$+HUF_{0T}+DEV_0$	$+HUF_{01}+DEV_0$	
3. Forward leg of shorter term FX swap	$-DEV_0$	$-HUF_{01}$	
4b. Forward leg of new shorter term FX swap	$+DEV_0$	$+HUF_{1T}$	
	ASSETS	LIABILITIES	

REDEMPTION OF LONGER TERM FX SWAP
T. point in time

	ASSETS	LIABILITIES	
Starting point	$+HUF_1 - HUF_{01}$	0	O N - B A L A N C E
5. Forward leg of new shorter term FX swap	$+DEV_0$ $-HUF_{1T}$		
6. Forward leg of longer term FX swap	$-DEV_0$ $+HUF_{0T}$		
SUM – ON-BALANCE SHEET	$\mathbf{+HUF_{0T} - HUF_{01}}$ $\mathbf{+HUF_1 - HUF_{1T}}$	**0**	
SUM – OFF-BALANCE SHEET	**0**	**0**	O F F - B A L A N C E
Starting point	$+HUF_{0T}+DEV_0$	$+HUF_{1T}+DEV_0$	
5. Forward leg of new shorter term FX swap	$-DEV_0$	$-HUF_{1T}$	
6. Forward leg of longer term FX swap	$-HUF_{0T}$	$-DEV_0$	
	ASSETS	LIABILITIES	

Note: For illustration purposes, we did not indicate interest paid on the liquidity requirement or surplus arising in the balance sheet upon rollover (at date 1), but used simple nominal values (principal).

ANNEX 8: SCHEMATIC PRESENTATION OF THE CASH FLOWS OF THE SHORT TERM FX SWAP + GOVERNMENT SECURITIES STRATEGY

Transaction		Currency	Gov. sec. purchase	Rollover of FX swap	Maturity of government securities
			Date of deal		Date of maturity
Gov. securities	Principal	HUF	$-S_0$		$0S_0$
	Interest	HUF			$+S_0 \cdot r_{HUF}^{0T}$
1. Spot leg of FX swap		HUF	$+1 \cdot S_0$		
		FX	-1		
1. Forward leg of FX swap		HUF		$-F_{01}$	
		FX		$+1$	
2. Spot leg of FX swap		HUF		$+1 \cdot S_1$	
		FX		-1	
2. Forward leg of FX swap		HUF			$-1 \cdot F_{1T}$
		FX			$+1$
Total cash flow	Principal	HUF	0	$\approx S_1 - S_0$	$\approx S_0 - S_1$
		FX	-1		$+1$
	Interest	HUF	$-$	$\approx (-r_{HUF}^{01} + r_{DEV}^{01}) \cdot S_0$	$\approx (-r_{HUF}^{1T} + r_{DEV}^{1T}) \cdot S_1 + r_{HUF}^{0T} \cdot S_0$
		FX	$-$		

Note: In the table we assume that at maturity, the foreign currency loan is a loan repayable in a lump sum, with periodically variable interest. The yields in the table indicate non-annualised yields.

The cash flows contained in the above table suggest that the forint liquidity requirement arising upon rollover is offset by the forint liquidity surplus arising at maturity. The final total cash flows differ from those of the direct foreign currency loan, in that:

1. the investor receives the amount of foreign currency interest in forints at an interest rate of an earlier period (valid at conclusion or rollover), and

2. it is regarded as a favourable strategy over the direct foreign currency loan,[74] if:

$$r_{HUF}^{0T} \geq r_{HUF}^{01} + r_{HUF}^{1T}$$

In other words, if the yield priced in the government bond for the period of hedging exceeds the yields paid through the FX swaps.

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[74] If we define yields in an annualised form or with compound interest: $(1 + r_{HUF}^{0T})^2 \geq (1 + r_{HUF}^{01}) \cdot (1 + r_{HUF}^{1T})$.

ANNEX 9: SEPARATION OF COMPOSITION, VOLUME AND EXCHANGE RATE EFFECT AGGREGATED AND BY SECTOR

Chart 1

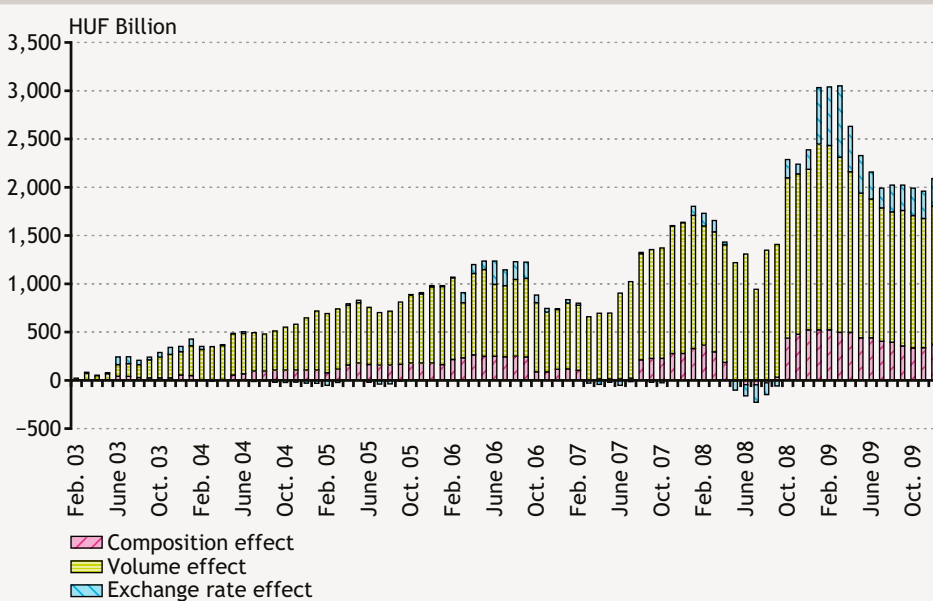**Monthly change in the on-balance sheet open foreign currency position of the domestic banking system and its decomposition**
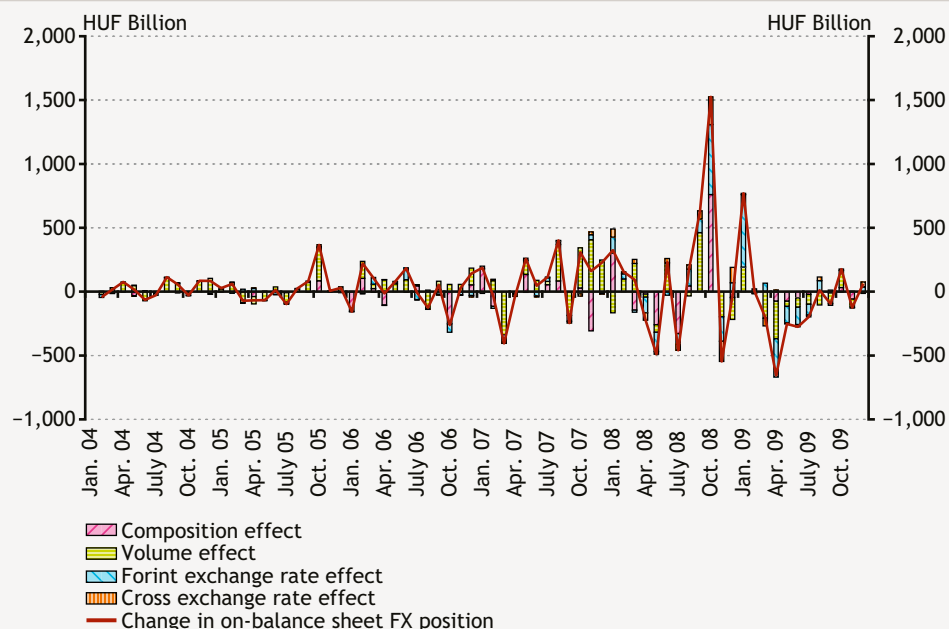
Sources: Supervisory balance sheets, D01 report, MNB.

Chart 2

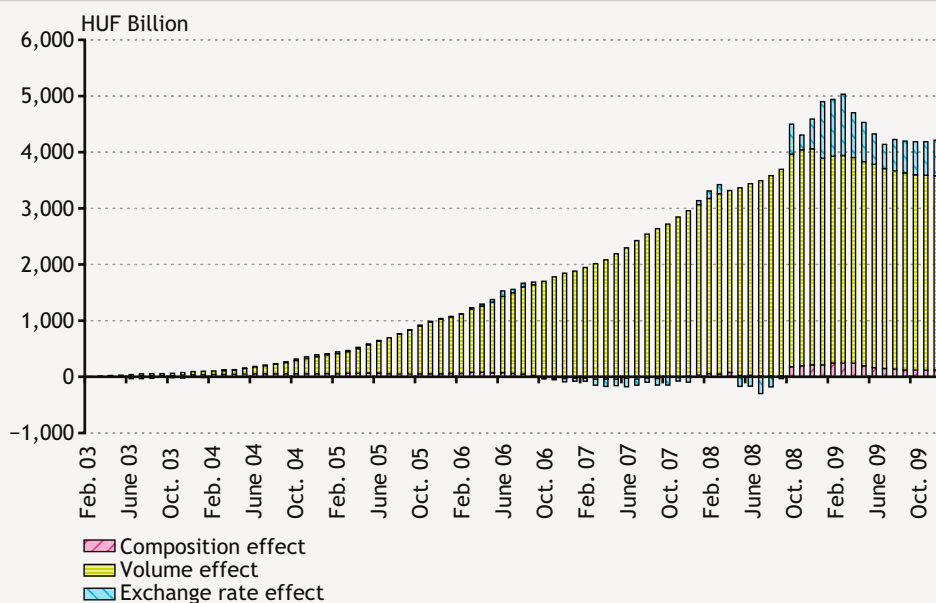**Effect of the corporate sector on the balance sheet foreign currency position and its decomposition**

(cumulated since early 2003)

Source: MNB.

Chart 3

Effect of the household sector on the balance sheet foreign currency position and its decomposition
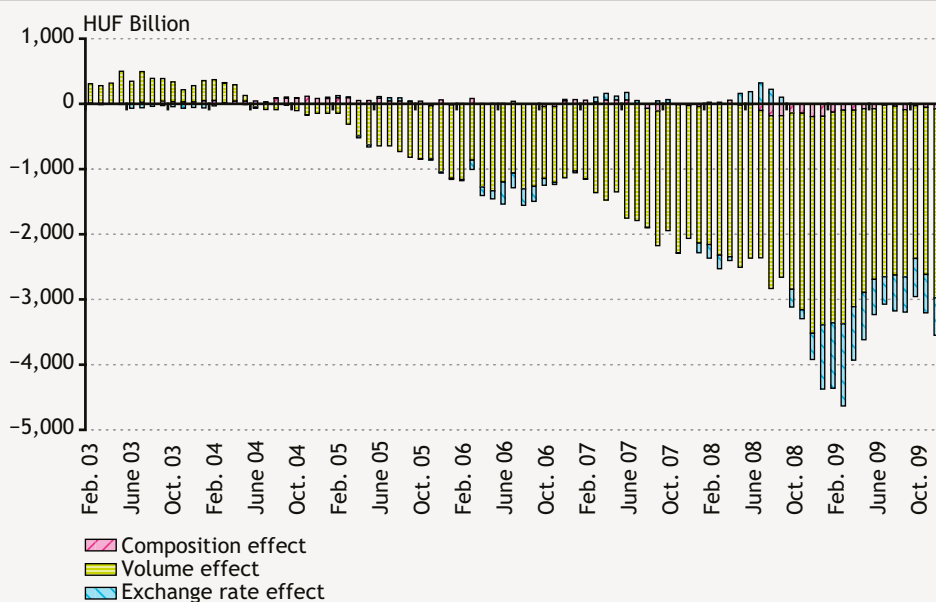
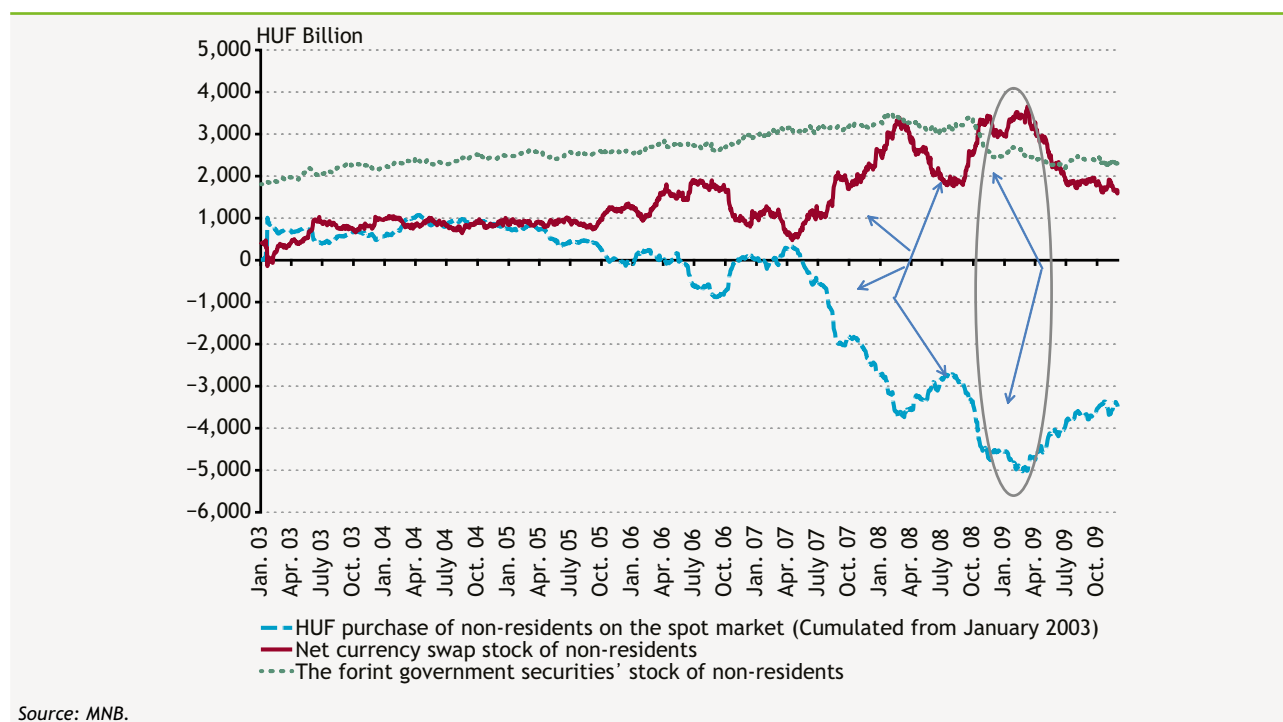*(cumulated since early 2003)*

Source: MNB.

Chart 4

Effect of the non-resident sector on the on-balance sheet foreign currency position and its decomposition
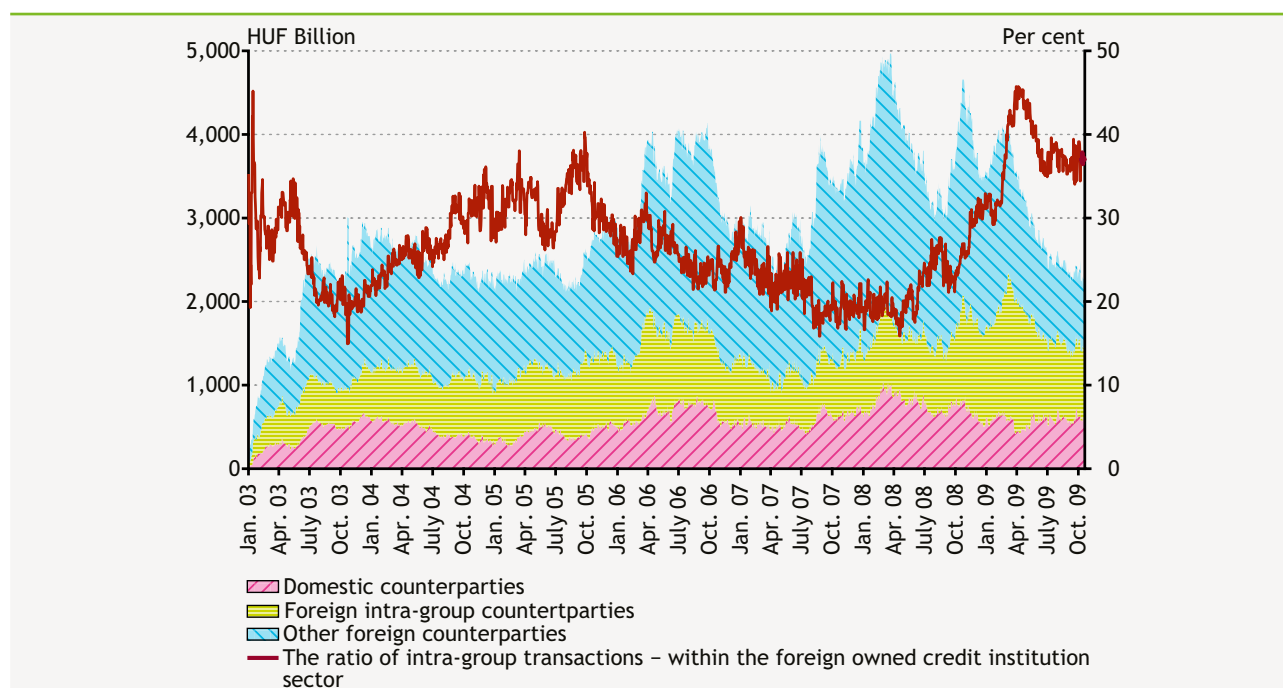
(cumulated since early 2003)

Source: MNB.

ANNEX 10: CO-MOVEMENT OF THE SWAP + GOVERNMENT SECURITIES STRATEGY OF NON-RESIDENTS AND VOLUME EFFECT DERIVED FROM THE ON-BALANCE SHEET FOREIGN CURRENCY POSITION


HUF Billion

- – – HUF purchase of non-residents on the spot market (Cumulated from January 2003)
- —— Net currency swap stock of non-residents
- ······ The forint government securities' stock of non-residents

Source: MNB.

ANNEX 11: GROSS HUF/FOREIGN CURRENCY SWAP STOCK OF THE FOREIGN OWNED DOMESTIC CREDIT INSTITUTION SECTOR BY TYPE OF COUNTERPARTY

HUF Billion   Per cent

- Domestic counterparties
- Foreign intra-group countertparties
- Other foreign counterparties
- —— The ratio of intra-group transactions – within the foreign owned credit institution sector

Source: MNB.
Note: The transactions are calculated at the current foreign exchange rate of the foreign currency amounts in the forward leg. The chart shows transactions providing foreign currency liquidity in the spot leg.

ANNEX 12: AVERAGE REMAINING MATURITY OF THE GROSS HUF/FOREIGN CURRENCY AND FOREIGN CURRENCY/HUF SWAP STOCK OF THE DOMESTIC CREDIT INSTITUTION SECTOR
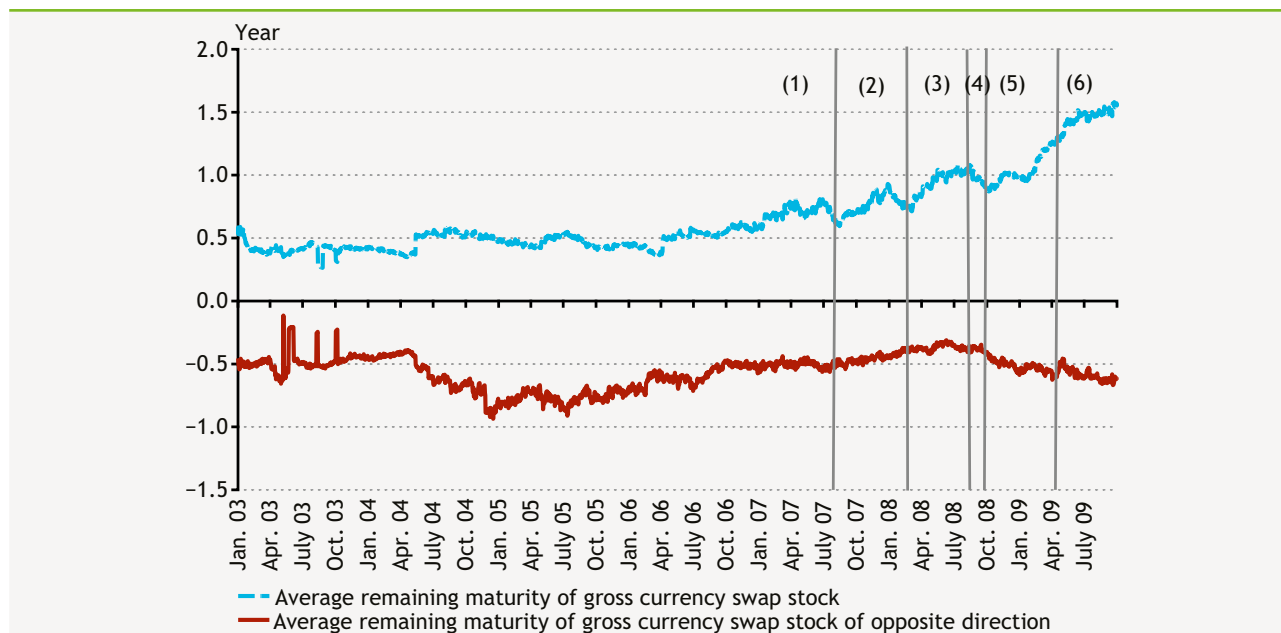
Source: MNB.
Note: For illustration purposes, the remaining maturity of transactions of an opposite direction (providing foreign currency liquidity in the spot leg) are shown with a negative sign. This also includes transactions concluded with domestic counterparties.

ANNEX 13: AVERAGE REMAINING MATURITY OF THE GROSS HUF/FOREIGN CURRENCY SWAP STOCK OF THE DOMESTIC CREDIT INSTITUTION SECTOR CONCLUDED WITH NON-RESIDENTS BY CURRENCY
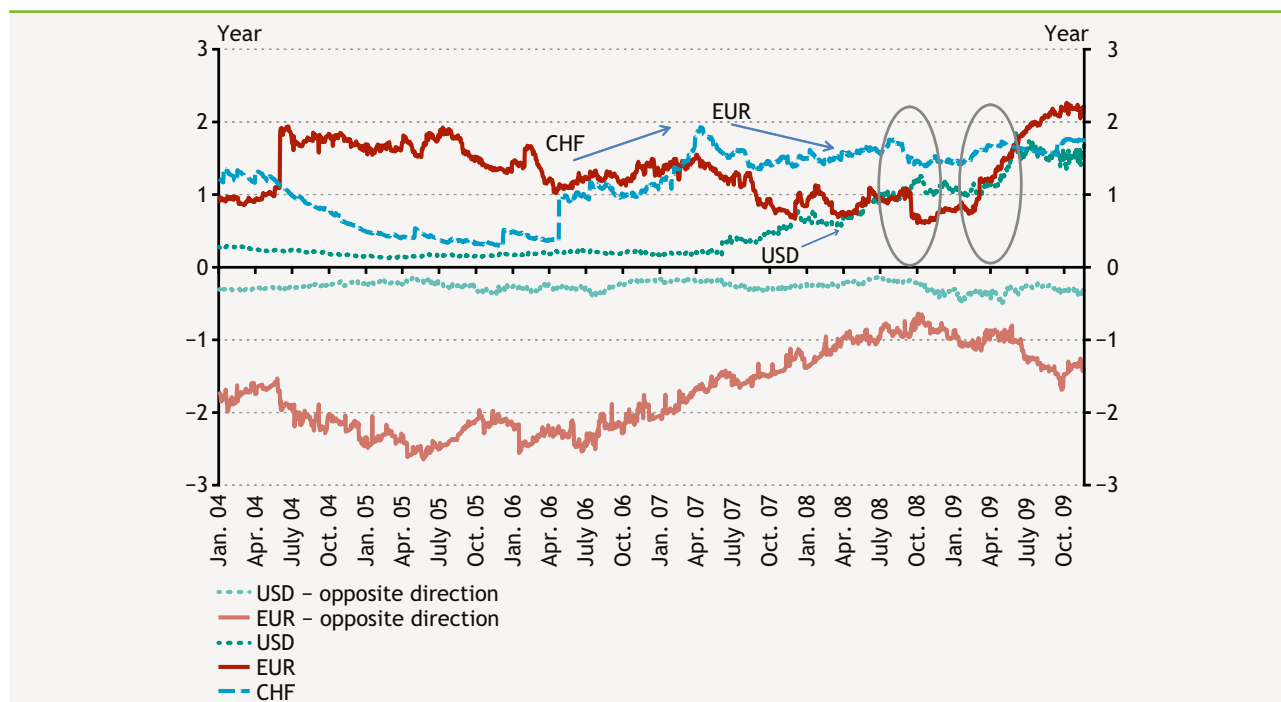
Source: MNB.

ANNEX 14: BALANCE OF PAYMENTS, EXTERNAL DEBT AND SWAP STOCK: BALANCE SHEET RELATIONSHIPS[75]

The trends in the net swap stock seen in recent years are closely related to the indebtedness of the country and the structure and size of external capital flows. We demonstrate the above with the aid of an analytical framework based on macro level balance sheet relationship.

Let us take the balance of payments equation as a basis. The balance of payments identity may also be defined where the net financing requirement *(NFR),* i.e. the combined deficit of the balance of payments and the capital account balance, may be financed with two forms of recapitalisation: non-debt generating *(ΔND),* and debt generating *(ΔD)* capital flows.

$$NFR = \Delta ND + \Delta D \qquad (1)$$

Non-debt generating capital inflows are defined as direct capital investments (including reinvested earnings and intercompany loans) and (equity) portfolio investments. All other financing items are defined as debt generating items. Contrary to the standard structure of the balance of payments, in our analysis we do not attribute a central role to international reserves; we consider that to be an item reducing debt generating capital.

By restructuring equation (1), we can establish that the change in external debt corresponds to the portion of the net financing capacity which is not hedged with non-debt generating capital flows.

$$\Delta D = NFR - \Delta ND \qquad (2)$$

External debt *(D)* may be basically divided into two parts: a part denominated in forints (HUF) and one in foreign exchange (FX). The first group contains government securities, mortgage bonds purchased by non-residents, issued in forints, and forint receivables vis-à-vis banks. The second group contains foreign issued foreign currency bonds and foreign currency cross-border loans. As a fundamental difference between the two parts, in relation to the debt elements issued in forints, the non-resident investors also assume the exchange rate risk arising from changes in the HUF exchange rate, in parallel with the default risk of the domestic counterparty.

$$D = D^{HUF} + D^{FX} \qquad (3)$$

The situation is reversed for domestic participants. Since the cash flow of domestic participants is typically in forints, the risk on their side is the inflow of funds in foreign currency. Thus, depending on the denomination, external debt carries an exchange rate risk for a given sector; either non-residents have a long forint position or domestic participants have a short foreign currency position.

In our analysis, we divided domestic economic participants into three sectors: general government (G), the banking sector (B) and (non-bank) private sector (P). All three sectors are in the position to raise external foreign currency funds.

$$D^{Fx} = D_G^{Fx} + D_B^{Fx} + D_P^{Fx} \qquad (4)$$

As a basic difference between the three sectors, while general government and the private sector raise external funds to finance their own expenditures, the banking system lends the raised funds. If the banking system lends the externally raised funds domestically in foreign currency (L_P^{Fx}), it does not take up an open position; it passes on the exchange rate risk linked to the loan to the domestic customer.[76] If it provides the loans in forints, it takes up an on-balance sheet open foreign currency position.[77]

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[75] Bethlendi et al. (2005).

[76] In theory, the banking system may provide foreign currency loans to certain segments of general government, such as local governments, but the ratio of these loans is small, and therefore for practical purposes, we disregard these.

[77] In the derivation we use certain variables with a sign where the positive value corresponds to a long HUF/short foreign currency position for the sector included in the index. This is opposite to the sign of the most charts relating to the domestic banking system.

The total exchange rate exposure of banks is limited by both law and internal prudential provisions. This means that if the on-balance sheet open position exceeds a certain level, it must be hedged with off-balance sheet (derivative) transactions. Banks can conclude a derivative position either with non-residents (DER_F), or the domestic private sector (DER_P). These transactions are recorded among the off-balance sheet items of domestic banks. Among the derivative products concluded with non-residents, currency swap transactions play a dominant role in terms of the net stock. Thus, the actual open position of banks may be derived as follows:[78]

$$OP_B = D_B^{Fx} - L_P^{Fx} - DER_P - DER_F \qquad (5a)$$

Non-residents have forint exposure *(OP)* not only if they buy forint instruments, but also if they open a long forint derivative position. In theory, non-residents can directly conclude derivative transactions with companies, but we will disregard these for practical purposes.

$$OP_F = D^{HUF} + DER_F \qquad (5/b)$$

The private sector can have an exchange rate position in three forms: first, through direct raising of external foreign currency funds; second, through domestic foreign currency loan borrowing; and thirdly, with derivative transactions:

$$OP_p = D_P^{Fx} + L_P^{Fx} + DER_P \qquad (5c)$$

The general government does not typically conclude derivative transactions or raise domestic foreign currency funds, and therefore its exchange rate exposure corresponds to its net external foreign currency debt.

$$OP_G = D_G^{Fx} \qquad (5d)$$

On the basis of the combination of equations (3) and (4), the following identity is produced:

$$D = D^{HUF} + D_G^{Fx} + D_B^{Fx} + D_P^{Fx} \qquad (6)$$

Supplementing equation (6) and with the substitution of equations (5/a,…d), the following result is produced:

$$D = (D^{HUF}+DER_F)+(D_G^{Fx})+(D_P^{Fx} + L_P^{Fx} + DER_P)+(D_B^{Fx}-L_P^{Fx}-DER_F-DER_P) = OP_F+OP_G+OP_P+OP_B \qquad (7)$$

In other words, the amount of external debt corresponds to the level of the exposure of the four sectors against the HUF exchange rate.

By restructuring equation (7) and substituting equation (2) derived from the balance of payments, a balance sheet identity may be drawn up also for the long forint derivative position (taken up through the banking system) of the non-resident sector:

$$\Delta DER_F = NFR - \Delta ND - \Delta D^{HUF} - \Delta D_G^{Fx} - \Delta D_P^{Fx} - \Delta L_P^{Fx} - \Delta DER_P - \Delta OP_B$$

The dominant portion of the long forint derivative position of non-residents is made up of the net swap stock concluded with domestic banks. In the charts included in the study, the net swap stock increases if non-residents sell forints in the forward leg: if the net swap stock increases, ΔDER_F is negative. On the basis of the formula, we may establish a relationship between the increase in the swap stock and foreign currency lending, although numerous other factors are also at play. In technical terms, the increase in the swap stock is attributable to the fact that the rise in the net financing requirement is exceeded by the combined rise in the other variables on the right side – one element of these is the domestic foreign

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[78] The net open position thus defined is of an opposite direction to the on-balance sheet and total open foreign currency position defined in the charts of the study. In the equations, the DER_F variable takes up a positive value upon the long forint position of non-residents. Thus, its sign is also opposite to that of the net swap stock contained in the charts of our study. The net swap stock of non-residents in the charts increases if the non-residents sell forint in the forward leg.

currency loan. Since the above formula reflects a balance sheet relationship, and the variables on the right side are correlated, the ceteris paribus change in the variables on the right side cannot be interpreted.

ANNEX 15: METHODOLOGY OF ESTIMATING MARGIN CALL DYNAMICS

Upon a major shift in foreign exchange rates, the market value of the forward leg of FX swap transactions also changes significantly. In such cases, the value of transactions concluded with the counterparties may reach a limit which, if exceeded, the customer is required to provide additional collateral. The amount of additional collateral is commonly determined on a mark-to-market basis. The market value of the forward leg may be defined with the following formula in terms of the bank's customer:

$$NPV_t = PV(F_{t,T} - F_{0,T})$$

Where T is the maturity date of the FX swap, t is the current date, $F_{0,T}$ is the forward exchange rate priced in the FX swap transaction, and $F_{t,T}$ is the forward exchange rate relating to date T on the current date. The bank is required to deposit the foreign currency value of this market value as deposit at the customer.

By expressing the forward exchange rate with the use of the covered interest rate parity, the above formula may also be defined as follows – assuming that the bank borrows a euro amount and lends a forint amount in the framework of the FX swap transaction:

$$\text{NPV}_t = -S_0 \cdot \frac{1 + r_{0,T}^{HUF} \cdot \frac{T}{360}}{1 + r_{0,T}^{EUR} \cdot \frac{T}{360}} + S_t \cdot \frac{1 + r_{t,T}^{HUF} \cdot \frac{T-t}{360}}{1 + r_{t,T}^{EUR} \cdot \frac{T-t}{360}}$$

Where $r_{0,T}^{HUF}$ is the annualised forint yield valid on the date of the deal, corresponding to the maturity (T) of the transaction, $r_{t,T}^{HUF}$ is the forint yield valid on the current date (t), corresponding to the remaining maturity of the transaction, S_0 is the initial HUF/EUR (spot) exchange rate, and S_t is the spot exchange rate valid on date t.

To apply the above formula, it would be necessary to use on all dates the prevailing spot forint and euro yield curve – particularly its short end.

For the purpose of simplifying the calculations, we estimated the margin call on the basis of the following formula:

$$NPV_t = S_t - S_0$$

Its value expressed in foreign currency on date t:

$$\frac{S_t - S_0}{S_t}$$

Following the calculations for each transaction, we performed aggregation in relation to outstanding transactions that were concluded before the given date: i.e. the margin call relating to the given date:

$$\text{MC}_t = \sum_{i=0}^{N_t} \frac{S_t - S_{0,i}}{S_t} \cdot VOL_i \, ,$$

where N_t is the number of outstanding transactions on the given date (t). VOL_i is the volume of outstanding transactions expressed in foreign currency.

Methodological problems:

- A result with dynamics similar to the mark-to-market principle is produced only if it is assumed:

  – that the yield rate spread $(r^{HUF}-r^{EUR})$ does not significantly change during the maturity of the transactions,

  – or if the typical maturity of the transactions is short (based on the stock outstanding), as this method – contrary to the formula of the forward exchange rate – does not take into account the passing of time $(T-t)$. As a result of this latter methodological problem, larger-than-actual fluctuations are produced in relation to transactions with longer maturity.

- However, it would be possible to interpret the received results by determining the degree to which the change of the foreign exchange rate modified the additional collateral requirement.

- It is also relevant as to which transactions we take into account: in practice, margin call (CSA) agreements are commonly concluded only on longer term (cross-currency) transactions concluded with non-group counterparties. It is therefore worth estimating the margin call only for these transactions.

- In practice, counterparties commonly require additional collateral only upon extreme changes in the foreign exchange rate: in such case, however, for all exchange rate changes during the period, according to the prevailing market value (i.e. in this case, the total cumulated – additional – collateral is required). In other words, calculations conforming to practices would produce a less "continuous" (but rather discrete) result. The estimate is based on the implicit assumption that the banks and their customers top up the collateral account on a daily basis, on the basis of changes in the exchange rate.

ANNEX 16: DECOMPOSITION OF CHANGES IN THE ON-BALANCE SHEET FOREIGN CURRENCY POSITION BY COMPOSITION, VOLUME AND EXCHANGE RATE EFFECT – METHODOLOGY

The method consists of the following steps:

1. Calculation of the exchange rate effect: This is performed with the aid of calculating changes in stock adjusted for exchange rate changes. We define the foreign currency stocks at the beginning and end of the period in original currency, and then take the forint value of the change in stock calculated from the above at the exchange rate of the given period. Finally, the exchange rate effect can be derived as the difference between the raw change in stock[79] and such change in stock adjusted for exchange rate changes.

The raw change in stock: $\Delta DEV_t = DEV_t \cdot S_t - DEV_{t-1} \cdot S_{t-1}$

where DEV_t and DEV_{t-1} indicate foreign currency stocks at the end of the given period and at the end of the preceding period, and S_t and S_{t-1} indicate the foreign exchange rate at the end of the given period and in the preceding period.

Change in stock adjusted for exchange rate changes: $\Delta DEV_{t,adjusted} = (DEV_t - DEV_{t-1}) \cdot S_t$

Exchange rate effect: $\Delta P = \Delta DEV - \Delta DEV_{adjusted}$

The resulting exchange rate effect is considered with a positive sign on the asset side and with a negative sign on the liabilities side.

2. Composition effect: We derive the composition effect jointly from the foreign currency flows adjusted for exchange rate changes and changes in stocks denominated in forints. If the change in stock denominated in forints (ΔHUF_t) and the

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[79] Difference between stocks expressed at the exchange rate valid on the given date.

change in stock adjusted for exchange rate changes *(ΔDEV_{t,adjusted})* have opposite signs, we then take the minimum absolute value of the two changes in stock and consider this sum with the sign of the change in foreign currency stock– in relation to items on the asset side.

Composition effect:

$\Delta CE=$

$$\begin{cases} sign(\Delta DEV_{t,adjusted}) \cdot min(|\Delta DEV_{t,adjusted}|; |\Delta HUF_t|), \text{ ha } sign(\Delta DEV_{t,adjusted})= -sign(\Delta HUF_t) \\ 0, \text{ otherwise} \end{cases}$$

we consider the above sum with an opposite sign in relation to items on the liabilities side.

3. Volume effect: The volume effect equals the difference between the change in stock adjusted for exchange rate changes and the composition effect.

Volume effect: ΔVE = ΔDEV_{t,adjusted} − ΔCE