Norbert Kiss M. and Zoltán Molnár: How do FX market participants affect the forint exchange rate?*

In our analysis, we describe and compare indicators regularly used in the course of money market monitoring, identifying the positions of FX market participants where co-movement with the forint exchange rate is most commonly observed. The correlation between the exchange rate and quantity indicators may be attributed on the one hand to the fact that market participants' directly unobservable exchange rate expectations are reflected in transactions and positions. On the other hand, these indicators are also determined by factors that are less affected by participants' expectations, or are linked to one-off liquidity shocks, yet they may affect the exchange rate through demand-supply effects.

The exchange rate position of participants shifts in reaction to trading strategies described in the analysis (spot or swap FX conversions related to the purchase/sale of HUF-denominated instruments, taking or hedging of exchange rate exposure, balance of payments items, etc.), and the domestic banking sector, as a participant vis-à-vis the initiating party, must transfer this position to another participant if it does not wish to assume exchange rate exposure. The effect of taken up and transferred positions is also reflected in exchange rate changes; the degree of change is basically determined by the heterogeneity of expectations. Position changes of FX market participants allow us to derive their expectations related to fundamentals and hence changes in the expected risk premium.

We attempt to identify changes in the risk premium in positions determined by participants' expectations of with quantity indicators used in the course of money market monitoring. Among the individual sectors, it is primarily non-residents, as initiators of the transactions, that are the quickest to change their behaviour in response to changes in the risk perception of Hungary, while resident non-bank participants adjust through the intermediation of the domestic banking sector. We observed substantial co-movement with the exchange rate in relation to all indicators; significant correlation can be identified within the short-term dynamics. The reaction of the exchange rate is most sensitive to the adoption of speculative money market positions and least sensitive to changes in the indicator defined as the widest aggregate, which also includes derivative positions. The relationship between indicators and the exchange rate may change in reaction to shocks; instability over time and structural breaks in the relationship may provide information as to the nature and effect of the shocks.

On the basis of our results, the adoption of a speculative long forint money market position by non-residents in the value of HUF 100 billion results in a 2.89 per cent appreciation of the exchange rate. This same coefficient is 1.42 per cent in relation to spot transactions and 1.15 per cent for the total forint position. In addition to the above, a bidirectional correlation is observed in relation to the forward stock of resident corporate participants: first, changes in the forward stock produce a tangible effect on the exchange rate, and second, changes in the exchange rate significantly affect companies' hedging activity.

MOTIVATION

In money market monitoring, changes in the HUF/EUR exchange rate are considered to be one of the key indicators. Accordingly, all market participants concerned pay special attention to variables which show noticeable co-movement with the exchange rate. Our experience suggests that the so-called "quantity" indicators, expressing the effect of money market participants' transactions and positions in the FX market, and the short-

* The views expressed in this article are those of the author(s) and do not necessarily reflect the offical view ot the Magyar Nemzeti Bank.

term dynamics of the exchange rate very frequently show a similar picture.

The aim of the analysis is to (1) describe and compare indicators expressing the exchange rate exposure of FX market participants, where co-movement with the forint exchange rate is most common, (2) review theoretical foundations of the correlation between indicators and the exchange rate, and empirically examine the degree of correlation between the variables at various times in the past.

In the analysis, we first examine the linkage that determines similarity between the short-term dynamics of the exchange rate and of the quantity indicators, then review FX market strategies, position taking possibilities that are most likely to affect the analysed indicators. Thereafter, in addition to the descriptive review and comparison of quantity indicators, we analyse the proximity and temporal development of their co-movement with the exchange rate.

WHICH FACTORS DETERMINE THE CO-MOVEMENT OF THE EXCHANGE RATE AND QUANTITY INDICATORS?

The effect of FX market participants' transactions are expressed by the quantity variables described below. The basis of a correlation between quantity variables and the exchange rate is that the current equilibrium exchange rate of a foreign currency is determined by the balance between its demand and supply. This is not in conflict with the hypothesis that expectations generally play a key role in long-term developments in the exchange rate. Expectations of market participants cannot be directly observed, but a large proportion of FX market transactions are motivated by the exchange rate expectations of participants, therefore variables reflecting demand and supply are also predominantly determined by expectations relating to economic fundamentals. Moreover, cash flows that are less sensitive to interest rates and exchange rates also account for a substantial share of FX market transactions, thus the exchange rate is also shaped by demand-supply effects that are to a lesser extent determined by expectations (FX lending, balance of payments items, FDI flows, etc.).

Thus, the close correlation may be partly attributed to the fact that market participants' expectations – which cannot otherwise be observed directly – are reflected in the transactions and positions, on the one hand, while the effects of certain demand and supply factors, to a lesser extent determined by expectations in the short term, are also reflected in the quantity indicators, on the other.

Our experience suggests that, among the sectors, the forint position of non-residents reacts most directly to changes in the risk perception of Hungary. Non-resident participants commonly react to an improvement in risk appetite by raising their forint positions, and this results in the strengthening of the exchange rate through higher demand. Analogously, diminishing risk appetite is accompanied by decreasing positions and a weakening of the exchange rate.

We also observed that a considerable portion of transactions of resident companies (e.g. exchange rate hedging activity of foreign trade companies, balance of payments items, FDI flows, etc.) show exchange rate sensitivity, that is, the common causal link is reversed in this case – these items tend to react only to the exchange rate. Such reaction, however, typically impacts the exchange rate, as emerging forint demand may bolster the national currency and thereby dampen certain shocks, although this effect is more moderate than attributed to the role of non-residents.

It follows from the above that the role of resident credit institutions as market makers is to absorb exposure arising from positions taken by non-residents, passing it on to other participants, typically to the resident corporate and household sectors. Beyond the indices of non-residents, in the resident sector the forward stock of companies constitutes the quantity indicator that shows significant co-movement with the exchange rate; changes therein are also absorbed by resident credit institutions.

The microstructure approach to foreign exchange rates also establishes a theoretical framework for the correlation between the exchange rate and demand-supply factors. According to this approach, changes in the exchange rate are best correlated with the so-called "order flow" indicator.[1] The order flow constitutes the net balance of FX market transactions initiated by buyers and sellers, hence functioning as the indicator of buying or selling pressure weighing down on the given foreign currency. Since non-resident participants are considered the initiating party in the non-resident/resident relationship,[2] changes in the cumulated forint position of non-residents are regarded as the order flow; on the basis of our previous results, a significant correlation can be observed between the non-resident order flow and the HUF/EUR exchange rate.[3] The

[1] See Gereben et al. (2005) for details on the microstructure theory.

[2] It is difficult to clearly identify the initiating party; it may change for each transaction even between the two same partners. It follows that identification of initiating and market maker roles is made under simplified assumptions.

[3] See Gereben et al. (2006) for details on results.

microstructure theory, however, is not in conflict with theories, according to which the exchange rate is determined by expectations related thereto, as the order flow is only considered to be a type of intermediate link between expectations and the exchange rate; views of market participants on the equilibrium exchange rate level are first manifested through the indicators.

WHICH TRADING STRATEGIES ARE MOST LIKELY TO AFFECT QUANTITY INDICATORS?

Below, we briefly outline trading techniques that are most likely to affect forint position indicators analysed below.

1. *Spot foreign exchange conversion and buying/selling of HUF-denominated assets.* FX buying/selling through spot transactions represents one of the most basic FX market activities. In this case, the main motivation of non-residents is to buy HUF-denominated assets and sell forint liquidity resulting from the reduction of HUF-denominated assets. (In terms of non-residents' demand, government securities and central bank bills are the most important HUF-denominated assets; significant changes are seldom in their share stock, while the activity of non-residents is typically minimal in relation to corporate bonds, mortgage bonds, etc.). In this case, the non-resident participant assumes the exchange rate risk; as a result of the forint purchase (forint sale), the long forint position of non-residents increases (decreases).

2. *Purchase of HUF-denominated assets with FX swap financing.* If the investor does not wish to assume exchange rate risk, it can finance the asset purchase with an FX swap transaction. The non-resident participant uses the forints acquired at the initial leg of the FX swap transaction to purchase the HUF-denominated assets (commonly government securities), while the forward leg of the FX swap transaction automatically hedges the exchange rate risk of the asset. Thus, in this case, the participant does not have exchange rate exposure; its strategy may be motivated by taking up an interest rate position. Although the implied yield (paid interest rate spread) of the FX swap transaction is offset against the net yield (received interest rate spread) of the purchased asset, the maturity of the financing FX swap transaction commonly varies from that of the forint instrument, therefore a shift in the yield curve may result in a profit/loss resulting from the varying interest rate sensitivity on the assets and liabilities side.

3. *Taking up of FX position through the parallel use of FX swap and spot transactions.* Within a generally speculative strategy, the participant wishing to take up a FX position establishes a so-called synthetic forward position by applying a spot transaction and a FX swap transaction in the opposite direction. Where a short position is taken in the given foreign currency, for example, the given participant finances the spot market sale with a FX swap transaction in the opposite direction (at the initial leg), that is, the foreign currency borrowed through the FX swap is immediately sold in the spot FX market. Thus, there is no net cash flow on the initial leg; the total net FX position is assumed on the forward leg of the FX swap transaction, and its direction corresponds to that of the spot transaction. Therefore, the direction of the desired position is determined by the spot transaction. It is possible that transactions on the final demand side are linked to a forward position of a non-resident bank's client, and the non-resident bank hedges only this forward transaction of the client with the above synthetic transaction, but it favours the combined position over a forward transaction in the interbank market. This is attributed to the fact that the spot and FX swap markets are significantly more liquid than the forward market, thus both the use of the desired strategy and the closing of the position are more flexible in this manner.

4. *Conclusion of forward transaction for hedging purposes.* Typically, resident non-bank companies are active in the forward market, which hedge their risk arising from foreign trade activities. As a common trend, the volume of exporting companies' forward domestic foreign exchange purchase transactions increases in response to a weakening of the exchange rate, as they use these transactions with a more favourable forward exchange rate level to hedge their potential exchange losses resulting from the future recovery of the exchange rate. Increased hedging activity – and forward forint purchases – can also function as a type of automatic support for the national currency if exchange rate expectations in the resident corporate sector vary from those of other market participants to an appropriate degree.

+1. *"Miscellaneous".* In addition to the above, it is essential to note factors that cannot be regarded as trading strategies in a traditional sense, but may have (had) a role in determining quantity indicators and the exchange rate. One of the most important such factor in Hungary is (was) **FX lending.**[4] Foreign exchange conversions linked to rising FX lending did not produce a pronounced

[4] Although the role of this factor has diminished substantially with the significant decline in FX lending, it has remained relevant in the long term, owing to normal instalments, while the one-off effect of early repayment scheme is observed for a short period, but in a concentrated form.

impact in terms of daily exchange rate dynamics, but the taking up of moderate but continuous one directional positions on a daily basis causes a major change in quantity indicators. The accumulation of small changes on a daily basis, where the resident private sector assumes a substantial long forint position, plays a significant role in the long-term trend of the exchange rate. The **foreign trade balance, a permanent surplus/deficit on the current account and the rechanneling of government FX revenues onto the market** can be similarly important factors, which may modify demand/supply factors in one direction in the longer term. These factors or one directional trends, however, are also regarded as fundamentals in the long term, whose effects may contribute to shaping expectations.

On the basis of the trading strategies described above, the exchange rate position of participants shifts, and the resident banking sector as the participant vis-à-vis the initiating party must transfer this position to another participant, provided it does not wish to take up the position. The taking up and transfer of such positions also has an effect on changes in the exchange rate. The strength of the link mostly depends on the heterogeneity of participants' (i.e. non-residents, resident companies and resident households) expectations, the degree of certain participants' propensity to assume the position at the price of a changing exchange rate. Owing to the above, we are mainly attempting to identify variables that can be linked to the aforementioned FX market strategies and are capable of identifying changes in the positions of participants, who are typically the initiating party.

WHICH INDICATORS CAN IDENTIFY CHANGES IN FORINT EXPOSURE?

In terms of the analysis, in an ideal scenario, we would be able to generate quantity indicators which exclusively reflect positions dependent on expectations of participants, as these would be optimal to support the monitoring of changes in risk premia. Since we are unable to measure the exchange rate and yield sensitivity of certain transactions, we can approximate changes in risk tolerance, the effects of which bear down on positions, as well, only through wider aggregates. Indicators we regard as most relevant:[5, 6]

Chart 1
Cash flows of a participant taking up a long forint position, corresponding to a synthetic forward forint purchase

	Near leg		Far leg	
	Forex	HUF	Forex	HUF
Spot deal	↓	↑	–	–
Swap deal	↑	↓	↓	↑
Net	0	0	↓	↑

A. *Long / short forint positions of non-residents aggregated per participant*. With this indicator, we aggregate speculative long and short forint money market positions built through spot and FX swap transactions between non-residents and resident banks (see the Annex for details on the calculation of the indicator.) The cumulated development of the indicator shows substantial co-movement with the HUF/EUR exchange rate.

According to the strategy (3) outlined above, the non-resident participant takes up a profitable position upon the strengthening of the forint exchange rate, if it buys the national currency and lends it on the same value date in the form of an FX swap transaction. Similarly, non-residents take up a short forint position if they borrow forints and sell on the same value date. The sale-purchase is transacted in the spot FX market, while lending/borrowing is conducted in the FX swap market.

The simultaneous conclusion of a spot transaction and a swap transaction in an opposite direction corresponds to a synthetic forward transaction. On the date of the initial leg of the swap transaction, there is no cash flow in a net sense, due to the opposite direction of the two transactions. There is cash flow, however, on the date of the forward leg, when the partners change back their foreign currencies, therefore this corresponds to a forward transaction (Chart 1).

By identifying the non-resident partners, in the indicator we aggregate the quantity and direction of spot and swap transactions concluded by a given non-resident on a given day, i.e. the change in its spot and swap position.

[5] The described quantity indicators are calculated on the basis of the daily operational FX market report of resident banks (so-called D01 report) which contains all transactions – of a considerable volume – of resident commercial banks in Hungary. The report contains the transaction's deal date, value date, name of reporting bank, type of transaction, foreign currency bought and sold, its quantity and the type of partner (resident/non-resident, bank/other). These data enable the calculation of daily aggregate turnover and stock data for each type of partner.

[6] We believe that changes in the exchange rate position of the household sector is also important, but we do not have available reliable time series with a daily frequency in this regard.

We aggregate changes in individual positions of *each non-resident participant,* thus these allow us to clearly identify the money market strategy of the given participant as opposed to aggregate indicators measured on a systemic level. Transactions concluded between non-residents, however, are excluded from collected data, as we do not have information available on these. This is not a disadvantage in relation to the other – next – indicator measuring the position of non-residents, as we are analysing the combined position of the total non-resident sector. In this case, however, we measure the individual transactions of the given non-resident participants in accordance with the defined rule. Owing to its nature, this indicator also reveals the closest link to short-term developments in the risk premium.

B. *Cumulated net spot forint purchases of non-resident participants.* The variable expresses the aggregation of the spot market transactions of non-residents, based on their direction. The indicator does not mean an actual stock-type measure (participants typically do not "keep" the acquired forints), but reveals the net resultant of the cumulated spot forint purchases and sales of non-residents from a given date. The variable basically reflects the effect of the two aforementioned strategies – (1) HUF-denominated asset purchases while taking up of exchange rate risk and (3) taking up of foreign exchange position through parallel use of FX swap and spot transactions. This indicator is relatively effective in measuring quantity effects on the exchange rate through non-resident participants, as non-residents commonly apply these two methods to open a forint position, and the indicator also shows the effect of position closings.

Although this indicator is sufficient in itself to estimate the quantity effect produced on the exchange rate, for the understanding of underlying trends and the distinction of the related two possible strategies, it should be interpreted jointly with indicators measuring non-residents' forint instruments and the net FX swap stock. The indicator has the disadvantage that it can also include cash flows related to unintended FX exposures (e.g. balance of payments items). In addition, it does not reflect the effect of transactions affecting the forint exposure of non-residents, but related to non-spot transactions (drawdown of options, settlement of forward transactions), although the sum of the latter items is not substantial in comparison to spot transactions.

C. *Total cumulated forint position of non-residents.* The total cumulated forint position of non-residents is a wider category in relation to the prior indicator. This variable measures the effect of the following transactions:

- the net **spot forint purchase** of non-residents based on deal date (this covers the prior indicator);
- cumulated value of conversions deriving from the **drawdown of option transactions** concluded with non-residents (based on value date, i.e. maturity);
- cumulated value of conversions deriving from the **settlement of forward transactions** concluded with non-residents (based on value date, i.e. maturity);
- unexpired option transactions concluded with non-resident participants, i.e. **open option position;**
- unexpired forward transactions concluded with non-resident participants, i.e. **open forward position;**

In terms of the forint position of non-residents, this indicator is regarded as a wider category than spot forint buying, as it also includes positions taken up on derivative transactions. This, however, means that changes in the exposure and actual cash flow may occasionally diverge (e.g. the period between initiation and exercise of options). We should add, however, that changes in the cumulated forint position are predominantly attributed to spot transactions, thus changes in this indicator too are mostly related to strategies (1) and (3), and only to a lesser extent to changes in the forward and option positions.

Similarly to cumulated spot forint purchases, this indicator does not mean an actual stock measure either (although it also includes stock data), thus it is primarily the direction of the indicator's change, the underlying trends, and not level values, that carry information. Similarly to the spot forint purchases of non-residents, the effect of items related to the balance of payments, FDI flows, etc., is also reflected by this indicator. This is a potential problem because changes in the indicator may suggest a higher-than-actual FX position.[7]

All of the above three indicators show the forint position of non-residents in some form; although they partly

[7] To illustrate this with an example, a non-resident participant converts dividend received in Hungary to foreign currency. In this case, his forint exposure does not change in comparison to the situation prior to dividend payment: he sold the forints received as dividend – no actual position was taken up. Notwithstanding the above, "one leg" of the conversion, i.e. a forint sale on the FX market, is immediately covered by the total forint position and spot forint position indicators of non-residents, indicating a decrease or a downsizing of the position. The "other leg" of the event, i.e. dividend payment, however, appears among the current balance of payments items only with significant delay, disabling comparison with these FX market indicators.

Table 1
Main properties of forint position indicators of non-residents

	A) Long/short HUF money market position of non-residents aggregated by market participants	B) Cumulated spot HUF purchases of non-residents	C) Total cumulated HUF position of non-residents
Which trading strategies affect the indicator?	(3) Taking up of FX position through the parallel use of FX swap and spot transactions	(1) Spot foreign exchange conversion and buying/selling of HUF-denominated assets (3) Taking up of FX position through the parallel use of FX swap and spot transactions	(1) Spot foreign exchange conversion and buying/selling of HUF-denominated assets (3) Taking up of FX position through the parallel use of FX swap and spot transactions
Possible underlying causes	Opening a speculative (synthetic forward) position	– Purchase /sale of HUF-denominated assets; – Taking up speculative positions; – Balance of payment items.	– Purchase/sale of HUF-denominated assets; – Taking up speculative positions; – Balance of payment items;
Major possible contra-side items		– HUF-denominated assets of non-residents; – Net FX-swap position of non-residents; – Balance of payments items.	– HUF-denominated assets of non-residents; – Net FX-swap position of non-residents; – Balance of payments items; – Opening or settlement of option/forward positions

contain overlapping items, they also reveal substantial differences (Table 1).

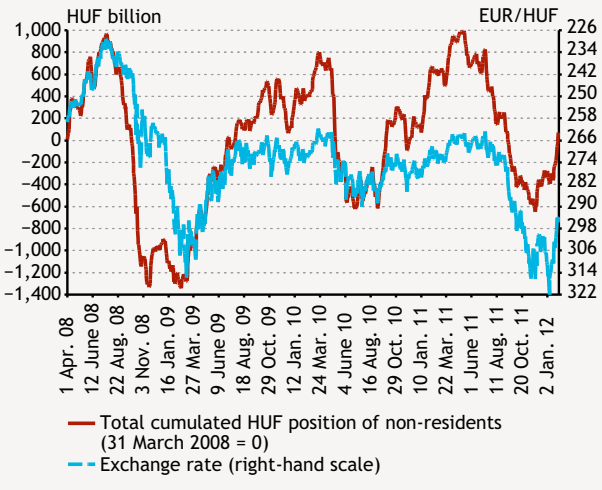
D. *Forward stock of resident non-financial participants*. The cumulated value of the unexpired forward transactions concluded by resident non-bank companies, i.e. **their open forward position** (total transactions cumulated according to the deal date, minus total expired transactions cumulated according to value date), indicates forward transactions concluded with a hedging purpose, that is, the application of strategy (4).

HOW DOES THE FORINT EXCHANGE RATE MOVE TOGETHER WITH THE POSITIONS OF FX MARKET PARTICIPANTS?

We analysed the co-movement of the listed forint position indicators with the HUF/EUR exchange rate in the period from 1 April 2008 to 31 January 2012.[8]

The long/short forint position of non-residents per participant, the cumulated spot position of non-residents and the cumulated total forint position of non-residents indicators show strong co-movement owing to the partial overlap of underlying data. Accordingly, their correlation with the exchange rate shows a similar picture. The indicators show close co-movement with the exchange rate during most of the period, although this relationship is also characterised by change and divergence at certain times, particularly in turbulent periods (Chart 2-5). Co-movement within the time series in less turbulent periods is attributable to the fact that non-residents' risk sensitivity and expectations related to the balance exchange rate changed, and this determined their transactions vis-à-vis residents.[9]

Chart 2
Total cumulated forint position of non-residents and the HUF/EUR rate



[8] In this chapter, in the description of the correlation between the indicators of non-residents and the exchange rate, we are moving from the direction of wider aggregates to narrower aggregates.

[9] As noted above, instead of applying an interpretation based on strictly defined explanatory and result variables, in this case we should rather interpret the relationship as a co-movement. For the calculation of parameters indicating the strength of the effect, however, we need to define the direction of causality; this underpins regression estimation, where we explain the short term dynamics of the exchange rate with quantity indicators. We believe that the daily frequency of data is adequate to ensure that endogeneity resulting from bidirectional causality causes negligible distortion in regression.

Chart 3
Cumulated stock of non-residents' forint spot position and the HUF/EUR rate

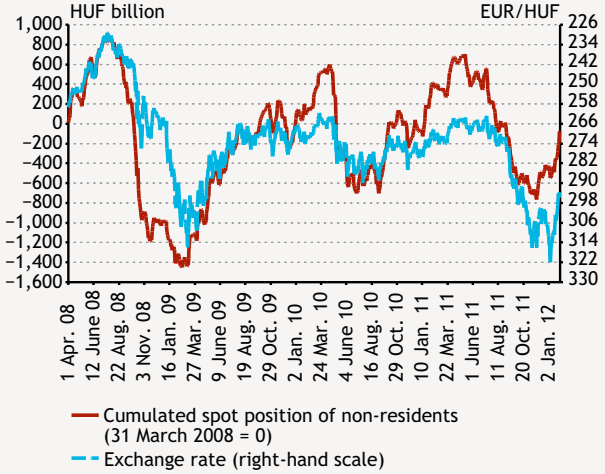


Chart 4
Cumulated stock of non-residents' short and long forint money market position per participant and the HUF/EUR rate

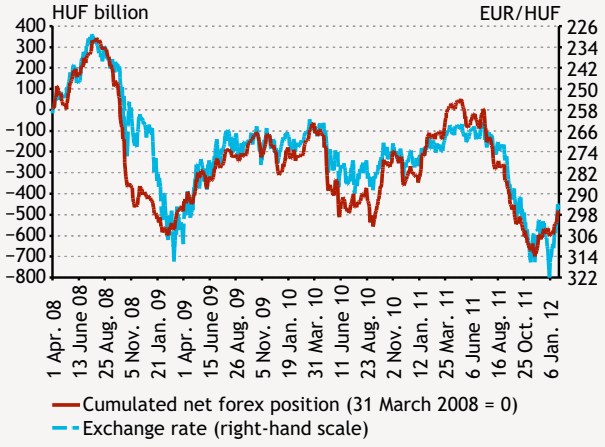
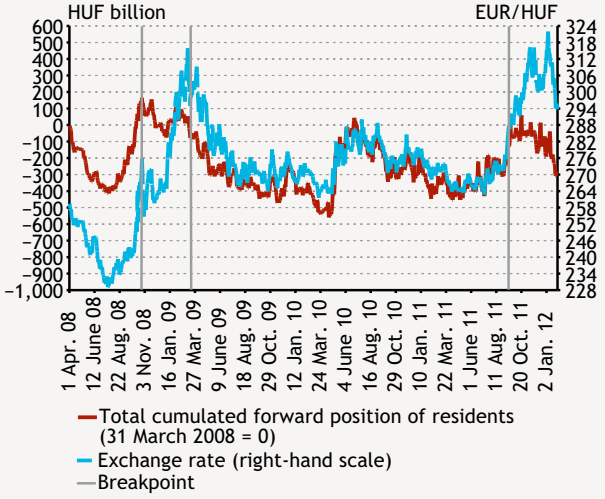


Chart 5
Total cumulated forward position of residents and the HUF/EUR rate



STABILITY OF CO-MOVEMENT

The link between the forint position indicators and the exchange rate changed several times during the analysed period. From October 2008, all three non-resident position indicators took a rapid decline, which was followed by the exchange rate only with several weeks' or months' delay. The strength of the link also weakened during this period. It is possible that traders expected a stronger equilibrium exchange rate in this period than warranted by unusually intense forint sales in themselves, and such expectations adjusted in the direction of weakening in the first months of 2009 only gradually, with a delay. The trend may have been partly attributed to the fact that forint sales in this period revealed by the indicators were generated mainly by the sharp reduction in the stock of non-residents' government securities holdings financed with spot market transactions; as a consequence, a substantial portion of the risk premium shock was reflected by rising yields in the government securities market and only partly and with a delay, by exchange rate expectations. In other words, spot market sales were attributed to the reduced government securities position and not to changes in non-residents' expectations.

At the end of 2011 and in the first days of 2012, the exchange rate depreciated significantly then recovered, accompanied by a relatively smaller change in positions. At that time, downgrades and communication relating to IMF/EU negotiations jointly changed expectations of all sectors, thus the exchange rate may have fluctuated significantly even without changes in positions.

Moreover, the cumulated total forint position and spot position temporarily diverged upward from the exchange rate between the end of 2009 and 2011 H1, that is, the increase in positions was only accompanied by a moderate strengthening of the exchange rate. This in itself is regarded as a normal phenomenon, as the exchange rate is influenced by many other factors as well.

The link between the forward stock of residents and the exchange rate changes in two cases. Between October 2008 and March 2009, at the peak of the pass-through of the international crisis, the weakening of the exchange rate was not followed by a rise in the forward stock that would have been warranted by co-movement in the past.

Table 2
Coefficients (projected to HUF 100 billion), t-statistics, adjusted R^2 indicators and Granger causality test results of regressions*

	Explanatory variables	β0 (t)	β1 (t–1)	β2 (t–2)	β3 (t–3)	Adjusted R^2	Granger causality
1	Total cumulated HUF position of non-residents with lags	–1.45 (–15.82)	not significant	0.41 (4.69)	0.17 (2.09)	38.42%	Yes
2	Total cumulated HUF position of non-residents	–1.15 (–12.04)	–	–	–	33.06%	
3	Spot HUF purchases of non-residents with lags	–1.57 (–15.93)	not significant	0.44 (4.60)	0.18 (2.10)	38.85%	Yes
4	Spot HUF purchases of non-residents	–1.42 (–14.77)	–	–	–	34.31%	
5	Long/short HUF position of non-residents with lags	–2.98 (–11.94)	–0.61 (–2.48)	0.82 (4.41)	0.57 (3.04)	30.15%	Yes
6	Long/short HUF position of non-residents	–2.89 (–12.79)	–	–	–	26.60%	
7	Spot HUF purchases of non-residents – Long/short HUF position of non-residents	–1.49 (–15.84)	not significant	not significant	not significant	36.40%	Yes
8	Forward position of resident non-financial sector with lags	1.09 (8.20)	0.20 (2.09)	not significant	not significant	13.21%	Yes. to both sides
9	Forward position of resident non-financial sector	1.11 (8.39)	–	–	–	12.89%	
10	Exchange rate changes with lags	0.12 (12.04)	0.05 (6.17)	0.04 (3.88)	not significant	16.43%	

** Daily changes are explained with daily changes for the period between 1 April 2008 and 31 January 2012. In equations 1-9, the dependent variable is percentage change in the EUR/HUF rate, while in equation 10 changes in the forward stock of resident companies. The explanatory variables are co-integrated with changes in the exchange rate. The majority of equations are heteroscedastic, therefore we adjusted the t-statistics with the White method.*

There are several possible explanations for the temporary change in the link. First, it is possible that bank partners expected lower hedgable foreign currency revenues due to declining export demand. It is possible that owing to possible losses suffered on earlier forward transactions, some companies made strategic decisions to reduce their hedging activity. Moreover, the forward transactions may have been limited by the volume of foreign trade activity, the higher volatility of the exchange rate, higher collateral levels raised by banks attributed to higher partner and market risks, and tighter price and non-price conditions. Declining turnover does not play a major role in this trend. The recovery of the exchange rate from March was again traced by the decrease in the forward stock. From this moment on, the two curves then closely moved together again until September 2011, when they diverged similarly to the end of 2008.[10]

EMPIRICAL ANALYSIS

Table 2 shows a total of 10 regression equations which mainly cover the link between forint position indicators and the HUF/EUR exchange rate.

We first analysed the correlation between quantity indicators and the exchange rate with the following regression estimate:

$$\Delta ER_t = \beta_0 * \Delta PM_t + \beta_1 * \Delta PM_{t-1} + \beta_2 * \Delta PM_{t-2} + \beta_3 * \Delta PM_{t-3} + \varepsilon_i \qquad (1)$$

where ΔER_t indicates the t daily change in the EUR/HUF exchange rate[11], ΔPM_t the change in the given position indicator between day $t–1$ and t (in HUF 100 billion), while ΔPM_{t-1}, ΔPM_{t-2} and ΔPM_{t-3}. show the value of changes, lags in the given indicator 1, 2 and 3 days earlier.

[10] A closer link between the forward stock and the exchange rate seemed to have been re-established in January 2012, although this currently remains unclear due to the low number of observance.

[11] We used the official exchange rates of the MNB. In addition to the MNB exchange rates, we also examined alternative exchange rates: the daily average of the average high frequency bid and ask quotations derived from the Reuters D2000 system and an alternative foreign currency basket representing the distribution of spot forint turnover. In this foreign currency basket, the EUR would have a weight of 79 per cent, the USD 10 and the CHF 8 per cent, while the role of other foreign currencies is negligible. The explanatory adequacy is considerably lower in the case of the exchange rate used from Reuters, while it does not show a significant difference from the MNB exchange rate in the case of the foreign currency basket. Overall, these specifications did not substantially modify the conclusions drawn, thus we consider the use of the central bank EUR/HUF exchange rate to be appropriate.

Table 3
Effect of quantity indicators on the exchange rate with different exchange rate levels*

Explanatory variables	Impact on exchange rate in per cent – [β0 (t)]	Impact on exchange rate in nominal term (HUF)		
		Exchange rate: average of full period (273,22 EUR/HUF)	Exchange rate: end of period (294,28 EUR/HUF)	Exchange rate: average of the last 5 months (300,65 EUR/HUF)
Total cumulated HUF position of non-residents	1.15%	3.14 HUF	3.38 HUF	3.46 HUF
Spot HUF purchases of non-residents	1.42%	3.88 HUF	4.18 HUF	4.27 HUF
Long/short HUF position of non-residents	2.89%	7.90 HUF	8.50 HUF	8.69 HUF
Spot HUF purchases of non-residents – Long/short HUF position of non-residents	1.49%	4.07 HUF	4.38 HUF	4.48 HUF
Forward position of resident non-financial sector	1.11%	3.03 HUF	3.27 HUF	3.34 HUF

** For the calculation we assumed a HUF 100 billion change in the given indicator.*

In regressions 1, 3, 5 and 8, we interpreted the percentage change in the exchange rate with changes in the given daily position and lags on the basis of formula (1).[12] In relation to all three indicators of non-residents, the given daily positions (and positions one day earlier, too, in case of speculative positions) show a positive correlation with changes in the exchange rate. Accordingly, the rising position is accompanied by a strengthening exchange rate, while positions two or three days earlier show a negative correlation. This implies that the exchange rate "overreacts" to the change in the position, and it is partially corrected two to three business days later. On the basis of the Granger causality test[13], all three indicators describing the positions of non-residents help to forecast the exchange rate, but this is not the case vice versa, i.e. the correlation is one directional.

Interpretation of the coefficients is limited by the fact that all four forint position indicators are autoregressive, i.e. the given daily change in position in itself significantly infers the position of the next day.[14] Since both the change in position and its lag significantly moves together with changes in the exchange rate, their effect clearly cannot be separated – the coefficients relating to them cannot be interpreted in themselves. We therefore prepared regressions 2, 4, 6 and 9 to measure the co-movement between the given daily change in position and the given daily change in the exchange rate, where we omitted the delayed explanatory variables.

Upon analysis of the β_0 coefficients, we see that the exchange rate reacts significantly more sensitively to the speculative money market position than to other indicators. While a HUF 100 billion position increase relating to the cumulated forint position and spot position of non-residents caused a 1.15 and a 1.42 per cent strengthening of the exchange rate, respectively, this value is 2.89 per cent in relation to short/long forint money market positions. At the exchange rate levels measured at the end of January 2011, these values correspond to approximately a 3.38, a 4.18 and a 8.50 forint shift (Table 3). In other words, on the basis of correlations in the past, the 1 forint change in the exchange rate at the current exchange rate level is typically attributed to a 30, 24 and 12 HUF billion change in the total forint position, spot position and speculative money market position of non-residents.

The total forint position and spot position of non-residents basically carries the same information on the basis of the R^2 indicators[15], and the difference is also small in relation to the coefficients. Changes in the position of non-residents, that are not related to the spot position (position changes related to option, forward transactions) do not contain substantial additional information. The 34-39 per cent R^2 indicators suggest a lower than average correlation between positions and the exchange rate.

In relation to short/long forint positions, the R^2 indicator is only 27-30 per cent, thus we suffer a loss of information by

[12] For example, in relation to the coefficients of regression 1, if the cumulated forint position of non-residents increases by HUF 100 billion on a given day, this in itself will lead to the 1.45 per cent strengthening of the exchange rate on the same day, and a 0.41 and 0.17 per cent weakening of the rate two and three business days later, respectively.

[13] Granger causality does not constitute genuine explanatory strength; where applied, knowledge of one variable helps to forecast the development of the other variable.

[14] In other words, the regression equations are characterised by multi-collinearity.

[15] The R^2 indicator shows what proportion of volatility of the dependent variable (daily percentage rate change in the exchange rate) is explained by explanatory variables.

regarding only the speculative transactions from position changes of non-residents. Owing to the above, in equation 7 we analysed the co-movement of the difference between spot positions and short/long forint money market positions with the exchange rate. The correlation is significant with a 36 per cent R^2 indicator, thus the co-movement of spot transactions linked to non-speculative positions with the exchange rate is also of a high level.[16]

Changes in the forward stock of resident companies are also a significant explanatory variable, albeit they show weaker co-movement with changes in the exchange rate (equations 8-9). The R^2 indicator is low and the correlation is relatively weak. This can also be evidenced intuitively: demand-supply conditions in the forward market indirectly affect the spot exchange rate through changes in the forward exchange rate, then through covered interest rate parity. The Granger causality test indicates a bidirectional correlation; the opposite direction (i.e. when the exchange rate is the explanatory variable and the forward position is the dependent variable) is stronger.

Equation 10 runs in the opposite direction, that is, it shows that the exchange rate change and its lags explain the forward position, too. The R^2 indicator is moderately higher in this case than in relation to equations 8-9. Together with the Granger test, this suggests that most residents only react to the exchange rate. Since the times series of daily changes in the exchange rate is not autoregressive[17], we can interpret the coefficients separately. In case of a one per cent weakening of the exchange rate, on the same day resident companies buy HUF 12 billion with forward transactions, an additional HUF 5 billion on the next day and an additional HUF 4 billion on the day after, thereby bolstering the exchange rate. It seems that a significant number of resident corporate traders react to exchange rate changes with a delay. The total change in stock equals HUF 21 billion for three days.

We also prepared equation 11, where we placed a dummy variable into the above regression 10, signifying the turbulent periods (October 2008–March 2009, and from September 2011), multiplied by β_0. We can thus separately calculate the coefficient of the given daily exchange rate change for turbulent and non-turbulent periods. Although the R^2 indicator did not improve significantly, the dummy variable is significant. In turbulent periods, resident companies react to a one per cent change in the exchange rate only with a HUF 9 billion change in stock, but with a HUF 13 billion change in other periods. This also confirms that the behaviour of resident companies changes significantly in turbulent periods.

The above discussion helps us in understanding why the split in the relation between the forward stock and the exchange rate (October 2008, September 2011) was accompanied by a rapid weakening of the exchange rate in the past. The depreciation may be faster and larger in periods when the resident forward stock is unable to bolster the weakening of the exchange rate.

CONCLUSIONS

On the basis of our analyses, we may draw the following conclusions:

- position changes of FX market participants allow us to derive expectations related to fundamentals and hence changes in the expected risk premium;
- a significant correlation may be identified between exchange rate position indicators and the short-term dynamics of the exchange rate;
- non-resident participants are first to react to a risk premium shock, often motivated by short-term speculation, while later resident non-bank participants commonly adjust through the intermediation of the resident banking sector;
- the relationship between indicators and the exchange rate may change in response to shocks; instability over time and breaks in the relationship may provide information about the nature and effect of the shocks;
- in the money market monitoring process, different quantity indicators should be jointly examined and analysed due to their varying information content;
- changes in non-residents' position and their stock of forint assets do not constitute a closed system, hence it is more meaningful to focus on the dynamics of changes in stock than on specific levels.

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[16] This also implies that non-resident positions are not only affected by changes in risk premia, but also by transactions not being connected with premia and exchange rate expectations (balance of payments items).

[17] In other words, the given daily change in the exchange rate does not significantly explain change on the next day.

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ANNEX: CALCULATION OF THE LONG/SHORT FORINT POSITION OF NON-RESIDENTS AGGREGATED PER PARTICIPANT

A non-resident participant takes up a profitable position in case of the strengthening of the forint exchange rate, if it buys the national currency and lends it on the same value date in the form of an FX swap transaction. Similarly, non-residents take up a short forint position if they borrow forints and sell on the same value date. The sale-purchase is transacted in the spot FX market, while lending/buying is conducted in the FX swap market.

The above method only takes into account FX swap transactions launched on the given trade date, but not maturing deals. Accordingly, the maturity of transactions would not play any role in this context, therefore the calculation should be expanded to the open FX swap stock. With a long forint money market position, the participant's forint spot position increases and its forint FX swap position decreases; with a short money market position, the participant's spot position decreases and its FX swap position increases. In relation to the spot market, the increased position covers a forint purchase, the decreased position covers a sale. In the FX swap market, the position reflects the net quantity of forints borrowed by the participant on the basis of its transactions in effect. Thus, the position increases if it borrows forints or its forint lending transaction matures, and it decreases if it lends forints or its forint borrowing transaction matures.

A given participant's spot position changes by ΔSP, its swap position changes by ΔSW on a given value date. If ΔSP>0>ΔSW, this corresponds to a long forint money market position (the given participant buys forints in the spot market with foreign currency acquired in the FX swap market). Size of the position will be:

$$min(\Delta SP, -\Delta SW)$$

Similarly, if ΔSW>0>ΔSP, this corresponds to a short forint money market position (the given participant sells forints in the spot market acquired in the FX swap market). The value of the total net position will be negative:

$$-min(-\Delta SP, \Delta SW)$$

Spot transactions are traditionally settled as t+2, i.e. the date of financial settlement follows the trade date by two business days. By contrast, swap transactions may have a settlement of t, t+1 and t+2. Primarily the spot leg of the position affects the exchange rate, therefore, the given daily money market position should be compared to exchange rate changes linked to the trade date of the spot transaction. Thus, the exchange rate moves together with the money market position aggregated for non-resident participants measured two business days later.

Chart 6
Date of the financial settlement and exchange rate effect of the spot transaction and swap transaction

	t	t+1	t+2	t+2
Spot deal	transaction			financial settlement
Swap deal	transaction	transaction	transaction	financial settlement
	↑			
	effect on exchange rate			