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(Kamatderivatíva-piacok Magyarországon 2009 és 2012 között a K14-es adatszolgáltatás tükrében)

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Contents

Abstract

MNB has received daily, transaction-level data on key Hungarian interest rate derivatives markets since the beginning of 2009 with the launching of the K14 report. The dataset that has accumulated since early 2009 provides an opportunity to better comprehend the structure and functioning of these markets. The goal of the current paper is two-fold: to study the data from a monetary policy perspective and to present a descriptive type of analysis of these markets for those interested; from active market participants to analysts, researchers.

An important finding from a central banking viewpoint is that interest rate expectations are the main motives for trading in the FRA market, hence price quotes are not biased by structural, risk management factors. However, the speculative and hedging motives are both present in the IRS market; the latter may alter pricing relative to expectations. The 3x6s in the FRA and the 2-year rates in the IRS market are respectively the most liquid and, hence, informationally the most reliable products. In the past years domestic banks positioned toward lower interest rates relative to foreign counterparties, though the extent of such open positions has changed over time. The empirical relationship between bank analyst rate expectations and FRA-positioning has been weak. However, in times of greater variation in analyst forecasts FRA-positions have varied more as well.

In the CIRS market domestic banks' activities of hedging the balance sheet currency mismatch and of foreign exchange liquidity management have led to a structural extra demand of foreign currency receiving swaps, which also resulted in large (negative) CIRS spreads. The commonly used CIRS transactions in the Hungarian market are floating-floating type basis swaps, and thus they are basically not used for interest rate risk management.

JEL: E44, F31, F32, G01.
Keywords: interest rate derivative, currency swap, forward rate agreement, financial crisis, counterparty limit, foreign exchange liquidity.

Összefoglaló

Az MNB 2009 elején indított K14-es jelentése, amely által a hazai kamatderivatíva-piacokról napi, tranzakciószintű adatokhoz jut, a piac korábbiaknál mélyebb elemzését, jobb megismerését teszi lehetővé. Jelen tanulmány célja, hogy ezeket az adatokat monetáris politikai szempontból is vizsgálja, valamint, hogy a piacon aktív szereplők, illetve az érdeklődő elemzők számára a kamatderivatíva-piacokról leíró jellegű elemzést mutasson be.

Monetáris politikai szempontból fontos, hogy az FRA-piacon a kamatvárakozások jelentik az alapvető kereskedési motivációt, így a jegyzéseket strukturális, kockázatkezelési tényezők kevéssé torzítják. Az IRS-piacon már vegyesen van jelen a spekulatív és fedezési motívum, ami a jegyzéseket a várakozásokhoz képest módosíthatja. Leglikvidebbnek és így leginkább megbízhatónak az FRA-k esetében a 3x6-os, az IRS-ek esetében a 2 éves szegmens tekinthető. Az elmúlt években a hazai bankok aggregált szinten mindkét piacon a hozamok csökkenése irányában pozicionáltak a külföldi szektorral szemben, bár ennek mértéke időben változott. A banki elemzői prognózisok és FRA-kitettségek között gyenge volt a kapcsolat, ugyanakkor megfigyelhető, hogy a nagyobb elemzői bizonytalanság időszakaiban az FRA-pozíciók is jobban szóródtak.

A CIRS-piacon a banki mérleg árfolyamkitettség-fedezése, illetve a devizalikviditás-kezelés okoz strukturális többletkeresletet a devizalikviditás-szerzés irányában, ami a magas swapszpredekben is tükröződik. A CIRS-ügyletek közül a hazai szereplők leginkább változó-változó kamatozású ún. bázisswapokat kötnek, így az instrumentumot alapvetően nem kamatpozíció menedzselésére használják.

1 Introduction

Interest rate derivatives are important financial instruments in terms of risk and liquidity management, expectation-based trading, and are essential informational tools for analysts and policymakers. Since the 1980s these instruments have provided a means for market participants to hedge interest rate and exchange rate exposures. Also, they have been used for holding trading positions to express private interest rate and exchange rate expectations distinct from that priced in the market. This type of trading activity has had a beneficial impact on market liquidity and in aggregating private information in prices, which has in turn made these markets important for policymakers and analysts alike. Interest rate swaps and forward rate agreements have grown in significance as benchmarks for future short-term interest rate expectations in the past decades both abroad and in Hungary. Currency interest rate swaps have, on the other hand, been a basic tool for managing both the foreign currency liquidity and the open exchange rate position for several domestic banks.

The novelty of the current study is the analysis of interest rate derivatives markets in Hungary based on data that has accumulated since the 2009 launch of the K14 report. The central bank receives daily, transaction-level data from each domestic bank within the K14 reporting framework. The provided data encompass the three most-traded interest rate derivatives in Hungary: simple interest rate swaps (IRS); currency interest rate swaps (CIRS); and forward rate agreements (FRA). The data allow the monitoring of sectoral exposures and trading volumes/liquidity, which is useful from both a financial stability monitoring perspective and in the assessment of the informational reliability of derivative prices. The current crisis has made the database even more focal due to the increased importance of stability issues and the appearance of information-distorting factors in prices. The four years of data in our sample after the launch of the report is, in our opinion, already sufficient to provide general insights about these markets and also to study their evolution, longer-term tendencies.

The analysis has several objectives. First, our goal is to investigate the data from monetary policy relevance aspects. Second, we would like to share aggregate information on the market (without the disclosure of private data) in order to enhance active market participants' anecdotes-based and own-trading based knowledge. Third, the publication is intended to provide information for analysts, researchers interested in Hungarian financial markets. The paper is mainly descriptive in nature, though some important and interesting conclusions are drawn based on the data.

Several questions are addressed in the paper, of which the most important are:

- How did the crisis impact market liquidity, structure and exposures?

- Are market quotes in line with transaction-level prices, and are prices reliably reflecting expectations?

- What are the motives for trading of participants in these markets: market making, hedging or speculation?

The paper is structured as follows. Section 2 presents a general overview of interest rate derivatives' function and history. Section 3 describes the three interest rate derivatives included in the K14 report using illustrative sample trades. Section 4 embarks on the descriptive analysis of domestic interest rate derivative markets: typical transactions' attributes, pricing relative to market quotes, market structure and trading motivations. Section 5 examines how the market structure and transaction attributes have evolved during the sample. The last section concludes.

2 Interest rate derivatives: a general overview

Interest rate derivatives are derivative transactions in which future payments depend on the movement of underlying interest rates. In the past decades an abundance of interest rate derivative products appeared in financial markets. They have ranged from the relatively standardised "vanilla" transactions that have been used since the 1980s (including the derivatives this publication deals with: simple and currency interest rate swaps, forward rate agreements, but also caps, floors, collars, swaptions, bond options) to the exotic, complex structured products tailor-made to fit specific corporation needs, which have experienced a boom in the last decade.[1]

One of the main functions of interest rate derivatives is to provide a means to hedge exposure to interest rate risk, i.e. to reduce asymmetry of this kind between the asset and liability sides of balance sheets.

Both financial and non-financial corporations' assets and liabilities depend on the levels of actual market interest rates. To cite some examples: loan and bond obligations' coupon payments may be referenced directly to, usually short-term, interest rates, which makes these liability-side items' future value dependent on these rates. On the asset-side loans provided by banks to households and corporations may also be indexed to reference interest rates and both financial and non-financial corporations may keep securities with floating rate coupons, which are explicitly tied to a reference rate. The present value of such items may however be less influenced, if the discount factor counteracts the effect of the reference rate. The present value of fixed coupon paying securities is affected by actual market yields. Rising yields decrease the price of fixed rate paying products, since the fixed payments' value declines in light of higher actual market yields.

Since the asset and liability sides of balance sheets are usually affected by interest rates to a different extent, this leads to a natural demand for interest rate derivatives on the part of those market participants who do not wish to take on all, or part of, the resulting interest rate risk. If, for instance, a market actor has a balance sheet that experiences a large devaluation of assets in case of a market rate increase, while the liabilities' value only changes modestly, then an increase in market yields implies a large loss for such an entity. To counter this, the market actor could buy an interest rate derivative, which offers a valuation gain in case of market yield rises.

From a systemic viewpoint it is important that the interest rate risk exposures of market participants may be matched to some extent by opposite sign positions of other market participants. A well-functioning interest rate derivative market can then lead to a hedging of these positions. However, if opposing (and intended to hedge) exposures do not cancel out, this leads to a systemic disequilibrium in the market. One way for the disequilibrium to moderate is through the adjustment of prices of asset and liability items. This, on one hand, steers participants on the aggregate toward taking on balance sheet items with a different interest rate risk exposure so that the market will be closer to equilibrium. This type of adjustment is however slow. For the market to be more flexible, participants with a speculative trading motivation are needed, who will accept market risk, i.e. unhedged interest rate exposures. The existence of participants with speculative motives is what allows other participants, for whom limited exposure is essential, to be able to hedge their balance sheet positions.

[1] See a general treatment of various products in Hull (2005).

A brief historical account of analysed interest rate derivatives

The rapid growth of interest rate derivative markets was largely a consequence of the multinational and later global activity of a growing number of corporations. On one hand, this tendency has introduced a currency mismatch in corporate balance sheets and cash flows. On the other hand, it was responsible for increasing interest rate risk in balance sheets as corporations were usually involved in distinct market activities in different countries and also, different countries had dissimilar financial market environments (legal, tax environments, and lending/securitisation market standards). Cross-country complex financial transactions could therefore have had significant costs. If, for instance, an American company needed a floating rate yen liability to match a floating rate cash flow of a Japanese asset portfolio then directly obtaining such yen funds (by bond issuance or bank loan syndication) was often a costly and time-consuming process. In contrast, via derivatives, the company could just resort to the accustomed U.S. domestic funding markets (for example issuing a fixed rate dollar bond or obtaining a floating rate bank loan in dollars) and use currency and interest rate derivative products to create a floating rate yen obligation.

Interest rate derivative markets were also boosted by an increased volatility of market yields in several advanced countries in the second half of the 1970s, which raised the interest rate risk for market participants. Financial corporations have faced especially large interest rate risk due to maturity mismatch in balance sheets. Therefore it was a natural reaction to develop and employ financial derivative products (interest rate futures, swaps, options) to reduce these exposures (Bicksler and Chen, 1986).

As argued above, derivative markets could only systemically consolidate opposing sign interest rate risks of financial entities. Probably the higher volatility, a need to hedge market risk and the wave of financial market deregulation in advanced economies in the 1980s have together brought about the appearance and expansion of the sector of financial market participants who traded with a speculative motive.

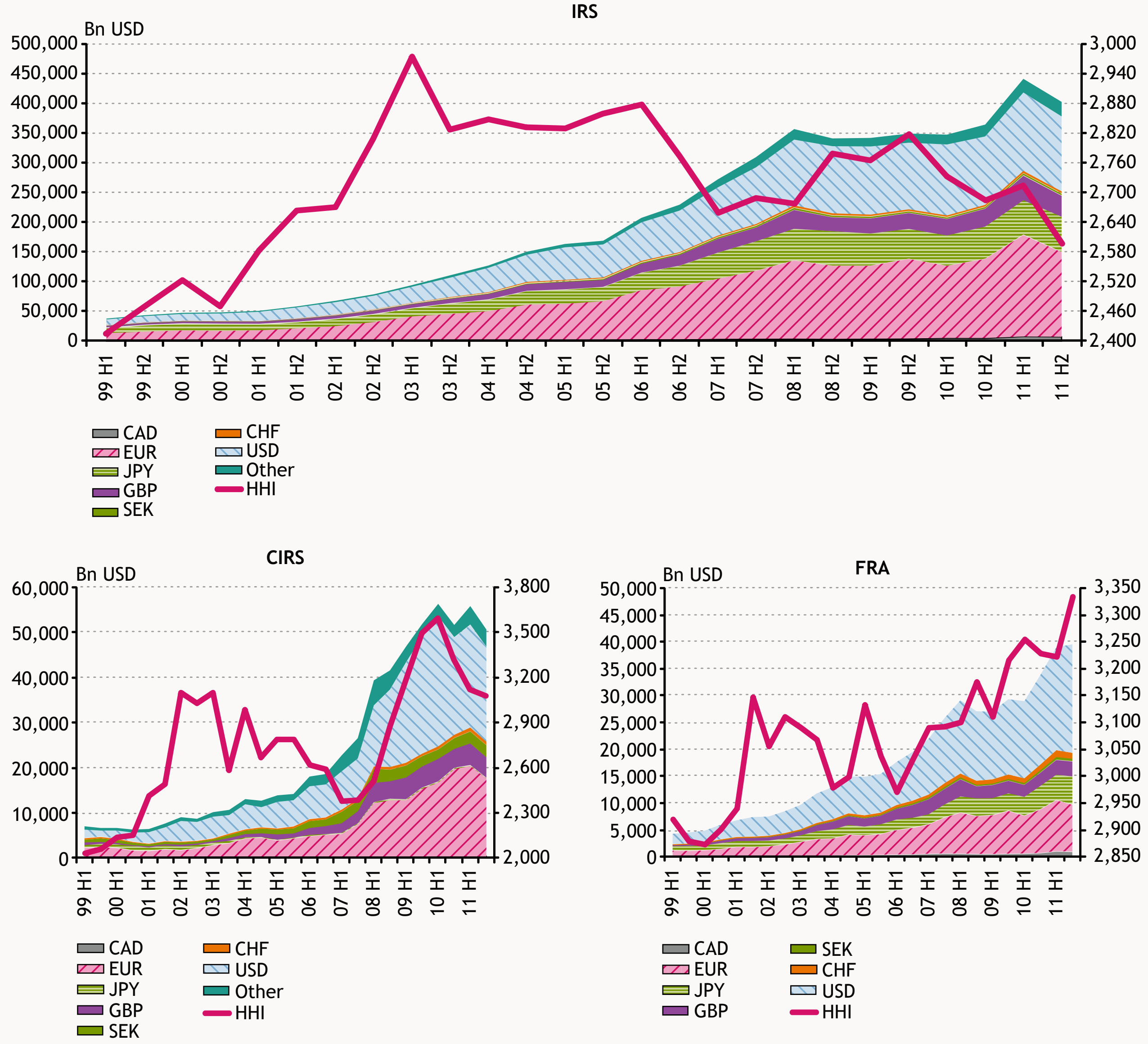
Later, on the turn of the millennium, the creation of the eurozone gave a further boost to interest rate derivative markets in Europe. Interest rate swaps have in particular quickly gained a market benchmark status for the quasi-risk free rate as its uniformity across the region stood in sharp contrast with disparate government securities markets. Due to the lower liquidity needs of transactions, speculative positions expressing future rate expectations could more easily be created via swaps than via sovereign bonds. On medium maturities, at least, the turnover in euro interest rate swaps exceeded that of eurozone core countries' government securities (Remonola and Wooldridge, 2003).

Interest rate derivative markets were characterised by an exponential growth in the 2000s until the financial crisis hit. The crisis halted growth of the interest rate swap and FRA markets (Chart 1 upper and lower right panes) as market participants decreased their counterparty limits. Both markets experienced stagnation and a smaller setback during the height of the crisis and in 2011, with an interim expansion in 2010.

Interestingly the market of currency interest rate swaps began expanding significantly during the crisis and by 2011 it reached threefold the size in 2007. The explanation is that the currency interest rate swaps began to replace the alternative currency liquidity management instrument, short-term FX swaps, as market players wanted to secure necessary foreign exchange funding for longer maturities. By relying on CIRS transactions instead of FX swaps rollover risk could be reduced.

This is reinforced by turnover statistics in the BIS Triennial Survey (BIS, 2010). Turnover in the CIRS market increased during the crisis, while it stagnated in the FX swap market. The order-of-magnitude difference between the two markets' turnover is the effect of different maturities. FX swaps are short-term instruments, which have to be frequently rolled over to cover the same exposure, while currency interest rate swaps of usually several years' maturity have to be rolled over infrequently, which leads to relatively smaller turnover (Table 1).

Chart 1
Size of the global IRS-, CIRS- and FRA markets



Note: Sum of open positions' (netted for entities) notional values.
Source: BIS (2012).

Table 1
Daily turnover in various markets

Average daily turnover (bn USD, April of given year)	1998	2001	2004	2007	2010
IRS	155	331	621	1,210	1,275
FRA	74	129	233	258	601
CIRS	10	7	21	31	43
FX swap	734	656	954	1,714	1,765

Source: BIS (2010).

Interest rate derivatives in Hungary before the crisis

Derivatives markets in Hungary began to rapidly expand in the 2000s. The act of currency liberalisation adopted in 2001 played a significant role in the boom as it allowed non-residents' market involvement to expand rapidly.

The announcement of currency liberalisation on May 4, 2001 was the first real impetus for interest rate swap and currency basis swap markets (Asztalos et al., 2003). Removal of regulatory controls not only allowed a growth of turnover in foreign exchange markets but also facilitated the spread of financial derivatives.

After the announcement of the forint's full convertibility several supranational organisations issued forint denominated bonds for foreign investors. These issuances were advantageous from the issuers' perspective, because, albeit having relatively higher bond yields, funding costs could be substantially decreased using interest rate and currency interest rate swaps. These bond issuances therefore greatly speeded up development of interest rate swap and currency interest rate swap markets.

The foreign exchange swap market (in particular the USD/HUF cross) deepened rapidly thereafter and already in 2002 its turnover exceeded those of uncovered interbank loans and repo markets (Balogh and Gábriel, 2003). Other than currency liquidity management, market participants used FX swaps also for speculating on future interest rate movements (Csávás et al., 2006). The foreign exchange loan boom beginning in 2004, in turn, resulted in FX swaps being crucially important in hedging open FX balance sheet positions. Currency swaps and currency interest rate swaps that could have also been used for both foreign exchange liquidity management and creation of synthetic foreign exchange funding were used to a lesser extent before the financial crisis.

Currency liberalisation facilitated the development of domestic (single currency) interest rate swaps as well due to encouraging foreign investor participation. The increasing volume of forint denominated securities (primarily government bonds) in foreign investor balance sheets increased demand for forint interest rate swaps as well (Farkas et al., 2004). Forint interest rate swaps' outstanding notional volume increased from approximately 1,000 billion HUN in 2003 to 12,000 billion in early 2007 with daily turnover estimated to be around 40-50 billion HUF (Csávás et al., 2007). We have less information on the pre-crisis stock and turnover in the FRA market. Based on MNB data collected for the BIS triennial surveys, before the crisis FRA daily trading was of the 20-25 billion HUF magnitude and according to market anecdotes FRAs were at that time already the most actively traded instruments for interest rate speculation in Hungarian money markets.

The financial market turbulence hitting Hungary in autumn 2008 had a significant impact on all domestic financial derivatives markets. Foreign currency became hard to access in FX swap markets: the cost of obtaining FX liquidity increased to previously unimaginable levels. Moreover the domestic banking sector faced additional foreign currency funding needs owing to margin calls due to the depreciation of the forint (Páles et al., 2011). Adverse experiences in the FX swap market contributed to market participants increasingly preferring the longer-maturity currency interest rate swaps. As mentioned above, a similar tendency was apparent abroad as well. We will turn to the issue in more detail later in the study.

Interest rate swap trading volumes also declined during the crisis, also in line with foreign experiences, which was due to two factors. On one hand, counterparty limits were decreased as a result of more stringent internal risk management rules, thus limiting the possible outstanding amounts. On the other hand, a widening of interest rate swap spreads disappointed investors in government debt markets, who have used swaps to hedge interest rate risk exposure.

The most notable change with respect to forward rate agreements has been the different interpretation of the instrument's pricing. Because the interbank lending market froze, the short-rate expectations content of the reference rate, BUBOR, virtually disappeared and the rate simply behaved as if it was pegged to the MNB base rate. As a consequence, trading in FRAs practically amounted to taking positions regarding base rate expectations instead of expectations on BUBOR movements (Pintér and Pulai, 2009).

Partly as a reaction to experiences of the crisis, MNB launched its K14 data collection in the beginning of 2009. This data set is what our study investigates, so our description of Hungarian interest rate derivatives begins at this point in the historical timeline. The K14 data set is useful for MNB as it can follow individual domestic banks' exposures in various market segments. The data informs MNB on which the key market players are; provides information on exposures' magnitudes and signs, and more generally on the derivative market's sectoral exposures.

Sources of data available on Hungarian interest rate derivatives

Availability of data on interest rate derivatives is poor compared to markets of standardised financial products. The reason is that interest rate derivatives are typically traded in OTC markets, so market participants directly trade with each other instead of dealing through a central counterparty as is the case in commodity and equity markets.[2] OTC trading makes data collection difficult as the market lacks a central actor, which would naturally collect (and could provide) trading data due to its function. In the OTC market data has to be collected from individual market players, which is more cumbersome, more prone to errors and has a further caveat that national central banks and regulatory bodies can only require market participants of their jurisdiction to provide data. The latter means that transactions between non-residents are not observed.

Non-standard products also make data reporting difficult. Although there are market conventions and international organisations such as ISDA publish general guidelines and frameworks for OTC contracts, still, it is up to trading parties to agree on specificities of the transaction. They may deviate from standards, for instance, in order to let one of the counterparties have a derivative product that more closely matches its balance sheet or cash flow structure. Deviations from standards and the related evolution of derivative products is also a factor that complicates data collection because the questionnaires aiming to conform with standard products cannot well grasp key features of special transactions.

International data sources about interest rate derivative markets are scarce. BIS data published in triennial surveys provides one rare data source on volumes and turnover, while information on currency interest rate swaps published by the Bank of England's Semi-Annual FX Turnover Survey is useful as it gives an overview of the important London market. Unfortunately, the latter does not extend to derivatives denominated in smaller emerging market currencies, and hence in the Hungarian forint. Regarding the future, one positive externality of derivative markets' regulation, which aims to introduce central counterparties to these markets, is that a valuable transactions database will be created.[3] Though it is not yet clear how much of these data will be publicly available.

In Hungary both MNB and PSZÁF, the financial market supervisory body, collects data on interest rate derivatives in several reports with varied structures and objectives.

- Data for the K14 report are sent to MNB on a **daily basis**. Data providers detail **each transaction individually** for forint IRS, FRA and CIRS transactions providing information about the **counterparty's name, the transaction volume, sign** (long, short), the **reference rate(s)** used, the **key dates** of the transaction (deal date, value date, maturity date) and the transaction **yield/spread.**

- MNB collects turnover and volume data of these derivative markets in the D24 and D25 reports on a triennial basis complying with the BIS survey.

- The D01 report of MNB collects transaction-level, daily frequency data on currency swaps, however it is not always clear whether the transactions are FX swaps or CIRS.

[2] A central counterparty is a market actor that matches buyers and sellers of financial products, and guarantees their transactions by interposing itself between matched transacting parties by being a seller to the buyer and a buyer to the seller.

[3] The OTC market's failures, which became evident during the crisis, led to efforts in several developed countries to centralise the clearing of standardisable derivative transactions. The relevant US federal law, the Dodd-Frank Act, was signed in 2010 (see Skeel, 2010), whereas EMIR (European Market Infrastructure Regulation) in the EU requires central clearing of eligible derivatives from mid-2013 for financial institutions and above certain thresholds for non-financial corporations (ESMA, 2012). See Smith (2012) for a good summary of the latter regulation. Due to the regulation reporting obligations will be more wide-ranging and according to current plans aggregated market statistics will be made public. Market participants inform that even without the regulation being in effect an increasing share of transactions have already been cleared via LCH.Clearnet, a London-based clearing house. The impact of LCH on the forint derivative market is discussed in more detail in Section 5.

- The PSZÁF reports 3DBA – 3DBE provide monthly frequency data on the outstanding notional volume of the analysed derivatives. The report segments derivatives along several dimensions: initial time to maturity (3 categories), sign of transaction, sector of counterparty, if the transaction is used for hedging, banking/trading book, currency denomination.

- PSZÁF 9AA-9AF reports gauge interest rate risk on a quarterly frequency with a focus on duration instead of time to maturity.

In the following we briefly describe the advantages of the K14 report (in the analytical possibilities aspect) compared with other important reports.

One of the key benefits of the K14 data set is the high, daily frequency of reporting. Other data sets including interest rate derivatives have at maximum a monthly reporting frequency, which does not allow sufficient monitoring of rapidly changing market environments. Daily derivative market events carry important information on the general state of Hungarian financial markets and on the positions of individual participants. A further disadvantage of lower reporting frequencies is that transaction aggregates on longer time intervals obscure market reactions to different events within the period. Quarter-end and year-end data may also be biased due to end-period balance sheet window dressing of market players, whereas such distortions could be dealt with using daily frequency data.

An important advantage of the new report is the inclusion of the name of the counterparty that is on the other side of the transaction. PSZÁF reports and BIS surveys also provide a sectoral disclosure on counterparties, but an exact knowledge of the counterparty allows different and more detailed sectoral segmentations. For example, it can provide information on positions with respect to the parent institution.

A major novelty of the report is containing information on the pricing of transactions. Other reports are about volumes, thus one cannot infer from these at what prices, spreads the transactions took place. Even though data of other sources (Bloomberg, Reuters, etc) can be used for analysing price developments on these markets, a shortcoming is that these are commonly indicative quotes, which might be different from true trading prices.

The report also tells more about maturities than other reports. Inclusion of deal dates, value dates and maturity dates allows a more precise calculation of interest rate risk exposures than in the case when only maturity bands are known.

The K14 report collects transaction-level data. This allows calculation of not only outstanding volume and turnover statistics, which are accessible from other data sources, but also various other statistics such as daily average transaction size, number of transactions, and so on, that would not be possible from aggregate data.

A shortcoming of the K14 data set, though, is that in the beginning of the reporting sample aggregated data on outstanding volumes based on the report is less detailed and should be interpreted with care. Domestic banks provided data on outstanding stocks of IRS and CIRS contracts at the launch of the report in the beginning of 2009; however, this data is less detailed compared to the later, daily reporting. For instance, it only contains sector of counterparty instead of the counterparty's name. Moreover there was no initial reporting of outstanding stocks of FRAs, thus the report's data set can only provide aggregate figures based on cumulating transactions since the launch of the report. Nonetheless this aggregation probably closely approximates the true outstanding volumes already by autumn 2009 because of the short length of such contracts and there are probably no notable errors by using these calculations at the end of the sample in 2012.

3 Interest rate derivatives included in the K14 report

Banks are required to provide data on three types of interest rate derivatives in the K14 reporting framework: single currency (forint) interest rate swaps (IRS); currency interest rate swaps (CIRS); and forward rate agreements (FRA). In this section we describe these three derivatives using real sample transactions in the Hungarian market.

Single currency (forint) interest rate swaps

The single currency interest rate swaps involve the swapping of a fixed rate and a (same currency denominated) floating rate cash flow between two contracting counterparties.[4] One of the trading partners periodically pays interest based on rates fixed at the time of dealing and, in return, receives periodic payments of interest indexed to a reference rate. When the reference rate rises, the value of the swap increases from the viewpoint of the fixed rate paying (and floating rate receiving) counterparty, since the received interest increases while paid interest is fixed. Market convention refers to the fixed rate paying counterparty as the one taking a long interest rate position since this side's payoff increases with the increase of the derivative transaction's underlying, the reference rate.

Although there have been some non-forint denominated single currency transactions carried out by Hungarian banks, most of the deals are forint-based and K14 reporting requires providing data only on this latter type of single currency IRS. In case of forint IRS transactions fixed interest rates are swapped for BUBOR-based floating rates.[5]

Chart 2 presents an example of a forint interest rate swap deal. The two participating banks (here referred to as BANK A and BANK B) contracted on 27 September 2011, the deal date. The transaction's value or settlement date, its effective starting date, is 29 September 2011, while 29 September 2013 is the maturity date, making the contract a 2-year IRS. BANK A, the data provider, pays the (notional times the) 6.5 per cent fixed rate and receives the (notional times) 6-month BUBOR rates effective at the beginning of each rate payment period. Payments are netted on payment dates so that only the difference of cash flows has to be paid. In Hungarian market conventions the floating leg has a semi-annual, while the fixed leg has an annual payment period.

BANK A thus has had a long IRS position being the fixed payer, while BANK B has been in the short position. The rise of the 6-month BUBOR during the contract generates a profit for BANK A on the contract and a loss for BANK B. Viewing interest rate developments up to end-2012, market rates have decreased hence the value of the contract changed favourably for BANK B.

Market makers calculate IRS fixed rates to equate the present values of the fixed rate and the floating rate cash flows (based on their rate path expectations). Market makers contribute bid and ask quotes on the IRS fixed rate and profit from the difference between the two. Thus market makers quote lower IRS rates for paying the fixed rate and a higher one for receiving it. In the example chosen above, the 2-year IRS fixing (calculated from domestic dealers' quotes sent to MNB at 10 a.m. each trading day) was 6.52 per cent on 27 September 2011, whereas the closing mid-quote in the London trading was 6.45 per cent on that day. Based on these two market rates and the transaction rate of 6.5 per cent it is not possible to tell which counterparty has acted as the price taker, paying the bid-ask spread to the market maker.

[4] There are also such (single currency) interest rate swaps, falling into the category of basis swaps, in which two floating rate cash flows are exchanged. In these cases the two sides' floating reference rates differ in either maturity or in the reference market. Since these types of IRS are not characteristic of the Hungarian market we only deal with fixed vs. floating interest rate swaps (so called coupon swaps) in the paper.

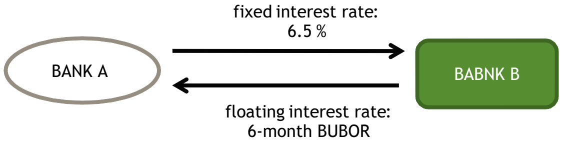
[5] OIS (overnight index swaps) thematically also belong to the single currency interest rate derivative category. In these transactions one of the counterparties pays a fixed interest rate (an actual money market short-term rate); whereas the other counterparty pays a floating rate: a cumulation of overnight rates during the term of the swap. See Erhart and Kollarik (2011) for more details on this type of transaction.

Chart 2
Example of an IRS transaction

Deal Date	Value Date	Maturity Date
27.09.2011	29.09.2011	29.09.2013

Paid notional (original currency)	Paid amount currency code	Received notional (original currency)	Received amount currency code	Name of paid interest	Duration of paid interest	Annualised interest rate paid	Name of received interest	Duration of received interest	Annualised interest rate received
1 000 000 000	HUF	1 000 000 000	HUF	N/A	N/A	6.50%	BUBOR	6 months	–

	BANK A pays	BANK B pays
29.09.2011	0	0
29.03.2012	0	1 000 000 000 * (BUBOR 6M)/2
29.09.2012	1 000 000 000 * 6.5%	1 000 000 000 * (BUBOR 6M)/2
29.03.2013	0	1 000 000 000 * (BUBOR 6M)/2
29.09.2013	1 000 000 000 * 6.5%	1 000 000 000 * (BUBOR 6M)/2



The movement in the yield curve during the term of the swap contract changes the (initially zero) value of the swap. This results in the contract also having a counterparty risk element. For instance, if rates rise, causing net payment obligations for BANK B to BANK A, then this constitutes a counterparty risk for BANK A due to the risk of BANK B not being solvent and not paying the obligation. In Hungarian market practice mitigation of such counterparty risk (CSA, margin accounts)[6] is not common. In case, though, that a margin account is created, the rise in market rates would cause a requirement for BANK B to post collateral.

Currency interest rate swaps

Currency interest rate swaps (CIRS) are interest rate swaps involving the exchange of interest cash flows denominated in different currencies. In the Hungarian market commonly the principal (notional amounts denominated in different currencies) are also exchanged in the beginning and at the end of the transaction. In these cases, when notional amounts are exchanged, the CIRS transaction also falls into the category of currency swaps. In the majority of deals the CSA is also part of the contract, and therefore the swap's market value (the difference between the present values of the two leg's cash flows) is evaluated, marked-to-market, usually on a daily basis and if it exceeds a pre-determined threshold then the counterparty with a larger payment obligation has to post cash collateral on a margin account to mitigate counterparty risk.[7] (It is up to the counterparties to decide, what thresholds are set and in which currency the collateral has to be posted.) It is important to note that the CIRS transactions with principal exchange do not involve an open FX position for either counterparties because the spot and forward legs of the transaction exactly offset each other. In many cases however the currency swap is combined with a spot transaction, in which case the two together do entail an open FX position.

As an example let's look at the following CIRS contract executed on 16 September 2011 (Chart 3). In the contract the data reporting BANK A is the foreign currency receiver (and forint liquidity provider) counterparty, which is the typical side Hungarian banks enter the transaction. From the viewpoint of BANK A, intuitively, the CIRS transaction is similar to a combination of a floating rate FX borrowing and a floating rate forint lending.[8]

[6] CSA (Credit Support Annex) contains the details and conditions of posting collateral. Usually the CSA is part of the ISDA agreement but there are cases of ISDA contracts without a CSA.

[7] Not all ISDA contracts include a CSA, but in case of currency swaps (FX swaps, CIRS with principal exchange) it is standard to include the annex.

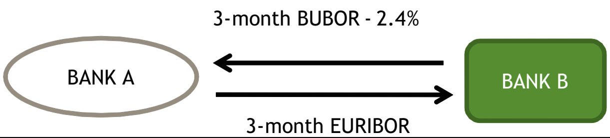
[8] Approximation of the transaction as a combination of two loans is inaccurate for a number of technical reasons. First, contrary to loans, in such derivative transactions the daily or periodic marking-to-market of the deal and posting of collateral on margin accounts to reduce counterparty risk is common. In some cases there is an FX reset in CIRS contracts, which adjusts the principal amounts to reflect changes in the exchange rate. In several textbooks CIRS transactions are described as combinations of spot and forward transactions. This, however, is only a valid approach for fixed rate paying currency swaps, the floating rate interest in basis swaps cannot be matched by standard FX forwards.

Chart 3
Example of a CIRS transaction

Deal Date	Value Date	Maturity Date	Data Provider	Partner	Paid notional (original currency)	Paid amount currency code	Received notional (original currency)	Received amount currency code
16.09.2011	20.09.2011	20.09.2013	BANK A	BANK B	2 870 000 000	HUF	10 000 000	EUR

Name of paid interest	Duration of paid interest	Annualised interest rate paid	Name of received interest	Duration of received interest	Annualised interest rate received
EURIBOR	3 months	N/A	BUBOR	3 months	-2.40%

	BANK A pays		BANK B pays	
15.11.2010	2870 MM HUF		1 MM EUR	
15.02.2011	1 MM *(3m EURIBOR)/4	EUR	2870 MM * d(EURHUF) * (3m BUBOR - 2.4%)/4	HUF
15.05.2011	1 MM *(3m EURIBOR)/4	EUR	2870 MM * d(EURHUF) * (3m BUBOR - 2.4%)/4	HUF
15.08.2011	1 MM *(3m EURIBOR)/4	EUR	2870 MM * d(EURHUF) * (3m BUBOR - 2.4%)/4	HUF
15.11.2011	1 MM *(3m EURIBOR)/4	EUR	2870 MM * d(EURHUF) * (3m BUBOR - 2.4%)/4	HUF
...	...		...	
15.11.2012	1 MM *(3m EURIBOR)/4	EUR	2870 MM * d(EURHUF) * (3m BUBOR - 2.4%)/4	HUF
15.11.2012	1 MM* d(EURHUF)		2870 MM * d(EURHUF) HUF	



On the value date, the beginning of the life of the swap, the counterparties exchange notional: BANK A pays the forint principal (2.87 billion HUF) and receives the euro principal (10 million euros) from BANK B. During the term of the contract, at every payment periods' end (at the end of every 3 months in case of 3-month reference rates) interest payments are exchanged: BANK A pays the 3-month EURIBOR and receives the 3-month BUBOR minus the 2.4 per cent so-called basis swap spread.[9] Therefore the basis swap spread is the extra cost that the forint providing counterparty incurs for accessing the foreign currency liquidity. At the maturity of the CIRS transaction the principals are again exchanged with opposite direction as in the beginning of the contract.

The net present value of a CIRS transaction's two legs is, similarly to single currency IRS, close to zero accounting for the basis swap spread and calculating based on market yield curves. The difference from zero is the profit of the market maker. Movements in the two currencies' yield curves and the exchange rate compared to the path priced in at the beginning of the transaction changes the market value of the swap. The effect of yield changes is generally low due to the floating rates so it is the exchange rate that primarily impacts the CIRS market value. In the above example the forint's depreciation causes a loss for BANK A on the deal.

In a part of CIRS contracts the counterparties agree to settle changes in the swap's value due to the exchange rate at interest rate payment periods. Then, the notional of the contract is also modified ("FX reset") to take this into account. In the example, forint depreciation would increase the forint-value of the EUR notional repayment and EUR interest payments so that these cash flows would exceed in value the forint denominated cash flows BANK A receives. In case of FX resets, at the end of the interest payment period the notional amounts are adjusted. If the exchange rate increases to 300 HUF/EUR in our example then, after settlement between the two banks, from the next period BANK B has to pay interest calculated for a 3 billion HUF notional and has to repay this amount at the maturity of the contract. Thus FX resets equate the notional values at the end of each payment period and the value of the adjustment is settled between the two banks.

[9] In fewer cases the spread is calculated for the euro leg. In this case the spread is positive thus the counterparty receiving the EUR notional at the beginning of the contract has to pay an extra interest over the EURIBOR.

Calculating the market value of the swap and posting collateral ("margining") to account for changes in the value can be more frequent than the interest payment frequency, also daily, which basically makes the periodic adjustments in FX resets smoother. In these cases the period-end cash flow between the banks owing to the notional-correction of FX resets is small, because changes in the swap value have already been transferred to a margin account during the period.

Finally, it has to be noted that CIRS transactions may involve floating or fixed rate payments in both legs of the swap. Fixed vs. floating deals involve an open interest rate position and as such can be used to hedge interest rate risk exposure. As Section 4 details, however, the Hungarian market is dominated by floating vs. floating (basis swap-type) CIRS transactions, similar to the one seen in the above example, in which case there is no such interest rate position.

Forward rate agreements

In *forward rate agreements* (FRAs) counterparties agree to exchange the interest on a forward loan with a pre-determined fixed rate *(the FRA rate)* and the same forward loan with a future reference rate (e.g. BUBOR). The principals *(notional)* are not exchanged, only the difference between the reference interest rate on the fixing date and the FRA rate are settled between the counterparties. On the fixing date the reference rate is fixed and so the value of the derivative is also known at this time. By market convention, the counterparties do not wait with the settlement until the end of the transaction, but rather pay the discounted value of the FRA on the value date, the date on which the forward loan starts.

In effect the counterparties agree on the exchange of a fixed rate and (an opposite direction) floating rate loan's interest payment. The floating rate becomes known only on the fixing day, so that the two counterparties are exposed to interest rate risk between the deal date and the fixing date. Similar to single currency IRS, the counterparty that pays the fixed (FRA) rate is said to have a long position, since the value of such position changes positively together with the increase of the underlying, the reference rate. In market practice the fixed payer counterparty is also called the derivative product's buyer and in some cases the borrower, since this side pays the fixed rate on the principal. In this paper we use primarily the long/short terminology, which refers to the position being profitable in case of the reference BUBOR is increasing/decreasing.

The FRA transaction is effectively a one-period interest rate swap. The similarity of the two derivatives is also underlined by the fact that an IRS can be constructed from a series of FRAs with the difference that the periodically paid fixed interest rates will be different for the series of FRAs. One key difference between the two products lies in the length of the contract. FRA typical waiting periods range up to 1 year, while IRS transactions usually begin with the deal date and the maturity range starts at 1 year. This results in different typical durations for the two derivatives, and hence different magnitudes of entailed interest rate risk. In case of FRAs, duration is determined mainly by the tenor (which is at maximum 12 months due to available reference rates), whereas duration of IRS are close to the difference between the length of the contract and the floating rate payment period, which is at least 9 months but more commonly several years. Therefore an IRS involves significantly larger interest rate risk than an FRA with a similar notional amount.

Details of an FRA transaction are presented using the sample transaction in Chart 4. Four dates are of importance for an FRA contract: the deal date, the fixing date, the value data and the maturity date. The *deal date* is the point in time when details of the transaction are laid down in the contract. The reference rate is fixed on the *fixing date* and the transaction is settled on the *value date,* usually the second trading day after the fixing date. The value date is the only date when cash flow takes place. The *maturity date* is determined by the reference rate's maturity and points out the tenor of the forward loan. The *run-up or waiting period* is the period between the deal date and the fixing date, which is the period when there is material interest rate risk involved in the transaction. The period between the settlement date and the maturity date is called the *tenor* of the FRA. This matches the maturity of the reference rate and thus the underlying forward *loan's length.* The length of this period is important as it determines the duration of the derivative.

Chart 4
Example of an FRA transaction

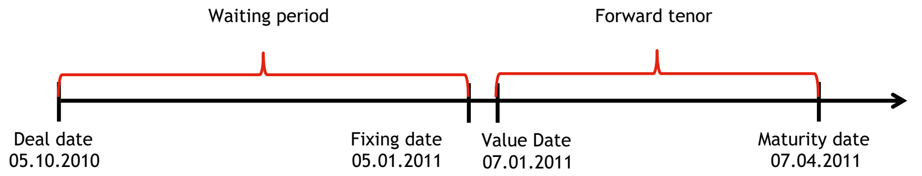
Transaction parameters (based on the K14 report):

Deal Date	Value Date	Maturity Date	Data Provider	Partner	Notional amount	Deal side	FRA fixed rate
05.10.2010	07.01.2011	07.04.2011	BANK A	BANK B	10 bn HUF	fix payer	5.43%

Dates, time periods:

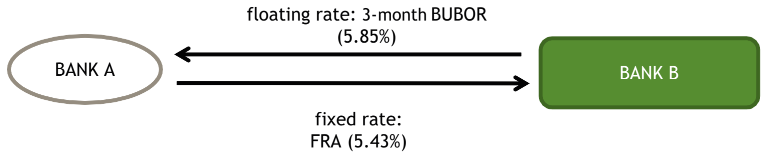
05.10.2010	Deal date	agreeing the parameters of the transaction
05.01.2011	Fixing date	fixing the reference rate (BUBOR rate)
07.01.2011	Value date (settlement/effective date)	settlement of the rate differential's discounted value
07.04.2011	Maturity/termination date	maturity of the loan referenced by the reference rate (this shows that the reference rate is the 3-month BUBOR)

05.10.2010–05.01.2011	Waiting period/Run-up period	time period between the deal date and the fixing date
07.01.2011–07.04.2011	Forward tenor	time period between the value date and the maturity date
05.10.2010–07.04.2011	Total maturity of transaction	time period between the deal date and the maturity date



Settlement:

FIXING:	BUBOR 3 month on the fixing date: 5.85%
Payment:	(BUBOR 3m-FRA fixed rate)/100*discount factor*(day/year)*Notional = (5.85-5.43)/100*0.9856*(91/360)*10 bn HUF = 10 463 636 HUF



The sample transaction above is a 3x6 FRA. The first number of the product denotes the run-up period (in months), whereas the second number refers to the total length of the transaction (between the deal date and the maturity date). The difference of the two – in this case three months – points out the FRA's tenor.[10]

In the example BANK A had a long FRA position. Since the reference rate, the 3-month BUBOR, was higher (5.85 per cent) on the fixing date than the FRA rate (5.43 per cent) the transaction yielded a profit for the long FRA counterparty, BANK A. Calculation of the settlement shows that the rate difference has to be multiplied by the discount factor and the notional amount and the annual interest has to be converted to 3 months, the tenor of the FRA.

[10] This terminology is different from forward rates of longer maturities. For example, the 5x5 year forward rates denote the 5-year forward rate in 5 year's time. Hence the second number of the product represents the tenor of the forward rate and is in years instead of months.

4 Hungarian interest rate derivative markets: general characteristics

Typical deals and liquid market segments

From a monetary policy perspective it is useful to know what type of contracts are actively traded in interest rate derivative markets. When analysing developments of price quotes (quotes which indirectly indicate future path of MNB base rate) it is important to consider the reliability of these indicators. Turnover statistics may be helpful in this respect.

Price quotes on broker screens and other market data providing sources (Bloomberg, Reuters) help dealers to assess the actual market price in active market segments. Another source of input about market demand and supply arrives directly from clients' orders and transactions. Through client activity dealers experience whether their quotes (and expectations) do create a balance between demand and supply; hence if these quotes are effectively an actual equilibrium market price. When dealers experience a more persistent demand- or supply-side pressure in the market, they modify their quotes accordingly. As a result, quotes will eventually reflect a more general market price rather than dealers' private expectations.

In contrast, there is no or scarce market feedback on inactive market segments, so that in these cases quotes more likely aggregate only dealers' estimates and expectations rather than those of the wider market. Furthermore, dealers also put less consideration into price quotes of market segments, which are uninteresting or irrelevant from a trading viewpoint, and thus these quotes may well be an imperfect aggregation even of dealers' private information.

Of the three analysed derivatives, forint interest rate swaps had the largest turnover. From January 2009 to December 2012 IRS with notional values totalling approximately 23,500 billion HUF were reported by domestic data providers. In terms of number of transactions, there were about 6,100 deals made in the full sample. The average notional was 3.8 billion HUF and daily average turnover was 26 billion HUF (Table 2).

The number of FRA transactions in the period was roughly half of that registered in the IRS market; 3-4 FRA deals per day were made on average as opposed to 6-7 IRS deals. However the average transaction size was significantly larger (16.5 billion HUF) and as a result the daily turnover was higher in the FRA market, averaging about 60 billion HUF per day. In four years the total notional amount of data providers' transactions exceeded 52,000 billion HUF.

Table 2
Turnover and transaction size: total market and most active segments

	HUF IRS		Currency IRS		FRA	
	Total	vs 6-month BUBOR	Total	3-month BUBOR vs 3-month EURIBOR	Total	3-month BUBOR
Number of transactions (full sample)	6,109	5,199	719	559	3,191	1,912
Turnover (full sample, trillion HUF)	23.5	17.5	7.0	5.2	52.6	31.6
Number of transactions (daily average)	6.8	5.8	0.8	0.6	3.5	2.1
Turnover (daily average, billion HUF)	26.0	19.5	7.8	5.8	58.4	35.1
Average transaction size (billion HUF)	3.8	3.4	9.8	9.3	16.5	16.5

Much less transactions and lower turnover was characteristic of the CIRS market. On a daily average there was less than one deal; 3 contracts were generated per week. The average notional was around 10 billion HUF and the total turnover was roughly 7,000 billion in the sample period.

Conversely, the other group of currency swaps, short-dated (fixed rate vs fixed rate) FX swaps, had a daily average turnover of approximately 500 billion HUF, 70-times that observed in the CIRS market. The net outstanding stock of FX swaps (the excess of FX liquidity receiving compared to FX liquidity providing swaps) was on the other hand of comparable magnitude to that seen in currency interest rate swaps (Section 5 gives a more detailed comparison of the two markets). The significantly larger turnover in the FX swap market is simply the consequence of the shorter maturity of these contracts, which necessitates frequent rollovers to maintain a constant open position. In case of CIRS, maintaining a constant open position requires fewer transactions, leading to a lower turnover.

It is worth briefly discussing how forint interest rate derivative markets' turnovers compared internationally. This can provide an indication of the relative liquidity of the Hungarian market. Countries in the wider EMEA (Europe, Middle East and Africa) region were considered here as they probably have a similar foreign investor group. To account for differences in country sizes numbers are also reported relative to GDP (Table 3). In terms of IRS contracts regional markets seemed to be similar in size, turnover was around 20-25 per cent of GDP. Yet, the forint market somewhat trailed regional peers, which may be a result of the relative sharp plunge in volume during the crisis. Turning to FRA markets, the forint market was larger in turnover (50 per cent of GDP) than others in the region. Both in case of FRA and CIRS markets the forint market's size was closest to that of the Polish zloty.

Ranking asset classes within countries by turnover, there was no apparent homogeneity in the region. In case of forint and zloty markets the FRA volumes exceeded those of IRS, the opposite of what was observed in case of the Czech koruna and the Israeli shekel. The CIRS market was usually the smallest in turnover of the three markets.[11]

Turning to maturity structures, 2-year contracts were the most popular in the forint IRS market: nearly half of transactions had a two-year maturity. The 5-year maturity had a share of 20 per cent; the 1- and 10-year segments each had 10 per cent shares of the market. There was a significant negative association between the size and the maturity of the contract (Chart 5). Most of the contracts (85 per cent) had the 6-month BUBOR as the reference rate, only 10 per cent was indexed to the 3-month BUBOR and the rest was pegged to the 1-month rate.

The two-year maturity was the most liquid one also in the CIRS market both by the number of transactions and the average transaction size. Contrasting the IRS market, there was a more even market share of maturities in the 1 to 5-year segment and average transaction sizes also pointed to similar liquidity. The longer market segment though had fewer transactions and smaller transaction sizes.

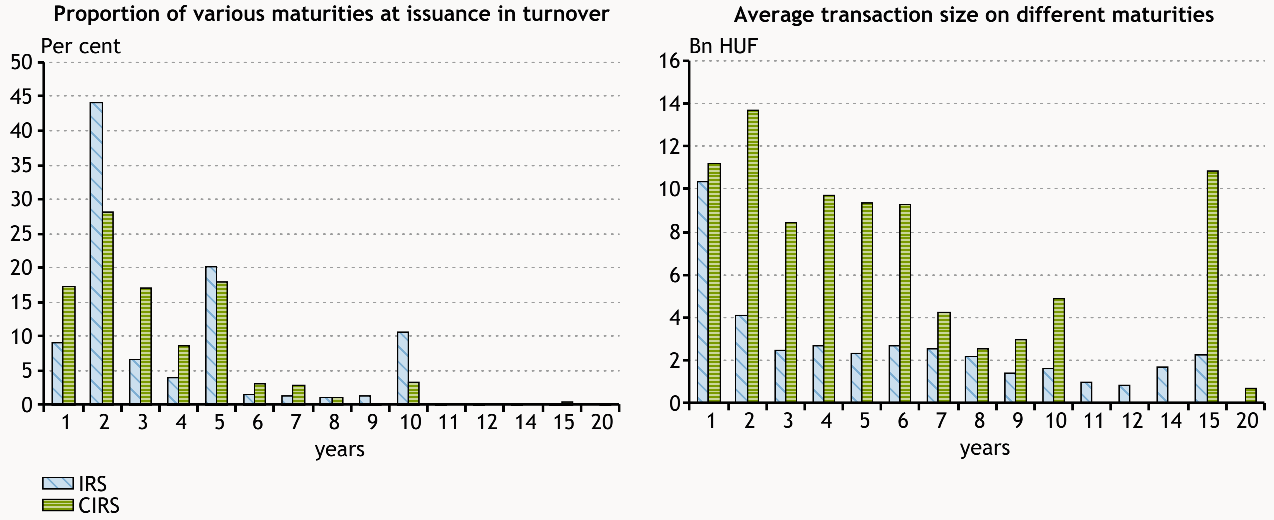
Table 3
Interest rate derivative turnover in 6 emerging market currencies in 2010

	IRS	FRA	CIRS	IRS	FRA	CIRS
	daily turnover (million USD)			annual turnover (% of GDP)		
HUF	107.1	243	45.5	20.8%	47.2%	8.8%
Czech koruna	208.9	191.1	30.1	26.4%	24.2%	3.8%
Polish zloty	483.0	774	180.6	25.7%	41.2%	9.6%
Turkish lira	1.7	–	1,908.0	0.1%	–	64.9%
Israel shekel	200.0	91.5	17.3	23.0%	10.5%	2.0%
South African rand	279.1	817.0	150.5	19.2%	56.2%	10.3%

Source: BIS (2010), UN.

[11] The market structure of the Turkish lira is strikingly different from that of other currencies. The high volume of the CIRS market could be a result of relative larger foreign issuances in this currency (e.g. Gereben and Mák, 2010). On the other hand the low volume of IRS suggests that some of the functionality of IRS was taken over by the CIRS market. This is possible if CIRS transactions are largely fixed vs. floating rate deals and do not entail notional exchange; hence do not require foreign currency liquidity.

Chart 5
Relative liquidity of maturities in the interest rate swap markets



Basis swaps (floating vs. floating rate contracts) constituted about 90 per cent of currency interest rate swaps. The fixed vs. fixed contracts had a 2 per cent, fixed vs. floating rate CIRS had an 8 per cent share. The forint floating rate was the 3-month BUBOR in most basis swaps; whereas the 3-month EURIBOR rate was most often referenced in the foreign currency leg (Table 4). 3-month USD LIBOR and 3-month CHF LIBOR contracts were also worth mentioning; the two together made up about 20 per cent of transactions.

A small part of CIRS contracts does not entail notional exchange; hence these only involve trading of interest cash flows during the life of the contract. We have information on this part of the market as of 2011 in the K14 report. Based on our data, around 7 per cent of CIRS contracts were non-notional exchanging; the majority of CIRS therefore involved notional exchange.

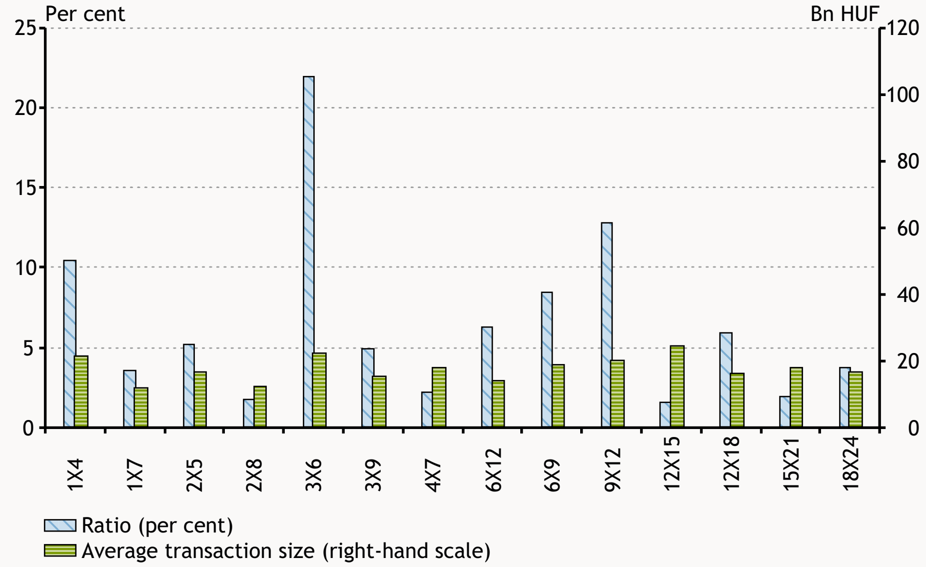
The time interval between the deal date and the value date, the run-up period, varied between 1 month and 2 years in the FRA market. Regarding the forward tenor, the 3-month contracts comprised two-thirds of deals (hence FRA contracts were mostly referenced to 3-month BUBOR); while one-third of deals had 6-month tenors. The market share of transactions with other than 3- or 6-month forward tenors was negligible. Overall, the 3x6, the 9x12 and the 1x4 contracts were the most popular FRA transactions (Chart 6). Contrary to the interest rate swap markets average transaction size seemed to be unrelated to maturity.

"Forward start" IRS and CIRS transactions are worth briefly mentioning. In these transactions the first interest payment period does not begin on the deal date, but only later: with the delay sometimes being several months. About 5 per cent of IRS and 14 per cent of CIRS transactions had the forward start feature. Just a few domestic banks dealt with such transactions. Based on market information these transactions usually had a speculative motivation and were only occasionally connected to the hedging of future open positions. For instance, in case of forward CIRS transactions,

Table 4
Share of foreign currency reference rates in the CIRS market
(per cent)

	CHF LIBOR	EURIBOR	USD LIBOR
1-month	0.08	0.08	0.00
3-month	5.19	73.86	16.36
6-month	1.01	1.32	1.93
12-month	0.18	0.00	0.00

Chart 6
Relative liquidity of FRA market segments



expectations about the future CIRS spread (Chart 3) may be a motivation to trade. When expecting this spread to decline, the trader can enter a forward contract that guarantees receiving the spread in the future, while entering another, opposite direction, spread-paying, contract before the value date. If the spread does decline then this combination of trades wins a profit.

Pricing

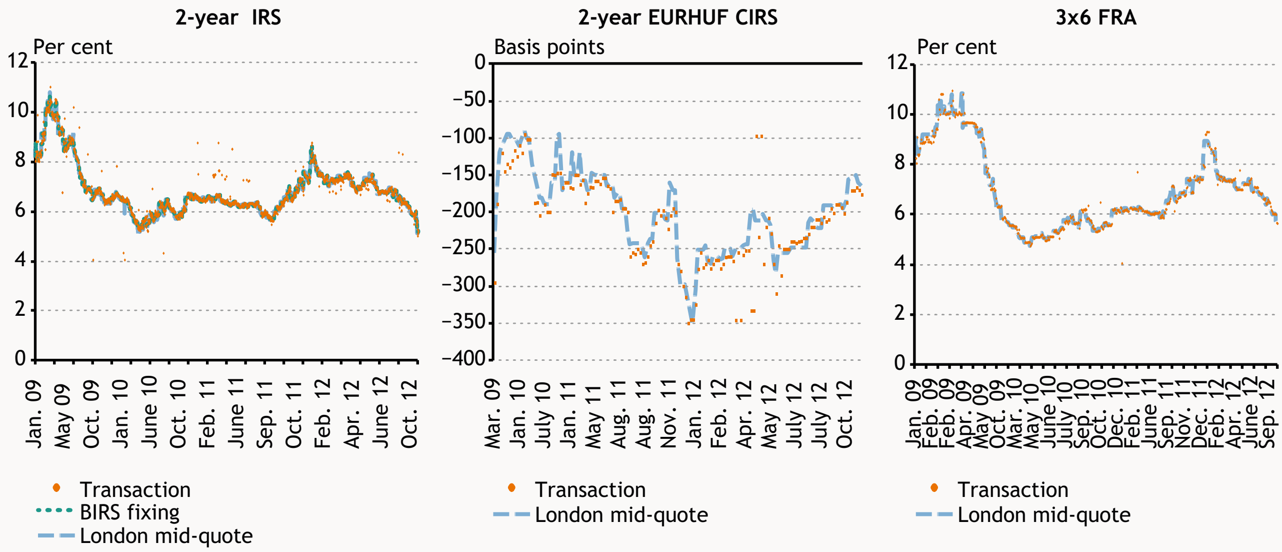
One of the advantages of the K14 data set is that it provides information on the pricing of transactions. To analyse traded transactions' prices we compared them with BIRS interest rate swap fixings (rates that MNB fixes each trading day at 10 a.m. based on domestic dealers' quotes) and closing quotes in the London market available from Bloomberg.

Most trades' prices fluctuated around daily fixings and quotes in all three markets; they did not materially differ compared to those (Chart 7). All three markets however exhibited several outliers. A part of these outliers were systematic reporting errors (these could be corrected), another part was due to deviation from standard deals (there were special, technical features of the contract not reported under K14, which influenced pricing) and there was no information on the source of a third part of errors.

Examining the distribution of differences between quotes and transaction prices, in most of the transactions this metric was below the size of bid-ask spreads. This was true independent of the time period – hence also in episodes of larger financial market turbulence –, and there was no statistically significant connection with either transaction size or maturity of contracts.

The data also provides a means to calculate the magnitude of extra spread compared to mid-quotes that data providers, i.e. domestic banks, paid to counterparties. To calculate such an extra spread the difference between the transaction price and the quote has to be corrected with the sign of the transaction. For example, in case of an FRA transaction, in which the data provider takes the long position, i.e. pays the fixed FRA rate, the FRA rate minus the mid-quote shows the extra spread that the data provider pays compared to what was available in the market. We label this amount the extra spread paid. On the other hand, in the case of a short FRA position, in which the fixed FRA rate is received, the mid-quote minus the FRA rate (so the negative of the previous difference) shows how much less the data provider receives compared to market quotes, which therefore is also a measure of the extra cost (extra spread) the data provider had on the transaction.

Chart 7
Quoted and traded prices in different markets



Our analysis shows that neither the direction of trade, nor the transaction size, nor the years to maturity had statistically significant (linear) effects on extra spreads based on usual Pearson-correlation measures, as these values were all close to zero (Table 5).

We also investigated if there were any notable differences of extra spread paid across domestic banks. This relates to the issue of trading motivations, which we will turn to in more detail in a later part of the section. Intuitively, those market participants who act as market makers should be receivers of extra spreads (negative extra spreads paid) for providing liquidity to the market, in effect winning the bid-ask spread. On the other hand, market participants who are users of the market, either by building speculative open positions or by hedging, should pay extra spreads for using market makers' provided liquidity.

We cannot reveal the results due to sensitivity of such information, but in general it can be said that the data does not support this intuition. Market participants who were closer to being market makers (based on both K14 data as well as market anecdotes) did not receive extra spreads. Nor could it be shown that smaller market players, likely to be market users, would have paid extra spreads. Although in the latter case there are too few observations to backup any conclusions.

There are two main reasons in our opinion for this seemingly surprising result. First, as we will later see, there are no "true" market makers among domestic banks, the data providers, in either interest rate derivative markets. Even the larger market players occasionally build open positions and hedge balance sheet exposures; and act as market users when doing so. The other explanation is related to the fact that the bid-ask spread in these markets is low compared to intraday volatility of quotes. The intraday variation causes the calculation of the extra spread to be imprecise, since the transaction price is not compared to the mid-quote relevant at the exact time of the transaction, but rather to the daily close.

Table 5
Extra spread paid by data providers and its correlation with contract features

IRS	**Fix payer (dummy)**	**Transaction size**	**Years to maturity**
	0.07	−0.01	0.01
CIRS	**Foreign currency providing spot leg (dummy)**	**Transaction size**	**Years to maturity**
	−0.03	−0.19	−0.09
FRA	**Fix payer (dummy)**	**Transaction size**	**Years to maturity**
	0.01	0.03	−0.02

Table 6
Extra spread statistics by market and partner type

Partner type	IRS market			CIRS market			FRA market		
	Average	Median	Standard deviation	Average	Median	Standard deviation	Average	Median	Standard deviation
Domestic credit institution	0.0	−0.5	9.7	−0.6	−4.0	8.6	−0.1	0.0	9.8
Domestic fund manager	2.0	−0.6	7.1	–	–	–	−5.5	−4.0	4.7
Domestic non-financial	4.5	0.3	10.8	–	–	–	–	–	–
Large international bank	−0.3	−0.5	9.0	7.5	8.0	12.3	−0.7	0.0	10.3
Own parent	0.4	0.5	8.0	−8.9	0.0	41.5	1.4	−0.5	16.5
Other domestic bank's parent	−1.4	−0.5	9.0	10.2	6.3	17.5	−0.8	−0.2	8.8
Other foreign	1.5	1.3	10.0	14.8	12.7	8.9	0.5	0.0	15.3
Total market	0.2	0.0	8.5	−3.3	2.0	36.3	−0.1	−0.0	11.7

Also, extra spread statistics do not seem to be significant when segmenting transactions by counterparty types. In most cases the average/median extra spread is not different from zero in view of the standard deviations. It is only in the CIRS market where we can discern an extra spread paid to "other foreign" counterparties (Table 6).

Extra spreads were also insignificant, when segmenting transactions in time (to different quarters).

Market structure

Net derivative positions and duration indicators can be calculated for each reporting entity by aggregating their total transactions outstanding at any given point in time. Since data providers report the counterparty's name for each transaction it is possible to assess bilateral positions between financial entities and, also, sectoral exposures. Based on data on the direction of transactions and durations, the market risk of portfolios can be calculated, i.e. what profit or loss reference rate increases/decreases or movements in the exchange rate could cause for the individual bank or a given sector. Of course, these calculations only reveal risk involved in interest rate derivative portfolios not total balance sheets of market participants: the profit and loss on other balance sheet items may counteract (or add to) the effect of derivative valuation changes.

Table 7 summarises data providers' (domestic banks') net open interest rate derivative positions on 31 December 2012. From the sectoral segmentation it is obvious that domestic entities primarily transacted with foreign counterparties; deals within the sector ("Domestic credit institution" row) and contracting with other domestic entities made up less than 10 per cent of total transaction volumes.

The further segmentation of non-residents shows that large international banks (about 10-20 global names) and parent institutions of domestic entities were the usual counterparties within the sector. There was a relatively smaller volume of transactions with other foreign entities.

Although domestic banks mostly dealt with their own parents, transactions with parent institutions of other Hungarian banks are also noteworthy ("Other domestic bank's parent" row). Market participants informed that the motivation of such deals is to avoid counterparty limits, which have become much more stringent during the crisis. Due to limits domestic banks can only take on a limited position with respect to other domestic banks. Yet the parent institution of one of the banks can help by intermediating in the transaction. In such limit-avoiding transactions the parent institution enters into a derivative transaction with its subsidiary and simultaneously enters into a derivative transaction with the other domestic bank. The latter transaction is identical to the first one except for the two having opposite directions: the parent bank being short in one trade and long in the other. The combination of the two deals hence does not result in any market (interest rate or exchange rate) risk for the parent institution, but it does entail counterparty risk with respect to both Hungarian banks. On the other hand the deals do not involve counterparty risk for the two domestic banks regarding each other (only with the better rated parent), whereas in terms of market risk, the two banks' position is identical to the case of having dealt directly with each other.

Table 7
Data providers' total derivative stocks outstanding vis-à-vis different sectors
(31 December 2012)

	IRS (Bn HUF)			CIRS (Bn HUF)			FRA (Bn HUF)		
	Long (fix payer)	Short (fix receiver)	Total	Spot foreign currency receiver	Spot foreign currency provider	Total	Long (fix payer)	Short (fix receiver)	Total
Domestic credit institution	**164**	**164**	**328**	**7**	**7**	**13**	**378**	**378**	**755**
Other domestic total	**54**	**58**	**112**	**95**	**6**	**101**	**0**	**7**	**7**
Domestic fund manager	31	14	44	0	0	0	0	7	7
Domestic non-financial	16	25	41	13	4	17	0	0	0
Category unknown (deal before 2009)	7	19	27	82	2	84	–	–	0
Non-resident total	**9,042**	**9,861**	**18,904**	**3,379**	**1,833**	**5,212**	**3,378**	**3,454**	**6,832**
Other domestic bank's parent	124	273	398	636	6	642	135	140	275
Large international bank	768	1,287	2,055	642	1,022	1,664	1,410	1,365	2,775
Own parent	5,511	5,852	11,363	1,883	650	2,533	1,823	1,924	3,747
Other foreign	458	304	763	159	11	170	10	25	35
Category unknown (deal before 2009)	2,181	2,144	4,325	84	157	241	–	–	0
Total	**9,260**	**10,083**	**19,343**	**3,481**	**1,846**	**5,327**	**3,756**	**3,839**	**7,594**

Note: As described in Section 2 the initial reporting of outstanding contracts at the beginning of 2009 was less detailed than daily reports since. As a consequence, exact sectoral categorisation is not possible for contracts entered into before 2009.

In sum, the positions resulting from direct trades between domestic banks were in magnitude similar to those of the indirect limit-avoiding trades in IRS market (328 and 398 billion HUF), but direct trades were larger in case of FRA (755 versus 275 billion HUF) markets, if we consider all transactions with other banks' parents as such trades. The indirect trades involving the parent institutions were much more important than direct deals in the CIRS market. This suggests that counterparty limits could be more stringent in the CIRS market than in the other two, possibly a consequence of larger counterparty risk involved in CIRS transactions due to the exchange of notional and due to exchange rate risk.

The transaction volumes with parent institutions were much larger than the volume of trades with other banks' parents – the indirect limit-avoiding trades. On one hand there could be opposite direction market risk exposures of parent institutions' and subsidiaries' balance sheets, which could explain some intra-group derivative trading. However, based on market information, most of such trades were also deals where the parent institution acted as an intermediary. Only in these cases the other side of the trade was a non-resident entity. Thus in such deals the parent institution enters into a derivative transaction with the non-resident that is identical to the trade with the subsidiary with the exception of the trade's opposite sign. Then, again, the counterparty risk is mostly borne by the parent institution, while the market risk affects the Hungarian subsidiary and the non-resident counterparty.

It has to be stressed that the K14 report only provides information on a segment of the total forint interest rate derivative market, because its scope extends only to transactions that involve domestic credit institutions. (Based on some market participants' estimates trading of forint derivatives outside Hungary, primarily in London, could be around 80-90 per cent of the total market.) The share of global names is probably larger in the external market, while that of parent institutions are probably lower. It is possible that Hungarian fund managers and non-financial corporations ("Other domestic" rows) have additional deals outstanding with foreign counterparties that cannot be observed in the K14 report. (Though, domestic bankers we queried did not consider this likely.) Non-residents other than large global names and parents of Hungarian credit institutions probably deal with foreign market makers not Hungarian banks, so that the small transaction volumes seen in the ”Other non-resident” row could conceal a larger true share in the total forint interest rate derivative market.

To check if domestic banks had different types of deals with various sectors, we examined differences in transaction maturities and transaction sizes. Pairwise sectoral means were compared by t-tests, while pairwise medians were compared by Mann-Whitney tests.[12]

Regarding transaction sizes the majority of tests indicate that contracts with non-residents were generally larger than deals between domestic banks, while rare transactions with other domestic entities (domestic fund managers, non-financial corporations) were much lesser in size compared to both non-residents’ and domestic banks’ deals. Transactions with parent institutions were larger in size than those with global names in IRS and FRA markets, but were smaller in the CIRS market.

In case of simple IRS and currency interest rate swaps, transactions with non-residents on average had longer maturities besides the larger size, so partly this sectoral variation can account for the positive correlation between maturities and transaction size. Within the group of non-residents, parent institution deals had longer maturities than deals with global names. Interestingly, deals with domestic non-bank clients had longer maturities (besides low transaction sizes). In the FRA market there were insignificant differences in run-up periods and forward tenors across sectors based on either the t-tests or the Mann-Whitney tests.

Market concentration and heterogeneity of open positions

We next turn to the discussion of two subjects closely related to market structure. First, we briefly examine the concentration of Hungarian interest rate derivative markets. Then, we assess measures of heterogeneity in net open positions.

All three interest rate derivative markets were characterised by large concentration: a few data providers were responsible for most of the transactions. The Herfindahl–Hirschman index, calculated as the sum of squared market shares, was largest in the single currency interest rate swap market. The index was close to 40 per cent. The currency interest rate swap and forward rate agreements market had lower concentration measures. Concentration increased in case of IRS and FRAs and decreased for CIRS transactions (Table 8) during the sample.

In international comparison (compared to developed markets) this level of market concentration is high. Based on the publication BIS (2012) similar concentration measures for major currencies were in the 5 to 25 per cent range for IRS and FRAs in the past years. For the EUR market they were closer to the bottom of this range. It is however important to once again stress that data based on the K14 report only extends to transactions of Hungarian data providers. Probably forint interest rate derivatives as a whole – thus also including the larger London market – have different concentration characteristics.

Table 8
Market concentration
(Herfindahl–Hirschman index)

	IRS	CIRS	FRA
2009	43%	29%	18%
2010	34%	35%	20%
2011	42%	38%	24%
2012	57%	20%	30%
Full sample	44%	28%	22%

[12] The null hypothesis of t-tests is the equivalence of the two groups’ means. In the current application the relevant hypothesis is that data providers’ contracts with two different sectors had equal maturities/transaction sizes. Mann-Whitney tests have a similar concept only these tests compare medians instead of means, which are more robust indicators, less influenced by outliers.

Table 9
Quantiles of data providers' net positions

Market	Percentiles	1 Jan. 10	1 Jan. 11	1 Jan. 12	1 Jan. 13
IRS	10%	–258	–169	–286	–306
	25%	–81	–38	–203	–186
	75%	54	75	3	9
	90%	102	153	20	84
CIRS	10%	–298	–248	–227	–440
	25%	–198	–177	–146	–222
	75%	0	0	0	0
	90%	48	139	240	176
FRA	10%	–123	–209	–283	–124
	25%	0	–191	–88	–73
	75%	20	-5	0	58
	90%	37	1	35	76

Turning to assessing heterogeneity of open positions, a simple way to approximate market risk exposure of data providers is to compare outstanding volumes of long and short contracts in case of IRS and FRAs, and to compare volumes of foreign currency receiving and providing contracts in case of CIRS. From Table 7 it is apparent that on 31 December 2012 the volume of short IRS contracts was larger than that of long contracts suggesting that domestic banks' aggregate IRS portfolio positioned in favour of lower rates, so that its value would increase when reference rates decreased.[13] There was a similar direction, albeit insignificant, short exposure to interest rates in aggregate FRA positions. In the CIRS market, in line with the Hungarian banking sector's balance sheet characteristics, foreign currency receiving swaps (or otherwise: forint liquidity providing swaps) dominated. The net long IRS position was held partly versus large global banks and partly vis-à-vis parent institutions. In the CIRS market the foreign currency liquidity was provided in net terms mainly by parent banks, and interestingly, on this date, domestic credit institutions were net foreign currency providers to global banks.

Nonetheless net positions (differences between long and short IRS/FRA and difference between foreign currency receiving and providing CIRS) were significantly smaller in volume compared to the total notional of outstanding contracts (sum of long and short IRS/FRA and sum of foreign currency receiving and providing CIRS). This indicates that opposite direction contracts of domestic banks versus other sectors (mainly non-residents) largely cancelled out in all three markets. Relatively small net positions were partly the result of opposite direction trades within banks but also across banks in the whole domestic banking sector.

Due to data protection reasons it is not possible to show net positions of domestic banks, not even in subgroup aggregates. However measures of cross-sectional variation can be provided. There was considerable heterogeneity in net positions of domestic banks in all three interest rate derivative markets (Table 9). In all three years and in all three markets the upper and lower deciles (upper and lower 10th of the distribution) but often even the upper and lower quartiles (25 per cent of distribution) were of opposite sign.

Thus opposite direction exposure of domestic banks partly cancelled each other out. This statement is true even in the CIRS market, and is in contrast with the general perception of domestic market participants that Hungarian banks are all positioned in the same (foreign currency receiving) direction.

[13] In the next section the measure of market risk exposure will be refined by using basis point values instead and, there, we will also elaborate on the dynamics of such exposures.

Motivations for trading in Hungarian interest rate derivatives markets

Why market actors participate in interest rate derivative markets is an important issue to investigate. On one hand forint IRS and FRA markets convey essential information for monetary policy on future short-rate expectations, thus it is worth knowing if these markets' price quotes are reliable indications of expectations or if there are structural factors (for example, systemic demand to hedge due to balance sheet exposures) that may bias prices. Compared to dealing in government securities, FRA and interest rate swaps do not require initial liquidity allowing more flexible reaction to changes in expectations. In the CIRS market, the main question is if and how domestic players use this instrument to hedge market risk exposure due to balance sheet asymmetries.

Our approach was on one hand directly interviewing banks (employees in treasury and/or asset-liability management divisions) and, on the other hand, analysing K14 report data. The benefit of gathering information based on interviews is trivial, but data can also help in several respects. The K14 data set allows us to observe the magnitude, frequency and direction of trading for each data providing bank and the net positions they obtain. This can separate "true" market makers from market users (of either speculative or hedging purposes), because the former is expected to trade frequently and in both short and long directions as they aim to profit from the bid-ask spread, rather than from taking on positions. On the other hand, those trading with a speculative motivation endeavour to take the position in the market that they deem profitable due to future rate movements, while those trading to hedge balance sheet exposures also enter contracts on one specific side of the market. Besides the K14 report, other bank reports to PSZÁF, the financial supervisory body, may also provide information to address the issue.

Banks primarily used the FRA market with a speculative purpose based on both market participants' telling and K14 data. Thus, market participants have aimed to profit from taking on long/ short positions that increase in value if reference rates increase/decrease. (In Section 5 we investigate if banks' FRA positions were consistent with banks' analyst forecasts and if FRA positions' and analyst forecasts' dispersion measures were related.) Though trading volumes were diverse across domestic banks, their open FRA positions were typically significant compared to the total volume of FRA contracts, so that they could be considered to take a specific side of the market with FRA deals. Only a few domestic banks had frequent and both short and long-sided trades (what could be expected from true market makers), but even these banks held significant net positions compared to the total volume of trades, therefore they could not be considered to be "pure" market makers. Hedging was only scarcely mentioned as a motivation for FRA deals.

The IRS market was the most diverse out of the three interest rate derivative markets in terms of trading motivations. Market making, speculative and hedging motives were all relevant according to interview answers. Just like in FRA markets, market making was not the only motivation for participation in case of any domestic banks. Those banks who conducted active market making (where we saw frequent two-sided dealing in transactions data) did not seem to aim at perfectly closing out open positions due to market liquidity or other considerations, thus they all held open interest rate positions to some extent. Though, the sizes of open positions compared to the total contract volumes outstanding were much less than in case of FRAs. (Due to the greater sensitivity of IRS to rate changes for similar notional amounts, typically there were larger interest rate risk exposures in IRS than FRA portfolios.) In interviews, several banks called attention to the tendency that in recent years market making has shifted from domestic players increasingly towards foreign participants. One reason was internal risk management rules of several market participants that allowed dealing only with members of the London Clearing House. As most Hungarian banks did not have such membership they lost such clients to non-resident clearing house members. Another reason that some mentioned was the strict counterparty and deal size limits that parent institutions' risk management imposed on domestic subsidiaries, which has been a major impediment to market making.

Most of the data providers, the domestic banks, held an open interest rate position in the interest rate swap market either to speculate on future rate movements or to hedge balance sheet positions. Individual cases were mixed with regard to motivation, gross and net volumes and direction of outstanding open positions. Regarding speculation two distinct cases were apparent from interviews: some used IRS to bet directly on future interbank rate movements, while others used IRS in combination with government bond dealing to anticipate movements in the difference between bond yields and IRS rates, the asset swap spread. Banks' balance sheet reporting to PSZÁF suggests (3DB tables on derivative contracts) that the speculation motive could have been stronger than the hedging motivation in the IRS market as the largest share of interest rate swaps were reported as trading book non-hedging purpose items.

In interviews, however, the same number of banks talked of a hedging motive next to a speculative one, though the relative importance of the two has varied across entities. Hedging purpose IRS deals were also varied regarding the direction of the positions among domestic banks.

The quarterly PSZÁF report on the duration of banks' balance sheet items (9A tables)[14] suggests that the duration difference between the asset and liability sides of Hungarian banks' balance sheets has been low and the interest rate sensitivity mismatch has been small. The balance sheet items concerning traditional banking practice, lending and deposit collecting, have not generated significant hedging need. On one hand even long-term loans have been indexed to short rates (BUBOR or foreign short-term reference rates) and thus have had low durations, and on the other hand deposits have also usually been considered low duration items, although this is subject to a view on depositor behaviour.

The hedging motivation for interest rate swaps were therefore usually related to the government securities portfolios on bank balance sheets' asset side or to the fixed rate bond issuances on the liabilities side – in case of the few Hungarian banks where this has been material. Those market participants, who aimed to hedge the interest rate risk involved in government bonds (market rate increases reduce the value of fixed income products and thus the value of government securities portfolios) entered into long IRS contracts, which generate valuation gains when market rates rise. In contrast, fixed rate notes issued by banks imply the need for short IRS positions. Since market anecdotes indicated that the foreign market segment of forint interest rate swaps has been an order-of-magnitude larger than the domestic segment, information on domestic banks' balance sheet does not aid us in inferring how much bias there could be in prices due to systemic hedging activity. Nonetheless, if it is also true of foreign market players that hedging activity is mainly connected to hedging the risk exposure of forint denominated government securities then this indicates a systemic structural demand for fixed rate paying, long IRS positions, which increases the IRS rate. Thus in this case structural demand may bias IRS rates upward compared to rates based on expectations purely.

According to interviews, the CIRS market has been used by domestic banks for two purposes. On one hand they have used CIRS deals to hedge open exchange rate position in balance sheets, a result of FX denominated liabilities being only a fraction of FX denominated assets. On the other hand CIRS have been used to manage foreign currency liquidity, the FX funding needed for redemptions of FX liabilities and for margin calls in case the forint weakens. The mostly one-sided positioning by domestic banks (foreign currency receiving currency swaps) has kept the spreads of basis swaps high (in absolute value). The price of obtaining FX funding in this market has ranged from 100 to 350 basis points since the crisis. Although, contrary to the general belief of market participants interviewed, the net foreign currency receiving position of domestic banks on the aggregate has been low vis-à-vis non-residents it is true that most domestic banks positioned in the FX receiving direction and only a few domestic banks positioned on the other side to take advantage of the high basis swap spread.

It is important to emphasize that the high (absolute) basis swap spread is not the price that Hungarian banks have to pay for a relative larger credit risk. There were plenty of transactions where Hungarian banks entered CIRS contracts on the opposite side, providing FX funding to high credit-quality non-residents and in these cases non-residents also had to pay the large price of obtaining FX liquidity. In such deals domestic banks received the large CIRS spread. The persistence of large CIRS spreads has partly been the consequence of market players not being able to access enough FX liquidity, which would be necessary to exploit and thus reduce the spread (FX liquidity can be swapped into forints to buy forint assets yielding a profit).

Another explanation for the existence of the large basis swap spread is that there has been a significant difference between the true and observed value of short-term Hungarian (BUBOR) and foreign (LIBOR/EURIBOR) interbank rates. On one hand, in past years BUBOR, and in certain periods/maturities also EURIBOR rates, were not effectively traded and thus could have been a biased measure of the true cost of short term uncovered loans between banks, the interest rate of which they are meant to represent. If, for example, BUBOR was biased upwards from the true value of cost of forint loans

[14] The 9A "interest rate risk" tables are more relevant for our analysis than the 4A "maturity correspondence" reports since the former deals with duration measures and so reports the time to repricing of floating rate items rather than the time to maturity of the contract. The shortcoming of the 9A report, however, is that it reports only items in the banking book and so cannot be interpreted as measuring the total balance sheet interest rate risk exposure of banks.

– or EURIBOR was biased downwards from the true cost of acquiring EUR interbank loans – then, this could already result in a basis swap spread of the sign experienced in the EUR/HUF CIRS and FX swap markets.

On the other hand the spread can be a consequence of the difference in the relative credit risk that interbank uncovered loans represent, i.e. that the credit risk of Hungarian banks reporting BUBOR is higher than the credit risk of banks reporting EURIBOR rates. Because FX resets and daily margining reduce counterparty risk, the credit risk of EUR and HUF legs of FX swap and CIRS transactions can be considered to be close to equal. Then, the difference between the risks involved in the uncovered interbank rates (BUBOR and EURIBOR) as opposed to close-to-equal risk in currency swaps can be an explanation for the existence of currency swap spreads. Finally, the model of Csávás (2012) argues that the covered interest parity is impaired, and basis swap spreads exist, because uncovered loans are risky and there is a cost to hedging default risk of interbank loans and government securities.

5 Evolution of Hungarian interest rate derivative markets

Changes of market characteristics in the past years

The three analysed derivative markets' turnover, liquidity and aggregate volume statistics displayed distinct dynamics in the four years of the sample period.

Interest rate swaps experienced a boom before the crisis, then, the events of 2008–2009, caused a considerable decline. K14 transactions data prior to 2009 are not available, but information based on market interviews and outstanding volume changes (Farkas et al., 2004; Csávás et al., 2007) suggest a daily turnover of around 50 billion HUF in 2004 and 2006. Derivative market statistics published by BIS in 2007 also indicated a 50 billion HUF daily turnover in April 2007. Csávás et al. (2007) claimed that the outstanding total volume of IRS contracts was 12,000 billion HUF at the end of 2006 and that it showed accelerating growth with a rate of 5,000 billion HUF per year.

In early 2009, K14 data revealed a total of 25,000 billion HUF in outstanding contracts by notional. This quantity suggests that the pre-crisis growth rate probably continued up until the events in autumn 2008. At the end of 2008 the escalation of the financial crisis and its spreading to Hungary has impeded IRS market growth for two reasons.

On one hand, the jump in government bond yields was larger than that seen in swap rates causing a widening of the so-called asset swap spread. A part of market participants, who intended to hedge the interest rate risk of government bond portfolios via (long) interest rate swaps have been disappointed in the financial derivative, because IRS valuation gains did not fully counter the asset side valuation loss caused by bonds. (It is important to note here that a considerable part of bond portfolio losses was still hedged by interest rate swaps, so those who had long IRS positions were naturally much better off than those who did not hedge exposures at all. The erosion in confidence regarding IRS was thus more related to its imperfectness as a hedging tool.)

The other cause of interest rate swaps' decrease in popularity was the change in banks' internal risk management rules. Risk management divisions imposed stringent counterparty limits, which considerably decreased the maximum interest rate position that could be held vis-à-vis market actors with weaker credit quality. The list of possible counterparties for transactions shortened and the volume of new contracts significantly decreased. Yet, because the demand for interest rate derivatives was still larger than what could be contracted with traditional partners based on new risk management constraints, this resulted in the expansion of the counterparty-limit-avoiding transactions mentioned before. In such transactions, domestic banks contracted with each other and foreign counterparties via the intermediation of a large foreign bank (typically one of the parent institutions).

Table 10 and Chart 8 document the fall in IRS market volumes. The outstanding stock of contracts continued to decrease until the end of 2010 realising a 40 per cent plunge in volume compared to the beginning of 2009. Comparison of redemptions and new contracts in the first half of 2009 (3,400 versus 1,200 billion HUF, see Chart 8) reveals the magnitude of the drop in turnover, because quarterly redemptions are a rough indication of how much interest rate swaps were on average initiated per quarter before the crisis. The difference between redemptions and new contracts suggests the difference between past and new turnover volumes. From the comparison with new contract volumes in 2009 it seems that turnover fell to around a third of pre-crisis values.

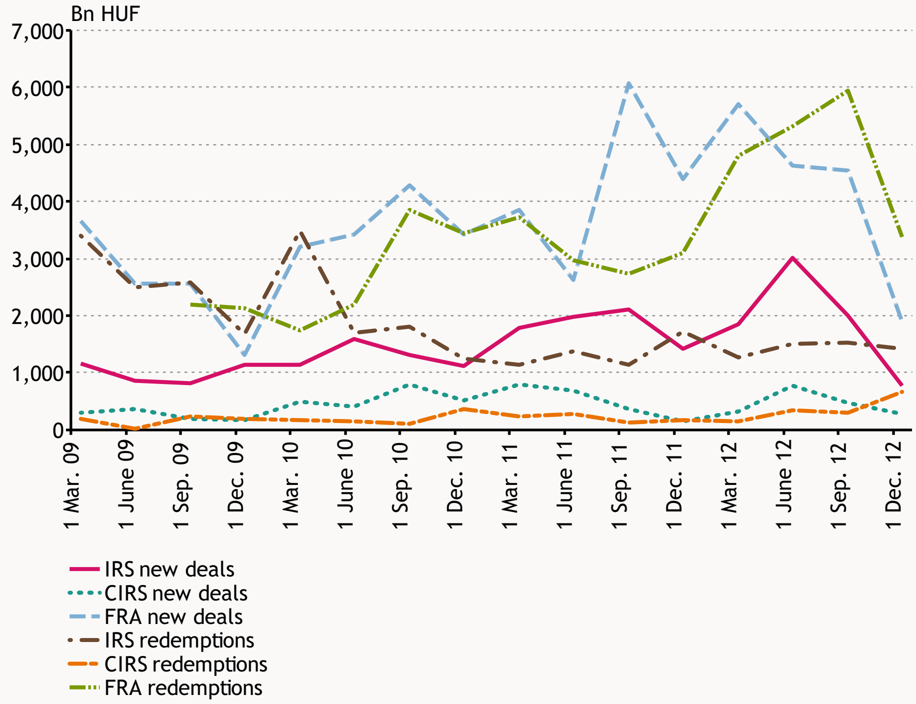
Table 10
Outstanding contract volumes, turnover and transaction size

	Total stock outstanding (bn HUF)			Number of transactions (per 6-month)			Average transaction size (bn HUF)		
	IRS	CIRS	FRA	IRS	CIRS	FRA	IRS	CIRS	FRA
31 Dec. 08	25,355	1,926	–	–	–	–	–	–	–
30 June 09	21,494	2,377	3,524	275	32	198	3.1	11.1	12.9
31 Dec. 09	19,184	2,329	3,060	374	29	85	3.0	5.8	15.4
30 June 10	16,740	2,920	5,778	359	31	247	4.4	13.3	13.9
31 Dec. 10	16,125	3,749	6,168	316	32	194	3.6	16.2	17.6
30 June 11	17,394	4,701	5,962	503	49	141	3.9	13.9	18.6
31 Dec. 11	18,061	4,916	10,597	377	21	202	3.8	7.5	21.7
30 June 12	20,134	5,506	10,799	566	80	213	5.3	9.7	21.7
31 Dec. 12	19,959	5,296	7,913	182	41	90	4.4	6.8	20.9

In the beginning of 2011 the trend changed, new contracts exceeded redemptions and thus the outstanding stock of IRS contracts began a gradual increase. Even renewed market stress in the second half of 2011 did not halt growth and so the total notional of outstanding contracts reached 20,000 billion HUF at the end of 2012. The expansion in IRS market volumes was predominantly the consequence of a rise in number of new contracts. Average transaction sizes did not change markedly over time (Table 10).

The dynamics of volumes in the CIRS market reveals a completely different picture. New contract volumes exceeded those of maturities throughout the period under review and the volume of outstanding contracts increased from around 2,000 billion HUF in early-2009 to above 5,000 billion HUF at the end of 2012. As in the case of IRS, though, the change in outstanding CIRS stocks and turnover was due to changes in the number of contracts. Average contract sizes were volatile and did not show clear tendencies. The more cautious foreign currency liquidity management of domestic banks and the aim to use longer maturity currency swap contacts was the primary cause of growth in the CIRS market.

Chart 8
New contract and redemption quarterly volumes in IRS, CIRS and FRA markets



Finally, statistics of the FRA market also showed an increase in outstanding stocks and turnover in most of the period. As mentioned before, data are not available on the initial outstanding stock of contracts at the launch of the report. Cumulated values based on turnover statistics may on the other hand represent true outstanding volumes satisfactorily only from autumn 2009. Based on such accumulation, the outstanding volume of FRA contracts increased threefold between the second half of 2009 and mid-2012.

Table 10 reveals that, in contrast with the other two markets, the growth of average contract size played an important role in the increase in turnover. There was also a jump in number of transactions in the second half of 2011, which could have been a consequence of increased market uncertainty concerning the domestic interest rate outlook.

The drop of transaction numbers and volumes in both IRS and FRA markets in the second half of 2012 confirms market participants' reports that activity significantly declined in forint interest rate derivative markets in 2012, which they partly attributed to increased risk aversion. In addition, an important change was the more considerable role of the London Clearing House (LCH from herein) as a central counterparty in forint interest rate derivative markets.[15] We do not possess information on transactions between non-residents – these are not included in MNB reports –, but market participants' information suggests that about 90 per cent of London dealings (which has constituted the majority of the total market) already took place via LCH as the central counterparty at the end of the period.

Trading with central counterparties increased due to regulatory reforms. Experiences of the financial crisis pointed out the need to increase the transparency and regulation of over-the-counter (OTC) derivative transactions to limit systemic risks stemming from these markets. The reform programme initiated by the G20 in 2009 included the notion that standardisable OTC transactions should be settled via central counterparties and that deals not transacted this way should involve larger capital requirements. In 2011 this was supplemented by the proposal to have more stringent margin requirements for the latter deals. On 16 August 2012 EMIR (European Markets Infrastructure Regulation), the European Union directive on central counterparties and trade repositories, came into effect. Additionally, CRD, the capital requirements directive of the EU, has also steered contracts toward those involving a central counterparty by setting larger capital requirements for bilateral deals. Using a central counterparty entails a smaller counterparty risk for contracting parties, which is usually taken into account by banks' risk management rules and trading incentives.

Larger trading with LCH intermediation has had several consequences. Because London banks have increasingly preferred dealing with LCH members due to the reasons outlined above, those Hungarian banks, which could not trade through LCH via a parent institution have seen their market activity decline. Although there were domestic banks trading on a market making basis in early-2012, this was not anymore the case on the turn of 2012–2013. LCH membership also influenced the price quotes for market participants. Those banks, who could not trade via LCH were regarded to represent larger counterparty risk, and thus they faced less favourable quotes (larger spread between the bid and ask prices). Another pricing consequence follows from the collateral currency. The collateral has to be settled in forints in deals with LCH intermediation, whereas a euro settlement is more common with domestic deals involving a CSA (Credit Support Annex). This difference constitutes a cost that increases IRS quotes by 1-3 basis points for LCH members.

Dynamics of market structure and positions vis-à-vis non-residents

Open positions of domestic banks can be calculated from their daily reporting of transactions in the K14 framework. The aggregates of those can then be used to measure the total open position of the domestic banking sector due to interest rate derivatives. The names of counterparties for each transactions are known, thus open positions can also be broken down into open positions vis-à-vis various sectors of counterparties. In the following we deal with the open position of the domestic banking sector measured in basis point values (BPV). Basis point values measure the effect on the value of a portfolio due to a one basis point increase in the market yield curve.

In case of single currency interest rate swaps and forward rate agreements the simplest way of assessing open positions is to first aggregate domestic banks' long and short positions for active contracts and then take the difference between the two. If the aggregate of long positions significantly outweigh that of short positions, then the banking sector profits from an increase in market yields on their interest rate

[15] LCH does not intermediate in CIRS transactions involving notional exchange.

derivative portfolio, whereas counterparties of the domestic banking sector (mainly non-residents as seen above) profit in case that market yields decline.

This simple method of calculating open positions could however be misleading as it does not account for duration differences between long and short portfolios. For instance, it could be that long contracts are larger in volume than short contracts, but long contracts have a lower duration than short contracts and are therefore less sensitive to yield changes. In this case even though the net long position is positive, the portfolio could decrease in value when market yields rise.

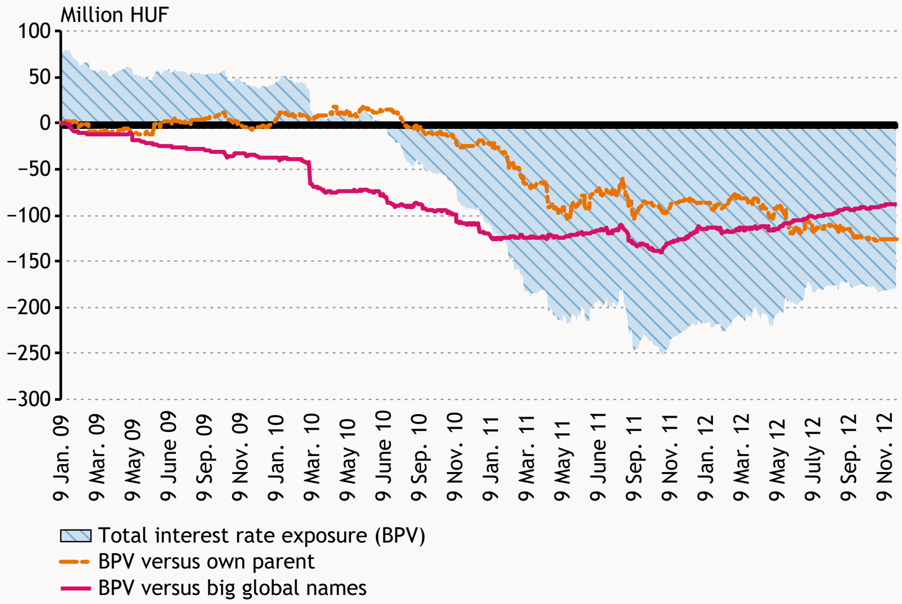
This is the reason market participants commonly use basis point values as a metric of interest rate risk exposure. The basis point value is an interest rate sensitivity measure similar to duration. The difference between the two is that duration measures change of portfolio value due to a unit increase in market rates (a 100 percentage point increase), while basis point value divides this amount by ten thousand, which results in the change of portfolio value due to – a much more realistic – 1-basis-point parallel shift in the market yield curve. (Technical details of basis point values in IRS and FRA are given in the Appendix.)

The interest rate exposure of domestic banks' IRS portfolios based on basis point values changed sign during the period. The long exposure of around 50 million HUF BPV throughout 2009 turned neutral in early 2010, and an increasing short position was characteristic between summer and autumn 2010 to late-2011. On one hand the change in positioning was a consequence of maturing long contracts that were created before 2009, but on the other hand it was also a result of more active new dealing of short contracts.

The change in positioning from mid-2010 could be explained by the different trading strategies, motivations of domestic and non-resident banks. From around this point in time the difference between forint government bonds and interest rate swaps (the asset swap spread) began to increase, which could have led non-residents to take long IRS positions that lock in such spreads. For several domestic banks positioning short in IRS could perhaps be explained by the run-up of CIRS contracts, where domestic banks typically receive a variable forint rate. Short IRS could be used to hedge such interest rate exposure.

Segmenting the open position by sectors reveals that domestic banks positioned increasingly short versus both global names and parent institutions. (Since we can only calculate such sectoral division for the deals contracted after 2009, it is the changes of cumulated positions that are worth elaborating not the level of such positions.) Yet, most of domestic banks' deals with parent institutions were counterparty-limit-avoiding technical contracts, so that the long parent bank

Chart 9
Interest rate risk exposure of domestic banks' IRS portfolios



positions were probably long positions of other non-residents – with parent institutions only serving as an intermediary without real interest rate risk exposure.

FRA portfolio positions varied more over time. From the last quarter of 2009 – when we can already safely draw conclusions about outstanding stocks based on FRA transactions – several sharp increases could be observed in the aggregate stock of FRA contracts outstanding. The first such increase occurred in early 2010 (Chart 10 right hand panel). The beginning of 2010 was an interesting period in several respects. On one hand worries relating to Greece intensified first at this point in time, which could have caused heterogeneity in opinions regarding impacts of foreign events and thus could have led to an increase in FRA dealing. On the other hand the change of government in Hungary could have led to diversifying the interest rate outlooks of market participants.

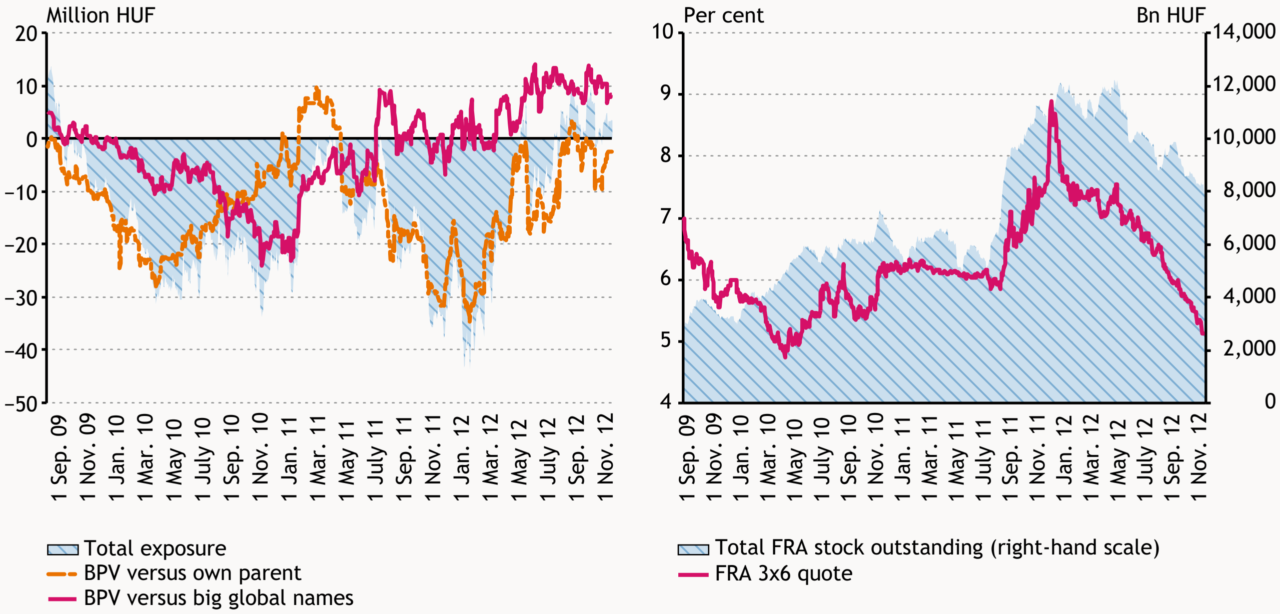
Similar to the IRS market, early 2010 was characterised by an increased short positioning of domestic banks versus both parent banks and large global names. Domestic market players therefore expected lower Hungarian rates than what was priced in by the market. This short positioning was characteristic of the whole sample period, although its magnitude and the counterparties which held the opposing long position have changed markedly.

In the beginning of 2011 short positions vis-à-vis large global banks have matured and domestic banks have increasingly been on the long side of deals versus this sector afterwards. On the other hand, short positions versus parent banks (which could be intermediating deals with other non-residents) have widened from summer 2011 – the time of intensifying eurozone periphery risks. Parent banks, or potentially their non-resident clients, have increasingly positioned towards higher market rates versus domestic banks. Outstanding stocks of FRAs have in this period jumped markedly, which thus were related to foreign counterparties hedging the risk of increasing Hungarian rates.

In 2012 the short positions of domestic banks matured and the sector upheld a neutral interest rate position in the second half of the period versus non-residents. As mentioned before, the increase of trading through central counterparties as well as a diminished appetite for speculative positioning contributed to the decline in outstanding stocks in this period.

In case of currency interest rate swaps we assess portfolio exposure based on the aspects of foreign currency liquidity flow and the exchange rate exposure of deals' forward (maturity) leg. CIRS transactions do not involve exchange rate risk, because the FX exposure on the spot leg is cancelled out by opposing exposure of forward legs. However the combination of a spot FX and a CIRS transaction often carried out in the market (the spot selling of FX or HUF liquidity received at the

Chart 10
Interest rate risk exposure of domestic banks' FRA portfolios



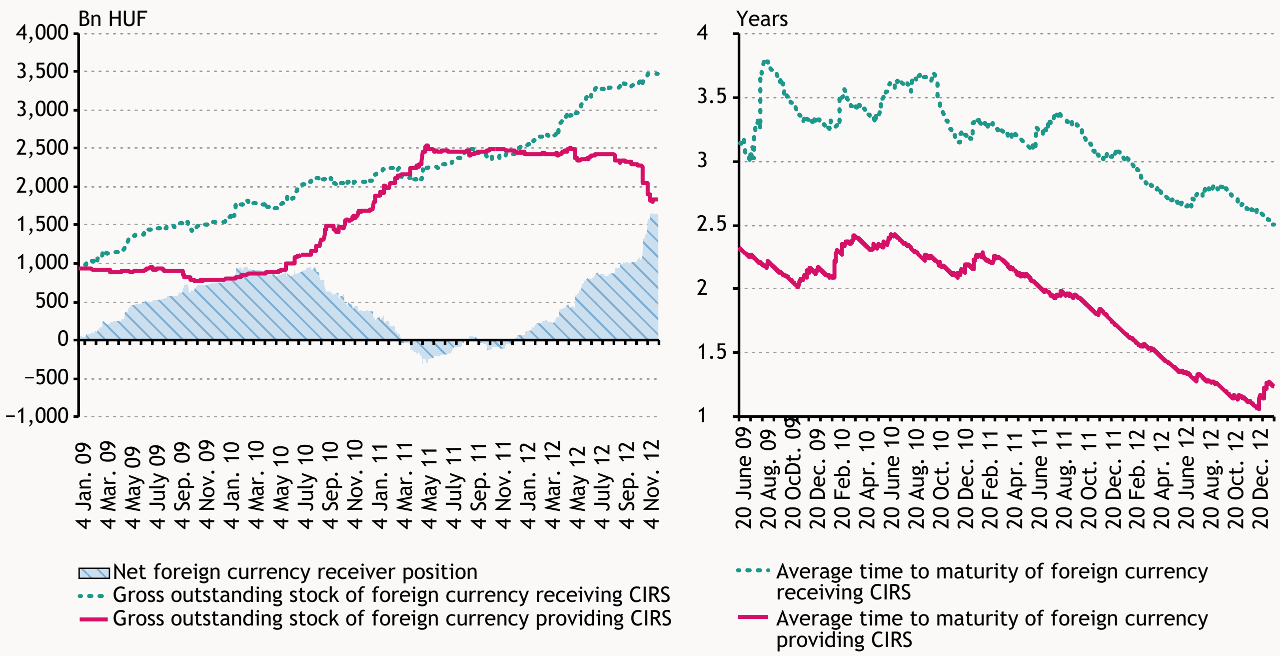
beginning of the CIRS transaction) does constitute a synthetic open foreign exchange position. This is due to the fact that the spot FX transaction cancels out the effect of the spot leg of the CIRS transaction, so that the FX exposure due to the CIRS forward legs remains unhedged. Another reason for exchange rate movements being important for CIRS contracts (even without a spot selling of received liquidity) is that the spot leg of the transaction is settled between counterparties at the beginning of the life of the swap, whereas the forward payments continue to involve counterparty risk. The size of such counterparty risk is affected by exchange rate movements.

For deals where foreign exchange liquidity is received by the domestic player at initiation, the appreciation of the foreign currency (depreciation of the forint) leads to a decrease in the value of the swap, because in this case the forint interest payments and the forint principal payment received at maturity only partially covers the interest and principal payments to be made in the foreign currency. And in contrast, the value of forward cash flows increases with an appreciation of the foreign currency versus the forint. A net foreign currency receiving portfolio combined with the selling of the spot leg earns a profit when the foreign currency depreciates versus the forint.

Since the mid-2000's, due to the boom in foreign currency lending, the domestic banking sector has systemically been on the foreign currency receiving side of swaps: using short-term FX swaps before 2009 and increasingly using CIRS deals afterwards. (Several MNB publications dealt with the Hungarian FX swap market. Of these, two also include recent crisis experiences: Mák and Páles [2009] provides a general overview, whereas Páles et al. [2011] is a comprehensive elaboration of the subject.) The domestic banking sector's ability to generate a synthetic FX liability by combining a foreign currency receiving CIRS with the selling of FX liquidity on the spot market has been a way to hedge the open FX position that resulted from the currency mismatch in the balance sheet. In case of a forint appreciation the increase in value of the CIRS transaction's forward legs countered the decrease in the forint value of the FX loan portfolio.

However, there are important differences in how risks are treated between CIRS swap partners and between banks and bank clients in case of FX loans. These have had significant consequences for banks that aimed to hedge FX loan exposures via CIRS transactions. Counterparty risks are mitigated by margin accounts and FX resets in case of CIRS, thus there is a cash collateral covering counterparty risks. Exchange rate movements however result in liquidity shocks: when the forint depreciates the losses in CIRS value have to be transferred in liquid assets to the counterparty (to margin accounts). This necessitates constant access to liquidity. On the other side, there is no such incoming cash flow from household and

Chart 11
Volume, direction and average time to maturity of domestic banks' CIRS portfolio



corporate clients with FX loans. Bank clients commonly provide real estate collateral to compensate banks for the credit risk in FX loans and there is no margin posting requirement in case of forint depreciation. Since banks generally use the currency swap markets for quick access to FX liquidity, the FX margin posting requirement in case of forint depreciation results in the increase of foreign currency receiving currency swap transactions.

Due to the balance sheet structure, the domestic banking sector has positioned on the foreign currency receiving swap side in FX swaps and CIRS basis swaps with notional exchange. Until 2009 mostly short-term FX swaps were used, basis swaps gained popularity mainly after this point in time. In 2009 and 2010 foreign currency receiving basis swap volumes increased more than foreign currency providing basis swap volumes, consistent with domestic bank balance sheets. The net FX receiving volume reached its peak in the CIRS market at 1,000 billion HUF in early-2010.

The dynamics of the net position changed in course of 2010. Improving conditions in the FX market slowed the increase of foreign currency receiving CIRS volumes, while foreign exchange providing transactions swelled in volume on the other side (Chart 11 left panel). Market sources explained that this has been a consequence of a previous cautious stance in accumulating FX liquidity that was excessive compared to real FX funding needs. When experiencing relatively less tension in FX markets, the large costs of CIRS spreads incentivised banks to lend out their extra FX liquidity via shorter segments of CIRS markets and in FX swaps.

Acquiring FX liquidity for longer maturities and partly lending that out on shorter dates have been characteristic of the whole sample period. This has been attested by the consistently and significantly longer average time to maturity of foreign currency receiving swaps (Chart 11 right panel). Although the rise in FX liquidity providing CIRS volumes was attributed to the activity of only a few domestic banks, this has been enough to close the net CIRS position of the banking sector by early-2011. The total currency swap position of the banking sector was still net FX receiving, but this position has been held in FX swaps rather than currency interest rate swaps.

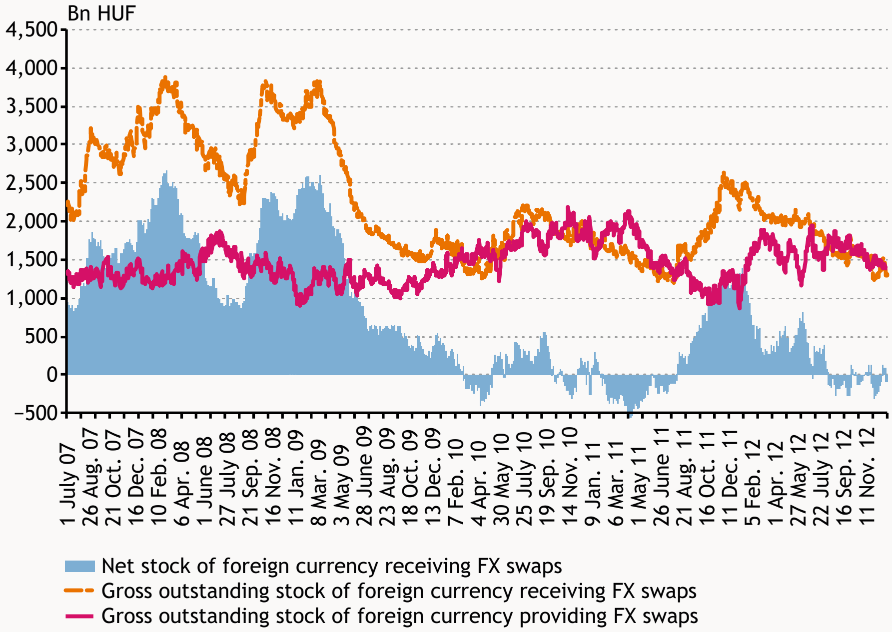
In summer 2011 the landscape changed again with the stock of foreign currency receiving leg beginning to expand rapidly and exceeding the FX providing leg by more than 1,500 billion HUF at the end of the sample. The risk of the sovereign crisis spreading to Italy and to the eurozone banking sector, as well as increasing Hungarian sovereign and regulatory risks led to renewed intensification of financial market tensions in 2011. This has affected currency swap markets via multiple channels.

The domestic banking sector once again began hoarding FX liquidity via currency swaps on a precautionary motive. On the other hand FX liquidity acquired via CIRS transactions was partly used to redeem direct funding of subsidiaries by parent banks, thus the CIRS market was used by non-residents to extract funds that they previously invested in the domestic banking sector. Third, there was an FX funding requirement for margining due to the depreciation of the forint. Moreover, the regulatory requirement of the foreign exchange funding adequacy ratio (DMM) in effect by mid-2012 has also contributed to increasing FX receiving CIRS volumes. Domestic banks aimed to fulfil requirements by increasing swap maturities and this adjustment began already in early 2012 (MNB, 2012).[16] In contrast, the reduction in domestic household open FX positions (due to households redeeming FX loans on one hand and increasing their holdings of FX deposits on the other) would have implied a decrease of banks' net foreign currency receiving swap positions. However, this factor proved to be weaker than the opposing ones mentioned above. The foreign currency providing CIRS stock of domestic banks practically froze in mid-2011, new contracts on this side of the market were smaller in volume than redemptions. In interviews, market participants claimed that another problem could have been increasing market tensions, which resulted in even tighter counterparty limits than before leading to constrained new contracting and lower maximum open positions allowed.

To supplement the previous account of CIRS market dynamics, it is worth briefly reviewing volume changes in the FX swap market. The D01 report is available for the period also before 2009, which reveals effects of the crisis (Chart 12).

[16] In terms of the DMM regulation banks are required to finance 65 per cent of FX assets by stable FX funds and currency swaps of more than one-year remaining maturity.

Chart 12
Domestic banks' short-term FX swaps' volumes vis-a-vis non-residents



Note: Currency swaps with less than one-year reported in the D01 framework are displayed, which is a good approximation of FX swap stocks only (thus excluding CIRS transactions).

In general it can be said that both FX liquidity receiving and providing sides' volumes have been more volatile than seen in the CIRS markets; largely a consequence of the shorter maturity.

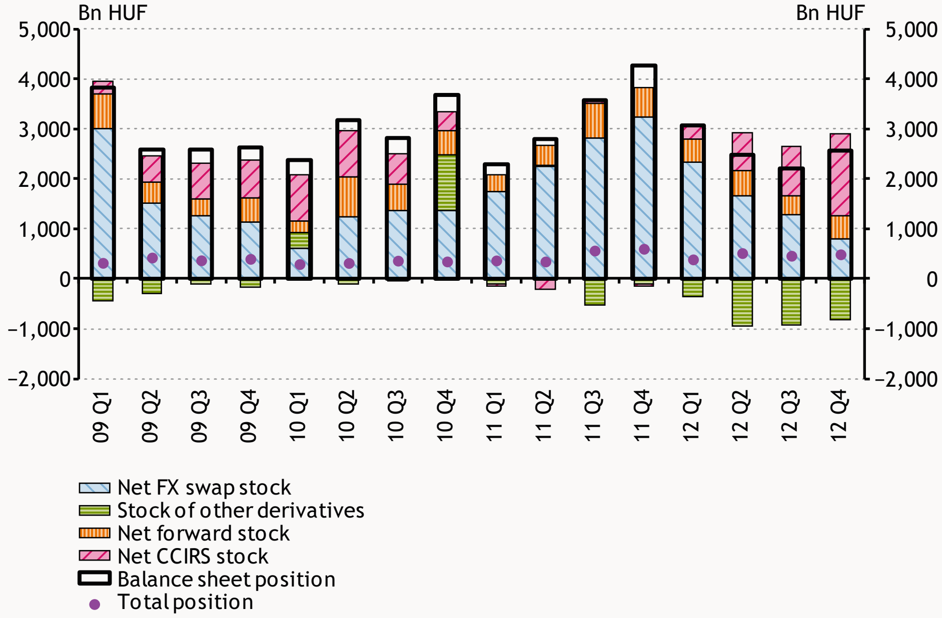
Domestic banks' net open position of FX swaps has varied considerably in the period preceding the default of Lehman Brothers with peak values exceeding those seen in the CIRS market at the launching of the K14 report. The significant FX exposure due to the FX loan portfolio was primarily hedged by short term (less than 3-month, but usually 1-week maturity) FX swaps due to their lower cost (the FX swap spread) and the perception that they do not entail significant rollover risk. During the crisis, though, supply of FX liquidity by non-residents fell and it became increasingly difficult (via considerably larger paid spreads) for domestic banks to rollover maturing FX swaps.

Although long-term CIRS also involved large costs for acquiring foreign currency, many banks decided to choose this alternative for precautionary reasons. The switching from FX swaps into CIRS transactions was most prominent in spring 2009. At this time net FX swap positions declined below the minima of previous years, while the CIRS market rapidly expanded.

There were no obvious trends such as those seen in the CIRS market on the FX providing side. The stock of FX swaps in which domestic banks provided foreign currency liquidity fluctuated in a wide band between 1,000 and 2,000 billion HUF. The events of the summer 2011 were noticeable in FX swaps as well, as foreign currency providing outstanding stocks fell. The DMM regulation's effect is also notable: in early 2012 banks closed short-term net foreign currency receiving positions by entering contracts on the other side thus the net FX swap position hovered around zero at the end of the sample.

It is useful to briefly discuss CIRS and FX swaps positions also in relative terms compared with the open FX position of the banking sector's aggregate balance sheet. Of the two instruments the banking sector relied more on FX swaps, though CIRS were at times also important in hedging the open FX position and acquiring FX liquidity (Chart 13). In the past years, on average, 70 per cent of open FX position was covered by FX swaps, 25 per cent by CIRS contracts and the remainder by other financial derivative transactions (forwards, options). There are important patterns to note: from mid-2009 the net position of the longer-maturity CIRS contracts increased in share versus FX swaps, while in 2011 short-maturity FX swaps regained dominance. Then, from the beginning of 2012, again CIRS contracts increased in importance.

Chart 13
Financial instruments hedging the open FX position of Hungarian banks' balance sheets



Note: FX swaps calculated as residuals.

The relationship between interest rate expectations and FRA positions

Up to this point, we analysed the dynamics of interest rate derivative positions mostly in terms of a domestic-foreign breakdown. However, the residency of the counterparties only partially reveals the heterogeneity of interest rate positions. As we have seen above, the bank-by-bank heterogeneity was partly offset at a higher aggregation level. A more in-depth analysis is needed also based on the information revealed by the Reuters survey: there was a negligible difference between the mean interest rate expectations of domestic and foreign participants in the period between January 2009 and December 2012, which may however conceal within-group variation (expectations given on end-of-year base rates in the two groups were on average 6.35 and 6.31 percent, respectively).

In this subsection we examine whether there has been a link between the interest rate expectations and FRA positions of domestic participants.[17] Based on the Reuters survey, first, we estimated the interest rate expectations related to the 1-year forecast horizon. Next, its difference from the average of the market was calculated. Concerning FRA positions, these were measured in net basis point values, as in previous subsections. Our hypothesis was that in periods when a bank's analyst expected higher interest rates compared to the consensus, the bank's FRA position was also higher, i.e that it had more of a net long (fix payer) position. The beginning of the examination period was September 2009, as FRA positions could be considered more reliable after that time.

For most of the banks, the connection between interest rate expectations and FRA positions was found not to be statistically significant; the correlation coefficients were below the value of 0.2 in these cases. For some of the banks the correlation coefficient was however over 0.4 for the whole sample, but the relationship was unstable and the results should be interpreted with caution because of the short sample period (in some cases consisting of only 7 observations). Moreover, for one bank the correlation coefficient resulted in a negative coefficient (around −0.4).

[17] Only FRA transactions are analyzed given that these reflect short-term interest rate expectations better than IRS transactions. First – as described earlier – the use of the FRA market is motivated with a (pure) speculative purpose, while on the IRS market the hedging demand is stronger which can distort positioning relative to what expectations would imply. Second, the value of IRS positions is affected more by changes in the slope of the yield curve. Thus the basis point value, which measures the effect of a parallel shift in the yield curve, is more suitable for FRAs. The reason for analyzing only domestic banks' FRA positions is that regarding foreigners, we can observe only the part of their FRA positions where the counterparties are domestic banks.

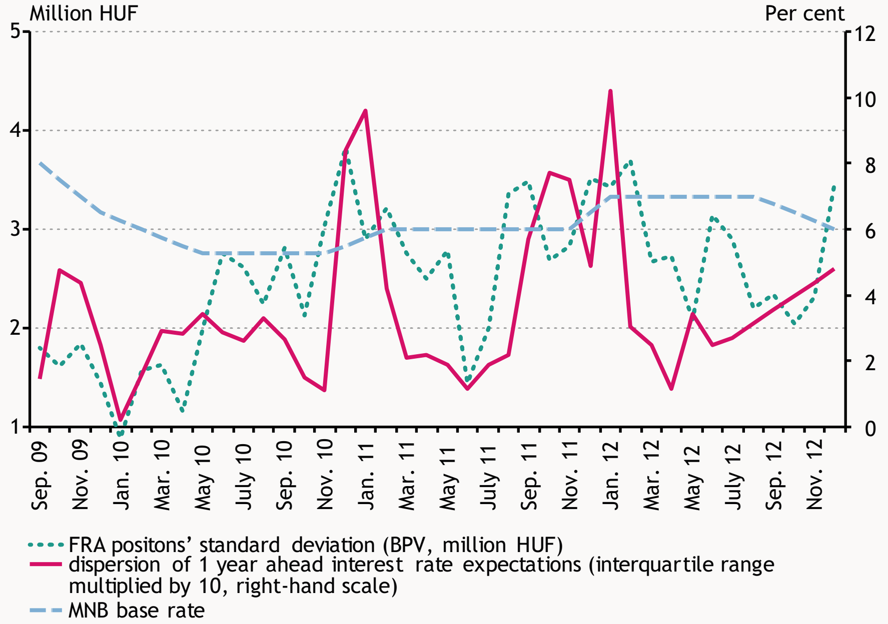
This weak relationship can be explained by several factors. First, traders in the dealing room of a bank may be trading FRAs based on their own expectations, and may not be necessarily considering the interest rate forecast of the analysts of the bank. The negative coefficient found at one bank may suggest another explanation. The expectations revealed in the Reuters survey are generally reflected in the investment recommendations of banks. If a client follows this recommendation, while the trader has an expectation opposite to the analyst, it is easier to trade with that client. This can be reflected in a negative relationship between the two analyzed variables and it can provide an explanation also for the low coefficients (as periods with negative and positive coefficients may be changing in the sample).

Based on the considerations above, we investigated other variables that are less affected by the sign of interest rate expectations or positions, but which reflect the general heterogeneity of the market. We did not require the variables to be correlated for each bank. Thus variables related to a somewhat different group of participants could be used in case that they well represented interest rate expectations and FRA positions of the whole market. The examined variables were the *cross-sectional standard deviation of the net FRA positions* of domestic banks, which was compared to the *interquartile range of domestic participants' 1-year interest rate expectations* (subtracting the first quartile from the third quartile). An advantage of the latter indicator is its low sensitivity for changes in the composition of the sample.

There was a medium-strong positive relationship between the two variables; higher heterogeneity of FRA positions was found to be related to higher uncertainty of interest rate expectations (Chart 14). The correlation coefficient of the two variables was also significant (0.46). Furthermore, the two variables reached minimum values at the same point in time, in January 2010. The relationship can be considered strong in light of the different forecast horizons that the two time series relate to (the transaction-weighted average maturity of FRAs is around 4 months).

At the beginning of the two central bank rate hiking periods there was a remarkable increase in both indicators (at the end of 2010 and 2011). Regarding interest rate expectations, this jump occurred after the first rate hike following a long period of flat interest rates. In such periods the increase of interest rate uncertainty could be considered normal even when monetary policy is predictable given that participants who earlier projected flat rates could gradually change their expectations. In autumn 2011, there was an increase in the uncertainty of interest rate expectations preceding the second rate hiking period of the sample. This happened in parallel with the increase in the forint risk premium. In all of these

Chart 14
The uncertainty of domestic bans' FRA positions and interest rate expectations



Note: Based on FRA positions of 8 banks and interest rate expectations of 7 to 13 Reuters survey respondents. Domestic banks operating as subsidiaries of EU-based banks were excluded. Standard deviation of FRA positions was calculated from positions measured in basis point values. Interest rate forecasts were measured in percentage points and the 1-year horizon was estimated by interpolation. The interquartile range is the difference between the first quartile and the third quartile which – to facilitate visualisation – was multiplied by 10 in the chart.

three cases the heterogeneity of FRA positions rose one month before interest rate expectations.[18] The same could be observed regarding foreign participants since their expectations were also unchanged in the preceding month. This kind of anticipation reflects that there is extra information about the uncertainty of interest rate expectations incorporated in FRA positions relative to that contained in the Reuters survey. A possible explanation is that the FRA market provides a fast way to bet on interest rate expectations without large initial funding needs while expectations recorded in the Reuters survey may be based on models which are able to react more slowly. In the beginning of the rate cut period in autumn 2012 there was no remarkable increase in either of the two indicators.

In the middle of 2010, after the end of the rate cut period, the connection between the two variables was less obvious. However, some conclusions could be drawn regarding the motivations behind FRA trades. While there was a jump in the heterogeneity of FRA positions, the increase in the uncertainty of interest rate expectations was lower and only temporary. This suggests that in a period of stable central bank rates, the interest rate expectation of the whole market was stable, while it may have been worth it for some participants to bet on interest rate changes despite the lower possible gains. It is also feasible that the answer lies is in the evolution and liquidity of the FRA market: with unchanged interest rate expectations, market participants put higher bets on the same interest rate changes, i.e. undertook larger positions.

A further observation can be derived from the above described periods. While the uncertainty of interest rate expectations was higher during central bank rate hike/cut cycles than during periods with flat rates, this was not the case for the heterogeneity of FRA positions (the average standard deviations of FRA positions were equal for the two sub-samples: the basis point value was HUF 27 million for rate hike/cut cycles and the same for flat rate periods). This also reflects that FRA trades incorporated somewhat different information so that it does matter which indicator is used to measure the uncertainty of interest rate expectations.

[18] This is confirmed also by the Granger causality test: the standard deviation of FRA positions Granger-causes the dispersion of interest rate expectations at 5 per cent significance level, while the opposite direction of Granger causality does not hold. This means that the lagged value of the dispersion of FRA positions is significant in the equation were the standard deviation of interest rate expectations is regressed on its own lag and the lag of the other variable.

Conclusion

The data set deriving from the K14 report reveals important characteristics of the Hungarian IRS, CIRS and FRA markets. Of the three, the FRA market has been the largest based on turnover volume, while the IRS market had the most number of deals. Currency interest rate swaps had significantly lower turnover compared to the other two derivatives, as well as compared to FX swaps, though the latter was partly the consequence of longer maturity of CIRS contracts. The two-year maturity was the most active segment in both the IRS and CIRS markets. An important implication for analysing purposes is that these are the maturities where price quotes best reflect aggregate market information, and hence market analysis should treat these maturities with relative larger focus. In the FRA market the 3x6s, 1x4s and 9x12s were found to be the most liquid, so informationally quotes on these segments have had a relative advantage. Transaction prices were close to market price quotes. This supports the adequacy of using price quotes in market analyses.

Market turnover – as a ratio to GDP – was most similar to the Polish market in the region. In line with international trends the Hungarian IRS and FRA markets experienced a fall in turnover during the crisis as a result of tighter counterparty limits. Also in agreement with foreign trends, the CIRS market – due to lower rollover risks – increased market share relative to FX swaps. Hungarian forint interest rate derivative markets were more concentrated than those of developed countries, though this result relates only to the domestic trading of forint interest rate derivatives.

In all three derivatives non-residents were the primary counterparty to reporting domestic banks. Deals with domestic clients and contracts between domestic banks were only a small fraction of the whole market. More stringent counterparty limits due to the crisis resulted in an increasing practice of using a parent institution to intermediate in deals with other domestic banks as well as non-residents. In such transactions parent institutions have assumed counterparty risk, but domestic banks have kept the interest rate risk position.

Interest rate expectations were the primary motive for trading in FRA markets, which is of relevance for monetary policy because it indicates that structural factors have not biased prices. Domestic banks have on the aggregate positioned more toward lower interest rates versus non-residents, though the extent of such relative positioning varied considerably throughout the sample. The correlation between banks' analyst forecasts and FRA positioning was weak. However, in times of greater dispersion of analyst projections positioning was also more varied in the FRA market. Such positional variability was found to contain extra information on interest rate uncertainty relative to analyst polls.

The interest rate expectations (speculative) and hedging motives were both relevant in IRS trading. Domestic banks have in the beginning of the sample positioned towards higher interest rates vis-à-vis foreigners, but this has changed sign in the second half of the period. We have only partial information on the relative proportion of hedging trades, since a majority of transactions take place in London. Nonetheless, we presume that due to the hedging needs of Hungarian government securities, which necessitate a long IRS position, structural factors probably bias quotes upwards relative to values that pure expectations would dictate.

In the CIRS market domestic banks' need to hedge open foreign exchange position of balance sheets and their demand for foreign exchange in a liquidity management aspect have led to a structural extra demand for foreign currency receiving swaps, which has generated a high (negative) CIRS spread. Nevertheless, contrary to general market thinking, the Hungarian banking sector on the whole did not always have a significant net position in FX receiving, because some domestic participants decided to offer foreign exchange liquidity to the market in order to realise the large CIRS spread.

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Appendix

Duration of IRS portfolios

There are several measures of the price sensitivity of assets to yield changes, of which we deal with those that measure the effect of a parallel shift in the yield curve. The most often used metric in this class of measures is the (modified) duration *(MD=(d(V)/V)/(d(r)))*, which is the percentage change of an asset's value *(V)* resulting from a unit change in market yield *(d(r))*.

In case of asset portfolios, though, it is more common to instead look at basis point values or ordinary duration *(BPV=d(V)/d(r) * 0.0001*; *(D=d(V)/d(r))*. Basis point values and ordinary duration measure the nominal instead of the percentage change impact of yields, so that modified duration is multiplied by the asset value *(BPV=MD * V * 0.0001)*. The division by 10,000 in case of BPV has the rationale that it is more useful to assess the effect of a realistic 1 basis point change rather than that of a unit change (100 percentage point increase) in yields.

Basis point values and ordinary duration are more straightforward to use when analysing the price sensitivity of a collection of assets, a portfolio. Each asset's modified duration only influences the portfolio's modified duration by their relative weights in the portfolio, thus the total modified duration is a weighted average of individual assets' modified durations. The basis point value (ordinary duration) of the portfolio on the other hand is simply the sum of basis point values (ordinary duration). In the following we use the term duration referring to the nominal measure, the ordinary duration *(D=d(V)/d(r))*.

It is noteworthy to emphasize that duration deals with the parallel shift of the yield curve and neglects effects of changes in the slope or curvature. Portfolios with similar duration and basis point values could still be differently affected if yield changes are uneven along the yield curve.

Duration of Floating Rate Notes

To understand the duration of interest rate swaps it is useful to first elaborate on the duration of a floating rate note (FRN), which pays coupon according to a reference rate in each interest payment period and pays the notional on the maturity date. The cash flows of the FRN can therefore be split into two parts: payments of the floating rate coupons $(\sum_{i=1}^{n} \mathrm{c_i})$ and payment of the notional *(N)*. For simplicity we consider no risk premia, i.e no spread on the floating rate.

The notional payment can be viewed as a zero coupon bond with a duration of approximately

$$D_N = \frac{\mathrm{d(P)}}{\mathrm{d(r)}} \approx -\frac{\mathrm{T*N}}{1+\mathrm{r_T}},$$

where *T* is the time to maturity, r_T is the annualised market yield for this horizon, and *N* is the value of the notional.

In case of r_T being relatively small, the present value of the notional payment is close to the negative of the product of time to maturity *(T)* and notional *(N)*. An increase of the market yield decreases the present value of the notional, which is the reason why the duration of this component is negative.

For the duration of FRN floating rate coupons let's first take the last interest payment period. At the time of the floating rate fixing – at the beginning of the last interest payment period – the coupon is equal to the notional times the actual reference rate; $c_\tau = r_\tau * N$. At this point in time, the present value of the FRN's notional and coupon payments equals the notional, therefore it is independent of market yields implying a duration of zero.

$$NPV_{FRN,T-\tau} = \frac{c_\tau}{1+r_\tau} + \frac{N}{1+r_\tau} = \frac{N*r_\tau}{1+r_\tau} + \frac{N}{1+r_\tau} = N * \left(\frac{1+r_\tau}{1+r_\tau}\right) = N$$

Later, during the last interest payment period the duration takes on a small negative value due to the fact that the last coupon payment is already fixed.

Knowing that at the beginning of the last payment period the value of the FRN will be equal to the notional results in the same above formula for the value of the FRN at the previous fixing date (T-2), and so the FRN's value is equal to the notional and its duration is 0 at this date as well. With the same logic it is easy to see that at the beginning of all previous (T-3, T-4 and so on) interest payment periods, the FRN's value is equal to the notional and its duration is 0.

Due to the duration of the FRN being zero at the floating rate's fixing dates, it has to be true that the negative duration of the notional of the FRN is cancelled out by the equivalent magnitude positive duration of FRN coupon cash flows ($D_C \approx + \frac{T*N}{1+r_T}$). Between two fixing dates, the increase in market yields decreases the notional's present value, however the increase in yields leads to increased coupon cash flows that compensate for this effect. The FRN's duration at fixing dates is therefore:

$$D_{FRN} = D_N + D_C \approx -\frac{T*N}{1+r_T} + \frac{T*N}{1+r_T} = 0.$$

Duration of interest rate swaps

A long (fixed payer) swap position has two cash flow components: negative cash flows of fixed coupons *(C_{fix})* and positive cash flows of floating rate coupons *(C_{float})*. The sum of the two component's duration yields the swap's duration. In case of FRNs we showed that the duration of floating rate coupons exactly cancels out the duration of the notional *($D_{float} = -D_N$)* at fixing dates. Then, the duration of a swap long position is exactly the negative of the duration of a fix par bond, thus on these dates the swap long position perfectly hedges the long position in a similar fixed coupon par bond.

$$D_{swap\_long}(fixing\ date) = -D_{fix\_coupon} + D_{float\_kupon} = -D_{fix\_coupon} - D_N = -1 * D_{fix\ bond}$$

Both cash flow components of long swap positions have positive durations. The fixed coupons' duration is negative, because yield increases decreases their present value. However, in a long IRS position the fixed coupons are paid, so that yield increases raise the value of the instrument from the swap long side's aspect. Previously we showed that the duration of the floating rate cash flow in FRNs is positive, which is analogous to the floating rate swap leg. Thus yield increases raise the value of this cash flow component as well.

At the beginnings of interest payment periods, the duration of long swap positions matches (in absolute value) the duration of a par bond with equal notional, horizon, and fixed coupon rate.[19] Between two interest rate fixing dates this equivalence however does not hold, because the FRN's duration decreases into negative territory as the next floating rate payment *($c\_float_{0,1}$)* is fixed and it loses its previous positive duration. Consequently the negative duration of the notional is not fully covered by the duration of floating coupons. During the interest payment period the duration of the notional also decreases (in absolute terms) and the FRN again reaches zero duration by the time of the next rate fixing. The additional duration component of the FRN during the interest rate payment is equal to the duration of a zero coupon bond maturing at the time of the next fixing with notional, *$N*(1+c_{float_{0,1}})$*. This duration is approximately the negative of the time remaining to the next fixing times the notional.

[19] This does not mean however that the duration of the swap's fixed paying leg is equal to the duration of the fixed bond. The bond's duration is – in absolute value – larger due to the notional. The swap's fixed paying leg's duration is equal only to the duration of the bond's fixed coupons. The equivalence of the bond's and swap's total duration is therefore the consequence of the durations of the notional and the floating rate payments being equivalent (in absolute terms).

Analogously, the difference between the swap floating leg duration and the notional duration is the duration of the zero coupon bond maturing at the next fixing date. The zero coupon bond's duration is negative, so this element decreases the positive duration of a swap long position. The total interest rate swap duration for long and short positions are:

$$D_{swap\_long} = -D_{fix\_coupon} - D_N + D_{zero} = -1 * (D_{fix\_bond} - D_{zero})$$

$$D_{swap\_short} = +1 * (D_{fix\_bond} - D_{zero})$$

Duration of interest rate swap portfolios

The (ordinary) duration of an IRS portfolio is the sum of (ordinary) durations of individual IRS elements. Similarly, the basis point value of the portfolio is the sum of BPVs of individual swaps in the portfolio.

At time t the duration of an IRS portfolio is:

$$D_{portfolio,t} = \sum_i D_{swap_{i,t}} = \sum_i N_i * \ sign_i * (D_{fix\_bond_{i,t}} - D_{zero_{i,t}}),$$

where N_i is the notional of the *i*-th element of the swap; $sign_i$ is –1 in case of a long swap position, and +1 in case of a short swap position.

The duration of the "fix bond" for each swap can then be calculated given the notional, the fixed coupon (the swap fixed rate), the actual market yield (in the analysis we calculated with the actual market rate on the horizon of the swap's maturity) and the time to maturity. In case of amortising interest rate swaps (about 10 per cent of the total stock) we calculated with a notional of half the original swap notional. For swaps contracted before 2009 the swap rate was not reported and we assumed an 8 per cent rate. The duration of the "zero coupon bond" in the above formula can be calculated for each swap given the notional, the actual fixed floating coupon rate and the market yield. Due to the small duration impact of this element we fixed this term to be notional times 0.2375 (half of the length 3-month and 6-month windows weighted by the relative weights of 3-month and 6-month floating rates in IRS contracts) to simplify calculations except in case of the last interest payment periods, where this term was assumed to be notional times remaining maturity.

The bias due to simplifications and approximations were tested on several time periods and for several market participants and were not found to be significant. These calculations are available upon request.

Duration of FRA transactions

The value of a long FRA position at time *t* is the discounted value of the expected payout:

$$p_t = \frac{(E(r_{T1}^{T2}) - FRA)}{1 + r_t^{T2} \cdot (T2 - t)} \tau \cdot N$$

where *N* is the notional, *FRA* is the fixed FRA rate and *E()* is the expectations operator. The subscripts and superscripts of market rates *(r)* denote beginning and end dates, respectively: *t* is the current date, T1 is the value date, T2 is the date of the contract's maturity (t < T1 < T2). τ represents the tenor, i.e. T2–T1. Hence r_{T1}^{T2} denotes the BUBOR rate on the tenor's horizon on the fixing date. Interest rates are in terms of annualised percentages (0.01=1%).

According to the expectations hypothesis the future expected value of market rate equals the forward rate:

$$E(r_{T1}^{T2}) = \left(\frac{1 + r_t^{T2} \cdot (T2 - t)}{1 + r_t^{T1} \cdot (T1 - t)} - 1 \right) / \tau$$

The forward rate we can be approximated by:

$$E(r_{T1}^{T2}) \approx \left(r_t^{T2} \cdot (T2 - t) - r_t^{T1} \cdot (T1 - t)\right)/\tau$$

Substituting this into the FRA pricing formula:

$$p_t \approx \frac{\left(\left(r_t^{T2} \cdot (T2 - t) - r_t^{T1} \cdot (T1 - t)\right)/\tau - FRA\right)}{1 + r_t^{T2} \cdot (T2 - t)} \tau \cdot N$$

In case of a parallel upward shift in the yield curve, r_t^{T1} and r_t^{T2} and also, the forward rate in the numerator changes to a similar extent, i.e. $\Delta r \ (= \Delta r_t^{T1} = \Delta r_t^{T2})$ as $\tau = T2 - T1$. (The similar change in the forward rate follows from the approximation above.) In case of one-digit yields the change in the denominator is negligible compared to the change in the numerator, so that the denominator can be taken to be constant and approximately takes a value of 1. Then the impact of a unit yield change is:

$$\frac{\Delta p_t}{\Delta r_t} \approx \frac{1}{1 + r_t^{T2} \cdot (T2 - t)} \tau \cdot N$$

$$\Delta p_t \approx \frac{1}{1 + r_t^{T2} \cdot (T2 - t)} \tau \cdot N \cdot \Delta r_t$$

The basis point value, then, denotes the impact of a 1 basis point change in yields on the FRA's value:

$$BPV \approx \frac{1}{1 + r_t^{T2} \cdot (T2 - t)} \tau \cdot N \cdot 0.0001$$

Thus the FRA BPV is in effect determined (approximately linearly) by the notional and the tenor of the contract. Compared to an interest rate swap a similar sign and notional valued FRA's duration is only a fraction of the swap's duration, because the length of the swap is typically much larger than the tenor (3 or 6-months) of an FRA contract.

The FRA portfolio's basis point value is determined by the sign, notional and tenor of individual contracts, when approximating the above formula's denominator by a value of one, an approximation which is adequate in case of normal yield environments.

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