MAGYAR NEMZETI BANK

MNB Bulletin

JUNE 2007

MNB Bulletin

June 2007

The aim of the Magyar Nemzeti Bank with this publication is to inform professionals and the wider public in an easy-to-understand form about basic processes taking place in the Hungarian economy and the effect of these developments on economic players and households. This publication is recommended to members of the business community, university lecturers and students, analysts and, last but not least, to the staff of other central banks and international institutions.

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Published by: the Magyar Nemzeti Bank

Publisher in charge: Judit Iglódi-Csató

H-1850 Budapest, 8-9 Szabadság tér

www.mnb.hu

ISSN 1788-1528 (online)

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Summary

DEAR READER,

The Magyar Nemzeti Bank assigns great importance to make those central bank materials available for the wider public in an easily intelligible manner which analyse economic and financial developments of public interest. This publication, which contains four studies, is the first issue of the second year of the MNB Bulletin. Three articles examine current issues of the Hungarian economy, namely banks' liquidity risk, corporate investment, as well as the relationship between foreign exchange market transactions and macroeconomic information, while in one article the central bank aspects of the monetary base are discussed from a theoretical point of view.

The study by András Komáromi presents the central bank aspects of the monetary base by comparing the textbook model with modern central banking practice. It calls the attention to the fact that in order to achieve their targets, most central banks focus on regulating some kind of short-term interest rate, whereas in the textbook model the central bank influences the money supply by determining the monetary base (M0). The article reveals that in today's practice the direction of influence between the monetary base and the broader monetary aggregates has turned round; today it is not the monetary base that determines the money supply, but the result of economic agents' portfolio decisions is reflected in the changes of the monetary base. It means that the growth rate of the monetary base does not carry any direct information either on the central bank's intentions or on prospective inflation.

The study by Péter Gál examines the developments in corporate investment, which were less favourable than expected. Investments are not only the engine of potential economic growth, but, as an important part of the aggregate demand, have an impact on the current output gap and thus on the current demand inflation pressure as well. Therefore, from a central bank aspect it deserves attention that the fall in investment in 2006 covered a wide range of investment goods (constructions, procurement of machinery) and sectors. Within this, the slackening investment by households as well as the non-tradable corporate sector is in line with the decelerating demand resulting from the fiscal adjustment. However, in light of the favourable European economic activity, export-oriented companies' falling investments still need to be explained. The study examines the possible explanations.

The study by Norbert Kiss M. and Klára Pintér analyses relationships between the forint/euro exchange rate, the economic fundamentals and foreign exchange market transactions. The analysis includes both the commonly used set of macroeconomic news (e.g. inflation, GDP) and the central bank communication. According to the findings, the model including central bank communication can explain a significant part of the exchange rate changes. The results related to the impact of macroeconomic announcements are in line with international experience: the effect of news becomes transmitted to the exchange rate partly in a direct manner through an immediate shift in the exchange rate and partly through the indirect information conveying role of the foreign exchange market transactions triggered by the news.

The study by Tamás Balás and Csaba Móré discusses banks' liquidity risk, central bank monitoring of which is of special importance in terms of financial stability. Hungarian banks' liquidity shock absorbing capacity is examined using a liquidity stress test, where the shock-absorbing capacity is measured as the maximum size of liquidity shock the bank can withstand in the short run on the strength of its liquid assets. Current findings suggest that financial stability is not jeopardised by liquidity risks. Looking forward, two main directions of further development in liquidity stress testing are proposed. On the one hand, it has to be taken into account that Hungarian banks are increasingly exposed to possible adverse changes in global liquidity, and on the other hand, that intra-group financing relationships may constitute a channel for contagion.

The Editorial Board

Tamás Balás–Csaba Móré: How resilient are Hungarian banks to liquidity shocks?

For central banks, monitoring banks' liquidity risk is of great importance from a financial stability perspective. One essential gauge for assessing liquidity risk exposure is whether banks have sufficient liquidity buffers to survive a potential unexpected funding crisis. In this article, we aim to assess the resilience of Hungarian banks to liquidity shocks by using a liquidity stress test. The test is based on a hypothetical stress scenario involving a bank-specific liquidity shock, triggered by a confidence crisis, for example. The shock absorbing capacity of a bank is measured by the maximum degree of liquidity shock the bank can withstand over the short run on the strength of its liquid assets. On the basis of the results of the stress test it is believed that the current liquidity risks essentially do not pose a threat to financial stability. As for large banks, with the overwhelming part of customer deposits, the current liquidity buffers would typically enable the maintenance of liquidity even under extreme circumstances. It should be noted, however, that Hungarian banks are increasingly exposed to fluctuations in global liquidity and that intra-group financing relations may represent a contagion channel. Therefore, in the future, the study of these risk scenarios may be important in further developing stress testing practices for both the central bank and commercial banks.

INTRODUCTION

With regard to the rapid credit growth in the Hungarian banking sector during recent years, changes in banks' liquidity risk exposure have so far received little attention.[1] Recently, however, some international organisations (IMF, World Bank) have drawn attention to the fact that the dynamic increase in bank credit, in addition to exacerbating other risk exposures, may also increase liquidity risks.[2] The concerns related to the liquidity position of banks are primarily due to the fact that the role of more volatile, foreign market financing has substantially increased, at the expense of stable deposit funds in the financing of the dynamically growing long-term loans. This shift in the structure of funding sources may increase rollover risks, i.e. banks' funding becomes increasingly sensitive to deterioration in risk perception, at both a bank (or banking group) level and at the country level, as well as to unfavourable changes in global liquidity conditions.

Another important aspect of the change in the funding structure is the growing role of parent bank financing, which is illustrated by the fact that, for some large banks, the ratio of parent bank funds to liabilities amounts to 20 to 30 percent.[3] While intra-group funding is seen as beneficial for increasing the efficiency of liquidity management and for containing funding costs, it also increases the potential risk of contagion within the group (ECB, 2006). In other words, a spillover of problems incidentally arising within the group may result in financing difficulties for those Hungarian banks which substantially rely on parent company resources. That explains the importance of examining the level of liquidity stress banks can cope with on the basis of their own resources, without resorting to parent bank support.

In assessing the liquidity risk of Hungarian banks, the central bank has so far primarily relied on balance-sheet-based indicators. As far as the changes in banks' liquidity risk exposures are concerned, recent analyses of balance-sheet-based indicators have resulted in a mixed picture. While the increasing role of foreign market funds has the potential to raise funding volatility, the substantial increase in the share of long-term foreign liabilities has reduced rollover risks (MNB, 2007). However, traditional balance-sheet-based indicators are, in themselves, insufficient for a comprehensive assessment of risk exposure, as they leave out of consideration contingency liquidity risk, which is an important aspect of liquidity risk. Contingency liquidity risk can be defined as the risk that the bank does not have sufficient funds to fulfil its obligations due to a sudden and substantial increase in its net funding requirements (Matz and Neu, 2007). Contingency liquidity risk may be due, for example, to a sudden, large withdrawal of deposits, an outflow of interbank funds or unexpectedly large drawdown

[1] For the purposes of this article, *funding liquidity risk* is the risk that the bank is either unable to fulfil its (short-term) payment obligations as they fall due or can only fulfil them at the cost of a substantial profit loss. This is different from market liquidity risks, i.e. the risk that the bank is unable to dispose of its marketable assets without incurring substantial losses, due to market disturbances.

[2] See reports by the IMF (2007) and the World Bank (2007).

[3] Funds from other members of the respective banking group are also included in parent bank funding, in addition to those directly obtained from the parent bank.

of open credit lines. In order to measure this risk, a liquidity stress test is employed on the basis of a hypothetical scenario, according to which the loss of confidence in a particular institution precipitates a substantial increase in net funding requirements for the bank. The main objective of the stress test is to assess the adequacy of Hungarian banks' liquidity buffers to withstand a potential funding crisis.

A SHORT OVERVIEW OF THE LIQUIDITY STRESS TESTS OF THE BANKING SYSTEM

In comparison with credit and market risk tests, liquidity stress tests of the banking system are considerably less widespread in the practice of central banks and the international financial institutions (e.g. the IMF) (Cihák, 2007). This absence is partly due to the lack of established and generally accepted concepts and modelling methods for assessing the exposure to liquidity risks. In addition to the above, the fact that the available regulatory reports are considerably less detailed than banks' internal risk reports, presents another problem for the authorities.[4] As far as the definitions of liquidity risk are concerned, liquidity stress tests tend to focus on the ability to fulfil payment obligations rather than the impact on profitability.[5] The liquidity stress tests of the banking system typically employ hypothetical scenarios to assess banks' resilience to liquidity shocks. Based on balance sheet data, the simpler methods examine the potential change in the liquid asset ratio of a bank in the wake of a presumed liquidity shock (e.g. a substantial deposit withdrawal).[6]

More complex liquidity stress tests, however, require the availability of data on the cash-flow-based maturity gap. In maturity tables, cash flows from assets, liabilities, off-balance sheet items, income and expenses are classified into maturity bands on the basis of contractual maturity. The maturity gap is the difference between cash inflows and cash outflows pertaining to the specific maturity bands. The typical hypothesis in maturity gap-based stress tests is that a substantial volume of customer deposits and/or interbank funds are withdrawn or that the markets of liquefiable securities become illiquid over a short period (e.g. one week to one month). In addition to the above, some banking system-wide liquidity stress tests also consider the possibility of interbank contagion. In maturity gap-based stress tests, there are two typical ways of quantifying banks' shock absorbing capacity:[7]

- the change, during a specific period, of the maturity gap or the liquid assets/maturity gap ratio following the liquidity shock compared to a normal scenario, and

- the length of time ('survival' period) during which the bank is able to maintain its liquidity after the outbreak of the liquidity crisis.

Considering both the methodological overview and data availability, we have employed the maturity gap-based approach, since it enables the 'shocking' of the liquidity position of a given bank for multiple variables. Due to their significant potential impact on liquidity risk and in addition to cash flows from assets and liabilities, we have also taken into consideration potential cash flows from contingent liabilities. The measure of shock absorbing capacity is identified on the basis of the *maximum* increase in funding requirements the bank is able to satisfy with its own liquidity reserves. In devising the stress scenarios, we have drawn on international and Hungarian experience on individual bank-level stress test practices.

DESCRIPTION OF THE STRESS SCENARIO AND THE MAIN ASSUMPTIONS

The starting point for the stress scenario is a bank-specific liquidity shock, e.g. triggered by a confidence crisis.[8] Accordingly, in the stress scenario it is assumed that a part of customer deposits and money market funds are withdrawn, in order to examine the level of liquidity shock the bank is able to survive on the strength of its own resources. The impact of the stress scenario on liquidity is measured over one-week and one-month intervals. As for the group of banks under review, it should be noted that mortgage banks, building societies and the "head bank" of cooperative banks have been excluded from the analysis due to the special composition of their liabilities.

Stress coefficients have been specified for cash inflows and cash outflows and liquid assets. For cash flows linked to assets and liabilities, the stress coefficients are an indication of the expected rate of rollover of the assets and liabilities in question under a specific risk scenario. For liquid securities, the stress coefficient reveals the level of haircut at which they can be disposed of in a stress situation or at which additional funds can be acquired by secured borrowing. The haircut used for Hungarian government securities has been adjusted

[4] For that reason, in several cases, banks perform the stress tests on their own set of data, according to the scenarios provided by the regulatory bodies.
[5] In that sense, the focus is exclusively on the downside risk, as compared to the profit and loss impact, where risks are two-sided (due to too low or too high liquidity).
[6] The use of these simpler methods may be justified by restrictions in the set of available data (e.g. the lack of a maturity table).
[7] Under both approaches it is assumed that the bank cannot resort to any external liquidity support.
[8] The bank-specific liquidity shock (withdrawal of customer and interbank funds) may be the result of actual or presumed credit losses, of a (two- or three-notch) downgrading in credit ratings or of the loss of reputation due to other reasons.

Table 1

Stress coefficients concerning cash inflows and liquid assets[9]

Cash and settlement accounts	Total stock	100%
Hungarian governement securities and central bank bonds	Total stock	98%
EMU government securities	Total stock	95%
Listed shares	Total stock	90%
Central bank and interbank deposits	Maturing within 1 week/1 month	100%
Customer loans (excl. overdrafts)	Maturing within 1 week/1 month	100%
Overdrafts		0%
Other assets	Maturing within 1 week/1 month	80%
Income (interest, fee, etc.)	Due within 1 week/1 month	80%

to values used in the MNB's collateral management, whereas conservative estimates were used for other items.

One of the important aspects of the stress scenario concerns the possible assumptions related to the granting of new customer loans (or the rollover of maturing loans). On the basis of international banking practices, it is assumed that banks make an effort to roll over maturing customer loans. However, in a crisis situation, the rollover of maturing loans is probably impossible to achieve in full measure, and the renewal rate may substantially vary by customer groups and types of loan. Since the cash flows linked to the various loans are only available in an aggregated form, a distinction can be made between bank overdrafts and other loans (with maturities).[10] In defining the stress coefficient it has been assumed that bank overdrafts are automatically rolled over, i.e. they are not paid back during the crisis period. Our assumptions concerning the loan renewal rate can be considered conservative as, at the level of the banking system, bank overdrafts account for 70 to 80 percent of loans maturing within one month. Table 1 contains a summary of the stress coefficients concerning cash inflows and liquid assets.

For cash outflows, it has been assumed that non-deposit liabilities maturing within 1 week or 1 month (e.g. interbank funds) are not rolled over, as they are highly sensitive to the worsening of risk assessment by market participants.[11] As the stress test examines the shock absorbing capacity of banks on a stand-alone basis, one important assumption is that potential parent bank assistance (or the rollover of parent bank funds) is not taken into consideration. As far as off-balance sheet items are concerned, with regard to guarantees, those expected to be drawn down are included, while with regard to credit lines, the actually reported amount or 5 percent (1 week) and 15 percent (1 month) of the full amount have been taken into consideration.[12] Table 2 contains a summary of the stress coefficients concerning cash outflows.

Resilience of banks to liquidity shocks is measured by comparing the one-week and one-month maturity gaps calculated through the assumption of the stress scenario with the customer funds. That indicator ('liquidity stress indicator') indicates the maximum rate of withdrawal of customer funds a bank is able to pay out, provided that it is unable to obtain new funds on the unsecured money market.

Finally, a few restricting assumptions must be mentioned before the presentation of the stress test results:

- Since the maturity structure is unavailable at a consolidated level or in a currency breakdown, the results are based on 'unconsolidated' and total (HUF + foreign currency) data. However, with regard to the substitutability between various currencies (due to well-developed FX swap markets), the importance of the lack of a currency breakdown was not considered significant.

- Since no maturity breakdown is available for the off-balance sheet items related to derivative transactions, the impact on liquidity of these transactions cannot be accounted for in the analysis.

[9] For cash inflows, higher stress coefficients indicate higher probability of cash flows incoming.

[10] Information on bank overdrafts is available from balance sheet data. It is assumed that all bank overdrafts are in the 0-7-day maturity band. If the amount of bank overdrafts was lower than the amount of loans falling into the 0-7-day maturity band, the data were adjusted accordingly.

[11] It should be noted that the deposits held by money market funds have been eliminated from interbank funds, as they typically fall into the group of customer funds collected by the banking group.

[12] The latter adjustment was necessary because of reporting errors by some banks.

Table 2

Stress coefficients concerning cash outflows (excl. customer deposits)[13]

Interbank liabilities (deposits)	Maturing within 1 week/1 month	100%
Interbank and other borrowed funds (loans)	Maturing within 1 week/1 month	100%
Debt securities	Maturing within 1 week/1 month	100%
Subordinated liabilities	Maturing within 1 week/1 month	100%
Other liabilities	Maturing within 1 week/1 month	100%
Expenses (interest, fee, operating costs, etc.)	Due within 1 week/1 month	100%
Guarantees	Due to be paid within 1 week/1 month	100%
Undrawn part of credit lines	Either: due to be drawn within 1 week/1 month	100%
	or: (1 week) total stock	5%
	and (1 month) total stock	15%

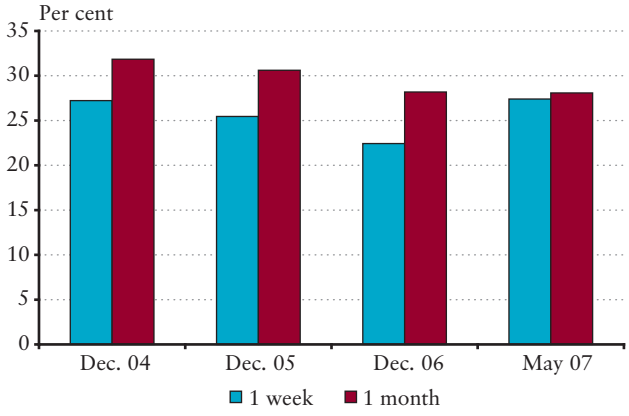
- In our stress test, we do not intend to investigate any contagion effect, which could have a significant impact on the substitutability between the forint and foreign currencies (swap market), amongst other things.

STRESS TEST RESULTS

The results of the liquidity stress test indicate the overall low liquidity risk exposure of Hungarian banks. While the 'liquidity stress indicator' varied widely for banks included in the analysis, the average rate was over 20 percent and 25 percent, respectively, over the one-week and one-month time horizons for all periods (Figure 1). The typically lower value of the one-week stress indicators is partly due to the fact that, up to the end of 2006, central bank deposits maturing between 1 and 2 weeks were not available for short-term management of a potential liquidity shock.[14]

Figure 1

Average one-week and one-month 'liquidity stress indicator' of the banks included in the analysis"

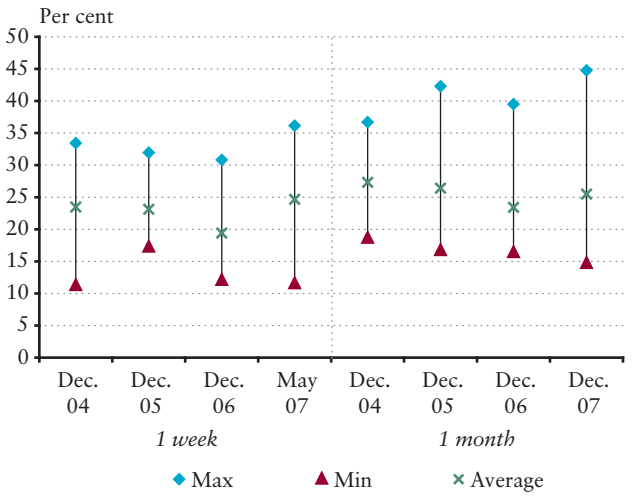


The distribution of the 'liquidity stress indicators' of systemically important large banks was separately studied, as these banks control around 80 percent of all deposits in the banking system.[15] While for the seven largest banks, the average value of the stress indicators is somewhat lower than the banking sector average, it still exceeds 20 percent over the one-week time horizon and reaches 25 percent over the one-month time horizon (Figure 2). At the dates examined, the minimum of the one-week 'liquidity stress indicator' for large banks was relatively volatile but it still remained above 10 percent.

The fact that no suitable benchmark is available for our 'liquidity stress indicator' renders the interpretation of the results of the stress test more difficult. It should also be noted

Figure 2

Distribution of one-week and one-month 'liquidity stress indicators' for large banks



[13] For liabilities, the 100-percent stress coefficient indicates that the respective liabilities are not rolled over.

[14] However, following the replacement of the two-week central bank deposit by a central bank bond from early 2007, this instrument has theoretically also become immediately available for the bridging of a potential liquidity problem.

[15] For the purposes of this article, systemically important banks are those with significant market shares in deposit markets.

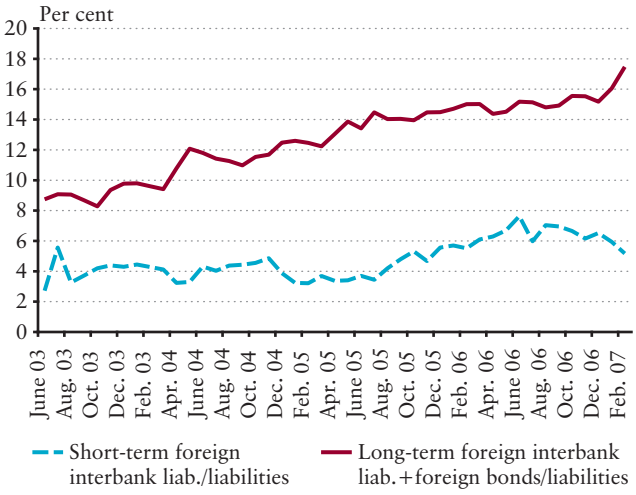
that the comparability of the results between various banks is also limited, partly because of the differences in business models (and financing patterns), even within the relatively homogeneous group of large banks. However, on the basis of the international experiences of banking stress test practices and historical experience of bank runs in Hungary, we believe that our assumptions can be considered to be conservative. According to the survey of Joint Forum (2006), in crisis scenarios, banks typically assume a withdrawal level lower than 10 percent for 'retail' deposits within a month, due primarily to the role of deposit insurance.[16] This is not contradicted by the Hungarian experience of bank liquidity crisis episodes as, in the case of Postabank, the withdrawal of customer funds at a level close to 20 percent essentially affected security-type liabilities not covered by deposit insurance.

Moreover, according to the Joint Forum survey, for wholesale (corporate, bank, government) deposits, banks presume a withdrawal rate of 20 to 50 percent at worst, where the lower and higher values refer to corporate and interbank deposits respectively. In our stress scenario, however, we calculated using a 100-percent outflow of interbank funds. With regard to the fact that our stress scenario also considers potential cash outflows due to contingent liabilities, our hypothetical scenario can be considered as rather extreme. Taking this into account, it is considered that, the average one-week and one-month "stress indicators", at 25 percent in May 2007, for systemically important banks are high. However, it should also be taken into account that the minimum of the liquidity stress indicator for large banks is considerably below the group average.

Two important factors should be mentioned that explain the typically high liquidity shock absorbing capacity of large Hungarian banks. First, the Hungarian banking system still has a substantial structural surplus liquidity, which increases the available buffer for containing potential shocks, the degree of which may vary from bank to bank. It should also be emphasised that, in recent years, banks have made significant efforts to obtain funds with longer maturities (over one year) for financing the rapid growth in lending. This is reflected in the maturity breakdown of foreign market funds of large banks, accounting for the overwhelming part of lending activities. In parallel with the brisk increase of long-term foreign-currency loans, the ratio of long-term

Figure 3

Foreign market financing sources of large banks broken down by maturity (as a percentage of liabilities)



foreign interbank funds and bonds to liabilities increased steadily and, by the end of 2006, its share was 15 percent as compared to the 6-percent ratio of short-term foreign interbank funds (Figure 3). Altogether, the transformation of the funding structure of banks has so far not been accompanied by a significant increase of rollover risks.[17]

CONCLUSIONS

On the basis of the results of the stress test performed for Hungarian banks, it is believed that the current liquidity risks essentially do not pose a threat to financial stability. The shock absorbing capacity of large banks, controlling the overwhelming majority of deposits, is generally high, but even that of lower-liquidity banks can be regarded adequate. Our conclusions are corroborated by the fact that the possibility of parent bank assistance has been disregarded in the tests, as they were designed to assess the resilience of Hungarian banks to shocks on a stand-alone basis.[18] The high liquidity shock absorbing capacity is partly due to the fact that, in parallel with the rapid increase in long-term lending, banks have been able to substantially lengthen the average maturity of their liabilities. In addition to that, substantial structural surplus liquidity has remained in the Hungarian banking system, which increases the reserves available in order to survive potential liquidity shocks.

[16] The Joint Forum is common forum of the international associations of financial regulators (BCBS, IOSCO, IAIS) in the banking, securities and insurance sectors.

[17] This analysis does not concern the profitability risks related to the change in the funding structure. It should be noted, however, that the profitability risk has increased at a higher rate than the renewal risk, since foreign interbank funds of a maturity over 12 months bear interests at variable rates and typically have a short re-pricing period.

[18] As referred to above, one of the reasons behind disregarding potential parent bank assistance is the possibility that an individual shock may ultimately be the result of parent bank problems.

On the assessment of the results, the fact that our stress test was restricted to the investigation of the impact of a bank-specific scenario should also be taken into consideration. One of the possible directions of the further development of stress test practices could be the examination of the impact of other risk scenarios on the liquidity of banks. Of these risk factors, the more in-depth analysis of the risks arising as a result of the potential tightening of global liquidity and of intra-group financing relations may be of primary importance. There are two reasons that seem to require giving increased consideration to group-level contagion risks. First, since some large foreign-controlled banks rely on parent bank financing to a substantial extent, shocks affecting the parent bank or other group members may generate serious liquidity problems for their Hungarian affiliates. Similarly, for Hungarian banks following an active international expansion strategy, negative shocks affecting their subsidiaries can have a significant impact on the liquidity of parent banks.

With regard to the above risk factors, it may prove useful for banks to regularly perform liquidity stress tests taking into consideration the specific features of their operations. While there has been considerable progress in this area in recent years, stress tests becoming an even more established standard risk assessment tool would certainly supportive of stability. The practices employed in order to measure the ability to withstand shocks under extreme circumstances serve practical purposes (Matz and Neu, 2007). First, measuring the level of preparedness for the management of extraordinary situations may reveal potential (hidden) liquidity problems. On the other hand, stress tests should be integrated into the risk management practices of the bank, e.g. by taking their results into consideration on reviewing risk limits or contingency plans.

REFERENCES

Cihák, M. (2007): "Introduction to Applied Stress Testing", *IMF Working Paper* 07/59.

ECB (2006): *"EU Banking Structures"*, European Central Bank, October 2006.

IMF (2007): *"Hungary – 2007 Article IV Consultation Concluding Statement of the IMF Mission"*, http://www.imf.org/external/np/ms/2007/050707.htm.

Joint Forum (2006): "*The management of liquidity risk in financial groups*", Bank for International Settlements, May 2006.

Matz, L. and P. Neu (2007): *"Liquidity Risk Measurement and Management. A practitioner's guide to global best practices"*, Wiley Finance.

MNB (2007): *"Report on financial stability"*, April 2007.

World Bank (2007): "Credit Expansion in Emerging Europe: A Cause for Concern?", in: *World Bank EU8+2 Regular Economic Report*, January 2007.

Péter Gál: Unfavourable investment data – risks to economic growth?[1]

Future potential economic growth is a factor of key importance in judging the expected output gap and the inflationary pressure it entails. One important element of potential growth is the level and growth of real capital, which is materialized via investment. The tendency of investments thus provides an indication on the future potential growth. On the other hand, investments in the economy are part of aggregate demand, and thus in addition to its impact in the future, it also affects the present output gap and inflationary pressure. Finally, investments also offer insight into the expectations of economic actors regarding future prospects.

The decline in the volume of investment registered in 2006, unprecedented in the last ten years, thus has particular significance from the central banks' perspective. This decline was experienced in a wide range of breakdowns: among the types of investment assets (construction, machinery purchases) as well as in corporate and household sector private investment. The drop in the household and non-tradable corporate sectors is in line with weak domestic demand resulting from the fiscal adjustment. But the fall of investment in the tradable sector is surprising in light of the favourable current state of and outlook for European economic activity. Although there was a modest correction in this trend in the first quarter of 2007, a lasting weakness in capital expansion may indicate the long-term presence of a disadvantageous investment climate in Hungary.[2]

INTRODUCTION

In 2006, the volume of national economy investment in Hungary dropped for the first time in the last 10 years. Investment in the export-oriented manufacturing industry started to decrease even before the announcement of the fiscal adjustment package. In the past, international economic expansion, primarily in the Western European countries, was the most important driver for investment by domestic industrial producers. Therefore, in light of the presently favourable developments abroad, the current drop-off in investment is surprising and represents a cause for concern with regard to Hungary's potential growth.

Consequently, it is very important to understand what factors are behind the weak performance of manufacturing investment, and to investigate to what extent these factors can be regarded as temporary or permanent. This paper addresses these issues, after describing the general role of investment and some stylised facts, as well as briefly explaining the investment behaviour of the sectors (non-tradable corporations, households, government) determined primarily by domestic demand.

THE GENERAL ROLE OF INVESTMENT

Developments in economy-wide investment deserve attention in three main respects. First, investment is an important element of aggregate demand: in Hungary, similarly to the converging countries, it amounts to 20-25% of GDP, and, due to its volatility, it also has a significant impact on changes in GDP.[3] As part of aggregate demand, it influences the current output gap and thus the current demand-side inflationary pressure as well.

Secondly, as a result of investment, the available capital of the economy expands. That is, there are more production facilities and thus higher potential GDP. Therefore, on the supply side, investment determines to a significant degree potential future economic growth, that is, a growth rate along which the output gap is zero and no demand side inflationary pressure arises.

[1] I am grateful to Gábor Kiss and Mihály András Kovács, for their help and suggestions which greatly contributed to this paper, and to other colleagues in the Economic and Monetary Policy Directorate, in the Financial Stability department and in the editorial board of MNB-Bulletin for their useful comments. All remaining errors are my own responsibility.

[2] The MNB already indicated this problem in its 2006 publication "Analysis of the convergence process", and also drew attention to it in the evaluation of the actual developments in its inflation reports published in February and May 2007. As the data were unfavourable for several quarters, this highlights the possibility that the trend was not temporary and would not correct itself automatically after the fiscal adjustment. Even though the Q1 2007 data show a significant increase in investments in manufacturing, bearing in mind the noisiness of investment data (see Box), and the sustained trends that lasted for several quarters, this exceptionally good data is considered, for the time being, as merely making up for several quarters of missed capital formation. Although this single data point has reduced the risks of potentially unfavourable long-term prospects, in itself it does not invalidate the possibility of a slowing trend in investments. The objective of this paper is to review the detailed arguments on the long-term or temporary nature of the investment problem and to describe the facts in more depth.

[3] Investments are one of the most volatile GDP components, and this is especially true in the converging countries (Benczúr-Rátfai, 2005).

Finally, business investment reflects companies' future expectations. The reason for this is that investments are worthwhile only if they are expected to be profitable enough.[4]

The relative importance of these three aspects differs according to which sector (corporations, households or the government) is investing. Additional investment by any sector increases aggregate demand, however, from the aspect of potential growth, corporate investment plays the most important role. Although clearly-targeted and appropriately implemented public investment – e.g. infrastructure improvements – also has a beneficial impact on future production potential, its effect is rather indirect and uncertain, as it does not directly create production facilities.[5] Information on the private sector's profitability prospects is mainly reflected in the dynamics of corporate investment and, to a lesser extent, in the dynamics of household investment.

STYLISED FACTS ON HUNGARIAN INVESTMENTS IN INTERNATIONAL COMPARISON

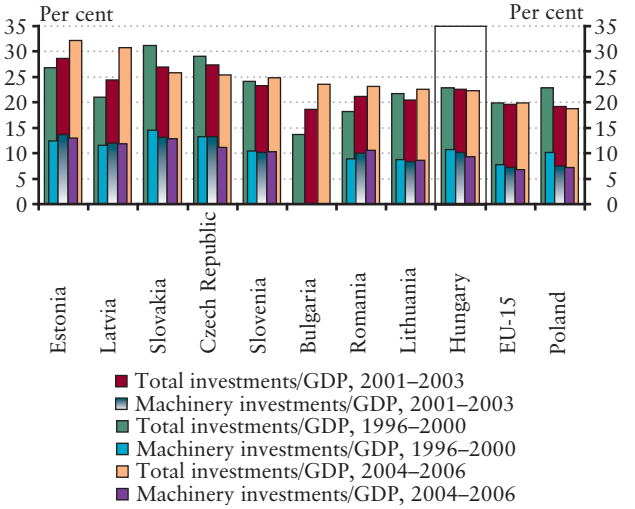
The level of economic development is largely determined by the amount of available real capital (machinery, equipment, buildings, intangible assets, etc.). More capital can generate higher income assuming constant levels of labour and productivity.[6] Thus, in less developed countries with lower per capita income, the per capita amount of capital is also generally lower. Investing in capital in converging countries with a lower amount of capital thus brings higher yields than it would in a developed country. This potentially higher yield motivates economic agents to expand capital at a faster pace than generally seen in developed countries. The expansion of fixed capital is, by definition, investment.

The goal of achieving convergence as fast as possible requires that Hungary should also spend a higher proportion of its total income on expanding the stock of real capital, i.e. on investment, as compared to developed countries. One indicator which captures this is the investment-to-GDP ratio. In comparison with other countries, Hungary's investment-to-GDP ratio stabilized at a higher level than that of the developed EU member states, in line with the expected economic convergence and higher growth. However, Hungary's ratio stands at a somewhat lower level than that of countries at a similar state of development (Figure 1). This was especially evident in the period following the latest EU expansion, starting from the end of 2004, when only Poland has shown a lower investment rate than Hungary in the region.

From the aspects of production capacities and possible future sources of income, corporate investment and machinery investment have special significance apart from the figures on total investment.[7] As statistical methodology problems render

Figure 1

Total investments and machinery investments in some of the new EU member states and in the developed European countries (EU-15)*



** Current price data expressed as a percentage of GDP, in a descending order of the total investment rate between 2004-2006. No data is available on Bulgarian machinery investment.*

Sources: Eurostat and MNB calculations.

[4] Household investments are mainly the expansion of residential property, thus they are not influenced so much by the general, short-term and medium-term changes in the economic cycle, but rather by the particular evolution of the property market, especially its supply side and the development of state subsidies. Over the long term, the determining factors may be demographic trends, financial deepening accompanying the economic development, and, to a certain extent, long-term income expectations.

[5] From the aspects of the purpose of their use, investments funded by the European Union are similar to government investments. The MNB's main finding in its convergence analysis in 2006 was that, according to earlier European experience, these investments, in general, have a fairly modest additional growth effect.

[6] This can be illustrated within an aggregate production-function approach. According to this, the level of production *(Y)* in the economy depends on three factors: the level of technology *(A)*, the amount of available real capital *(K)* and the amount of labour *(L)*. The general form is:

$$Y = f(A,K,L),$$

where the function *f()* is monotonously increasing in all of its variables.

[7] The other large group of investment goods cover construction investments. These investments are household, corporate property and infrastructure investment, implemented typically through state contracts. Investment in intangible assets (e.g. computer software) is has small share in Hungary's domestic investments, constituting about 2-3% of all investments in the last few years. Out of these components, mostly the machinery-type investments move together with the economic cycles (European Commission, DG Economic and Financial Affairs, 2007).

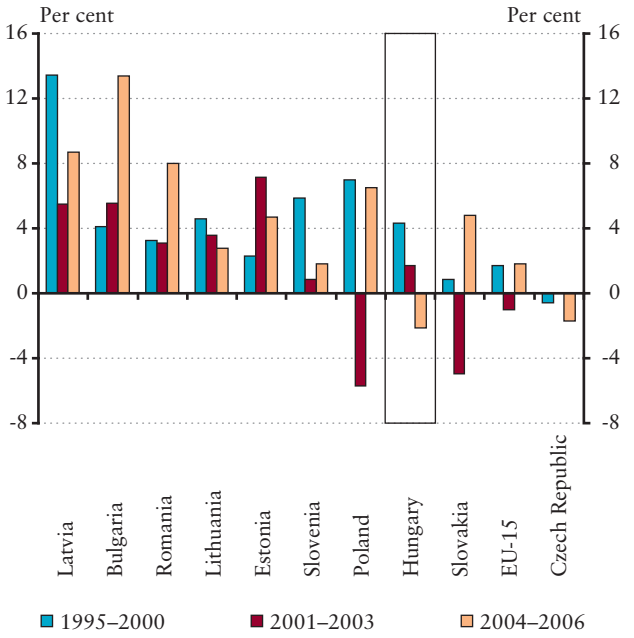
international comparison of the former breakdown difficult,[8] we use the latter, and look at the ratio of machinery investment to GDP (Figure 1). The levels of these ratios are less than half of total investment in every country. The level in Hungary is higher than the average of the developed EU countries, but is somewhat lower than in most of our regional competitors (the new member states), and it also shows a falling trend.

Furthermore, from the aspects of growth and aggregate demand, the real growth difference between investment and income also deserves attention. The relationship between growth in investment and growth in income can be demonstrated by the difference in their real growth rates. This is illustrated in Figure 2, which shows that investment can be considered a less powerful source of growth on the demand-side than it is in the case of our competitors in the region. Furthermore, the tendency seen in the difference of growth rates reveals that, besides the Czech Republic, Hungary is the only country where growth in investment has been lower than GDP growth since the start of the current upswing in the European economy in 2004. Consequently, the expansion of capital may well have been lower than necessary to serve the presently dynamic external demand, and that may create a supply side problem as well. This finding seems to be in line with some signs indicating that Hungary is possibly less involved in the current European economic boom than during earlier expansions.[9]

Taking into consideration that Hungary's lag behind the region's other countries is not significant in terms of per capita income, the tendencies presented here do not indicate that a serious investment problem has existed for a long time. However, what needs to be emphasized is that these trend put Hungary somewhere in the middle group among the region's countries and point in an unfavourable direction, especially according to the 2006 data.

Figure 2

Difference between the real growth rates of gross fixed capital formation and GDP



Notes: in a descending order of the average difference over the whole period. EU-15: the EU member states' average before EU enlargement in 2004.

Sources: Eurostat and MNB calculations.

Difficulties in analysing investment data

The academic economic literature and empirical observations suggest that the distribution of company-level investment is strongly concentrated over time.[10] This concentration is stronger than in the case of other corporate-level variables (e.g. corporate value added) with macro-economic significance. The analysis performed on Hungarian data also supports this proposition: in the period reviewed (1994-2004), the average company's largest value added exceeded the company's average value added by 60%, while the largest investment is more than two and a half times (260 per cent) higher than the investment of an average year.[11,12] The cross-sectional distribution of companies is also

[8] This is mainly due to the fact that the accounting of some large investments (e.g. infrastructure developments, PPP transactions etc.) is not clear, because it is sometimes ambiguous whether they belong to the state or to the corporate sector.

[9] The question marks regarding Hungary's export performance are presented in Box 2-1. of the MNB's "Report on Inflation" (May 2007), and they also underpin this claim. Furthermore, the 2006 manufacturing investment and production data since the middle of 2006 moved in an unfavourable direction compared to the dynamic growth seen all over Europe.

[10] The theoretical explanation is mainly linked to the costs of the implementation of new investments, to the difficulties of disposing of used capital and to the uncertainties regarding future profits. As a result, the reaction of capital to economic shocks is non-linear and consequently, investments are concentrated in time around the occurrence of a major shock. The conclusion of studies on American data (Carruth et al., 1998, Doms–Dunne, 1998) gives empirical evidence that companies strongly concentrate their investments over time.

[11] The analysis used companies' tax return data. Corporate level value added and investment data are approximated following the methodology described in the papers of Kátay-Wolf (2004, 2007).

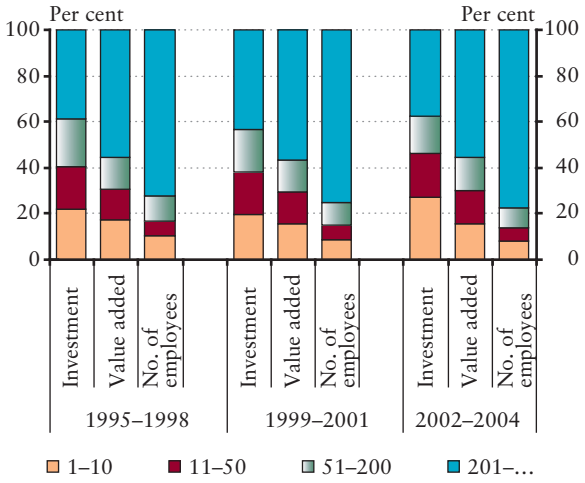
[12] The distribution of these company-specific ratios is strongly asymmetric (sloped to the right), therefore, we consider the average company to be the one with the median maximum/average investment or value added rate. The company-specific maximum/average ratios are calculated according to the following formula:

$$I^i = I^i_{max} / I^i_{average}$$

where i is the individual company, I^i_{max} is the value of maximum investment during the period of 1994-2004, $I^i_{average}$ is the average investment value for the period. We compared the median value of the distribution of these I-s with the median of the distribution of analogously defined company-specific value added ratios.

Figure 3

Distribution of investment, value added and number of employees among companies



**Company-level data are summed according to the rating intervals (10 largest, 11-50th place, etc.), then these sums are divided by the whole sample aggregates.*

Source: Annual tax returns of companies with double-entry bookkeeping (tax authority data).

more concentrated in the case of investments: on average for 2002-2004, the 10 largest investors accounted for nearly one-quarter of all investments, and the 50 largest accounted for nearly half of investments. These proportions are lower in the case of value added and number of employees, and this concentration difference has increased since 1994.[13]

Consequently, the analysis and forecasting of both micro-level and macro-level investment becomes more complicated, since this strong concentration may cause a higher probability that developments are less synchronised among companies, and the individual effects compared to the general economic trends have a stronger influence on the aggregate numbers than in the case of other indices with more even distribution in terms of time and cross-section.[14]

Partly related to this issue is the fact that the volatility and seasonality of aggregate (branch-level, economy-wide) investments are very strong compared to other macro variables (Benczúr-Rátfai, 2005), and this aggravates the problems related to the analysis and forecasting of short-term processes. Hungary has a special feature in terms of seasonality: among the OECD countries, only in Poland does the last quarter's data represent a higher (nearly 40%) proportion of the whole year's data than in Hungary.

Data availability is also a serious problem. The separation of aggregate investment into economically relevant groups (e.g. business investment, government-related investment, household investment) can only be performed with very rough approximations. The fundamental question from an aspect of the economy is whether the investment is of a business nature and thus reflects the future expectations of private companies, or the investment is initiated by the government. This, however, cannot be pinpointed unambiguously from the quarterly time series, because neither the legal corporate form (whether the party investing is an enterprise or not) nor the branch data (agriculture, manufacturing, etc.) reflect this aspect accurately. The reason why the legal form may not be accurate is that there are several state-supported companies which often make their investment decisions without considering market prospects, even though they are legally qualified as enterprises (e.g. BKV, MÁV, MVM, etc.). The problem with the branch-based breakdown is that the individual branches, even in a relatively detailed breakdown, include a mix of business-like enterprise companies and companies with government-related investments.[15] Due to the strong concentration and the sectoral breakdowns that can only be monitored by means of approximations, especially in the case of quarterly data publications, the short-term developments must be evaluated with caution, taking into account several breakdowns (e.g. branch-based, legal form based, types of assets) simultaneously.

Finally, it is important to note that investment data are revised relatively often and to a great extent. This is most probably not a Hungary-specific feature: for instance, the Bank of England also notes that investments are subject to the most revisions among the GDP items in the United Kingdom (Castle-Ellis, 2002).

[13] Obviously, the members of the largest companies' group change over time. According to our preliminary calculations, these changes become visible mostly in the investments.

[14] A good example for this is the investment data for Q1 2007, showing an unprecedented, 53% increase in the volume of manufacturing investment. According to press news, a multinational firm engaged in rubber manufacturing is implementing a roughly HUF 100 billion (EUR 400 million) investment in Hungary. In order to filter out the impact of this huge investment, we estimated the manufacturing industry's volume increase in investments without rubber manufacturing activity (NACE code 25). Without this sub-industry, the result is a significantly lower 15-20% volume increase, which is approximately the same magnitude as was experienced in the past economic booms of Hungary's export markets.

[15] The *Transport, storage and communication* (letter I in NACE) branch is a good example for this, because it includes motorway building, railway track renovations and investments of the Magyar Posta (Hungarian Postal Service), besides the investments of large business investors, e.g. that of Magyar Telekom.

EVALUATION OF THE ACTUAL DEVELOPMENTS

The robustness of the decline in investments in 2006 is demonstrated by the fact that the volume of both machinery-type and construction-type investment showed a decline in the last two quarters as well as in the annual figures of 2006. According to sectoral estimates, investment by branches associated with the corporate and household sectors has also decreased. Some growth was experienced in investments related to the government caused by motorway construction, but even this slowed down after the high growth rates of 2005.[16] In the following, we review the main reasons for the weak investment intentions, sector by sector.

On average, corporate investment accounts for 55-60% of total investment. Within this category, the investment climate is clearly unfavourable for companies producing goods or providing services for the domestic market. The reason for this is that even though Hungary's highly open economy is heavily influenced by the present favourable external upturn, the ongoing fiscal adjustment package will still cause a slowdown in domestic activity over the next year or two. The expected deceleration of domestic demand will have an unambiguously negative impact on companies involved in the non-tradable sector, beyond the impact of a more general, unfavourable business environment also affecting export-oriented industries, as described later.

Household capital formation accounts for 20-25% of total investment, and is mostly related to real estate. It has also moved in an unfavourable direction. This development was in line with the downturn experienced in the real estate market over the last two years. Due to the expected reduction of households' disposable income and also to the structural problems in the real estate market (slow adjustment of prices and quality), no significant change is expected over a one-to-two year horizon.

The third large sector is the government: it implements approximately 15-20% of investments in the economy. Investments related to the government represent the most variable items, and the uncertainties related to the accounting of such investments (e.g. PPP transactions, quasi-fiscal institutions, rating of public service providers) also make it difficult to analyse and precisely separate them from companies operating under market conditions (see Box). All what can be stated with high certainty is that the pace of motorway building slowed in 2006 compared to the earlier high level, although it still had a positive impact on the total investment figures. Looking ahead, there is a significant level of uncertainty in this respect as well, because it is unknown to what extent the infrastructure investments, partly financed by EU funds, (metro line construction in Budapest, railway improvements, road building, etc.) will replace already planned investments, and/or to what extent they will be accounted in the corporate or the government sector.

All of these developments thus can be directly or indirectly explained by the government's restriction on spending and by the weakening domestic demand, both of which were induced by the fiscal adjustment. As these factors are expected to be temporary, the decline in investment is probably also temporary in the sectors discussed so far. The income of the manufacturing industry, which is one of Hungary's most important industries of terms of exports and international competitiveness, is primarily determined by the increasingly robust external demand. Accordingly, in the past, the strongest driver for this industry's investment activity was European economic activity. However, the relationship appears to be weakening, as this industry has been gradually showing slower investment growth rates since 2004, whilst external demand has gathered pace. The favourable figure for the first quarter of 2007, in itself, does not rule out the possibility that Hungary may be facing a longer-term investment problem. In order to explore this issue, we must review the major factors influencing decisions on corporate investment, and also look at how these factors can explain the data over the last few years.

Thinking in a simplified corporate financing framework using the discounted present value approach, investment is a function of profits (cash-flow elements) and the cost of capital (discount rate). The more favourable the profit prospects, and the lower the costs of capital, the more projects become worthwhile to implement, i.e. the more sense it makes to invest.[17] Furthermore, the modern theoretical and empirical economic literature puts an

[16] The decline can be widely observed in other types of breakdowns as well: there was a reduction in the investment volume of nearly every legal form of corporate enterprise (limited companies, joint stock companies, etc.). Furthermore, according to the breakdown by branches, a positive change in volume was experienced only in the *Hotels and restaurants and Financial intermediation branches* and in the activities linked to the state (e.g. the *Transport, storage and communication branch,* partially containing motorway building.). Even though in Box we note that the investment time series are revised relatively often and to a great extent, looking at their past magnitude and the widely observed unfavourable tendencies of 2006, we can conclude that future possible revisions will probably not change the current qualitative picture.

[17] It is also worthwhile to mention that the majority of empirical analyses found that the income and the expected income have a relatively good explanatory power, whilst the effects of the cost of capital are difficult to measure, especially at a macro-economic level. Based on Hungarian company-level data, Kátay-Wolf (2004) showed a robust and significant relationship between company-level cost of capital and company-level investment, while the results of Reiff (2006) support significant, albeit moderate, macro-effects of profitability shocks.

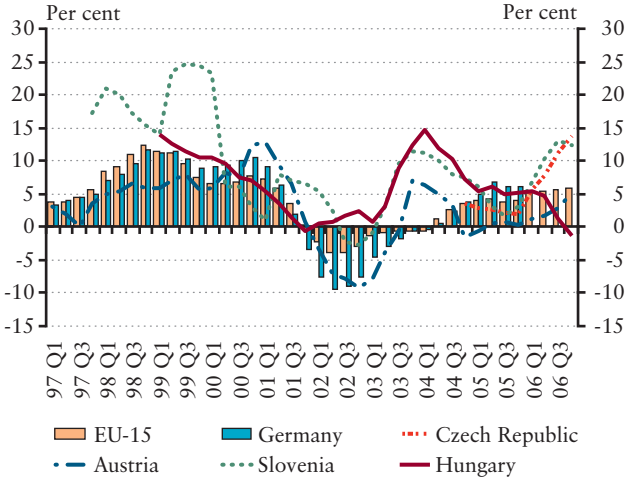
increasingly strong emphasis on the crucial role of uncertainty in determining investments. This is the so-called real-option theory of investments (Carruth et al., 2000; Carlsson, 2004; and Bond-Lombardi, 2004). The main driver of the effect is that the adjustment of capital has significant "sunk costs". It means that if economic developments turn unfavourable and if part of the capital becomes redundant, then its disposal can only be done with significant losses. For this very reason, in an uncertain economic or regulatory environment (frequent, unexpected changes in taxes, etc.), it is more worthwhile to wait and postpone investments.

Profits, which are the first and the empirically the most important factor, deserve a breakdown to further elements. These are the demand factors (revenues), productivity, and the costs of production and of investment, including the implicit costs incurred in running the business (e.g. administration costs). The demand of export-oriented industries is directly affected by external economic activity, while – due to Hungary's high degree of openness – it also has an effect on non-tradable companies' demand, although this effect is indirect and operates with a lag.

Therefore, from the aspect of revenues, the actual demand and future expectations of Hungary's export markets[18] play a key role in determining the export sector's investment activity, just as the data supports. In light of this, the strong uncertainty which surrounded the sustainability of external economic activity could well explain the slowdown in investment in the manufacturing sector in 2004-2005 (Figure 6). This general, economic environment-driven uncertainty clearly appeared in Hungary's most important export market, Germany. The IFO indices reflecting company managers' expectations in Germany were at unusually high, historic levels, and it was hard to reconcile with the actual data on German industrial production dynamics. Furthermore, German industrial orders, compared to earlier periods of economic recovery, increased, in an unusual, volatile way with repeated hiccups (Figure 5). A sort of "wait-and-see" corporate behaviour due to these uncertainties was seen in other countries in the region as well, and this is best captured by the changes in machinery-type investment (Figure 4).[19] The uncertainty associated with future demand and the ongoing strong growth in actual demand motivated companies to pursue more intensive utilisation of current capacities, rather than to initiate more costly investments.

Figure 4

Annual average volume indices of machinery-type investments in the region and in Hungary's major export markets

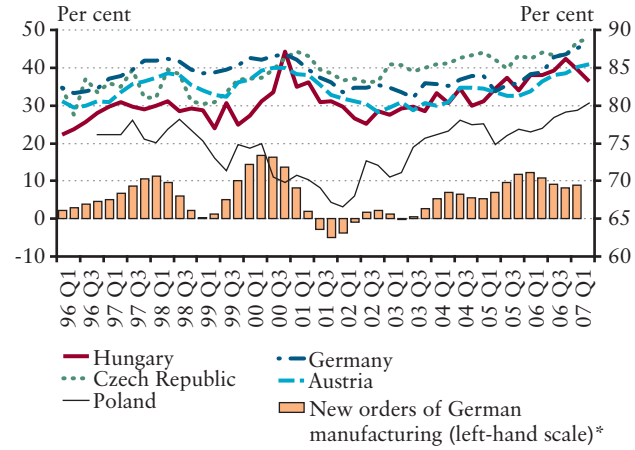


Data are unavailable for Germany in 2006.

Sources: Eurostat, KSH and MNB calculation.

Figure 5

Capacity utilisation in manufacturing in the region and in Hungary's major exports markets, and new orders in German manufacturing



** Year-on-year volume indices.*

Sources: Eurostat and European Commission (Economic Sentiment Indicators).

This tendency was observed both in Hungary and in the countries in the region (Figure 5), as reflected by the historically high levels of the capacity utilisation indices.[20]

[18] Hungary's most important export markets are the developed EU member states, especially Germany.

[19] Machinery-type investment characterise primarily industrial companies, and the majority of the industrial companies' investments are machinery-type investments. Hence, the analysis of movements of machinery-type investments may be the right approach to the study industrial investments; that offer a wider range of available international comparative data.

[20] Although the last two Hungarian data points indicate a decrease, the capacity utilisation index of the Enterprise Analytical Institute (GVI) of the Hungarian Chamber of Industry and Commerce shows a continuing increase reaching a historical record in Q1 2007. Hence all what we could robustly state on the level of capacity utilisation is that it reached historical heights, but its actual tendency is not unambiguous so far.

The uncertainty was finally replaced by sustained, stronger-than-expected external demand (German GDP growth in 2006 was 2.8% compared to expectations of around 1.2-1.6% in 2005), accompanied by a continuous improvement in future growth prospects.[21] Consequently, in the neighbouring countries, relatively strong investment activity started in 2005. In Hungary, just the opposite happened: investment activity tapered off (Figure 4), and this divergent path is apparent in total investment as well as machinery-type investment, which is primarily implemented by industrial companies.

Thus, even before the announcement of the fiscal adjustment, divergence from the regional trend had already started, and, as a result, the Hungarian economy experienced low investment growth rates such as were last seen when the European economy bottomed out in 2001-2002. Back then, however, due to the American stock market bubble burst, the deceleration in European growth was generally expected, and therefore it might have seemed more wise to meet the still strong European demand via higher capacity utilisation rather than by implementing new investments.[22] This explanation is further supported by the fact that similar developments were seen in other countries in the region as well as in Hungary's export markets (Figures 4 and 5). The economic downturn came relatively fast around 2001, and it was accompanied by a change in capacity utilisation.

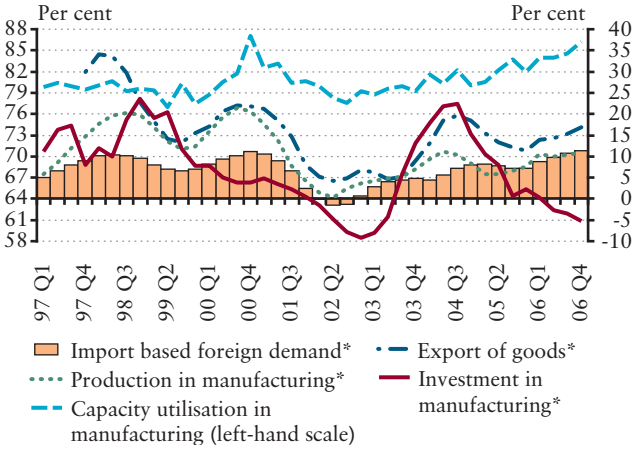
Around the end of 2005 and the beginning of 2006, it became increasingly clear that growth prospects were favourable in Europe, and they were indeed justified by the data. However, in Hungary, investment missed the upturn, therefore the companies can only satisfy the external demand by means of historically high level of capacity utilisation. This explains the seemingly contradicting numbers of low investment, strong exports and industrial production growth in 2006 (see Figure 6).

DOES HUNGARY FACE A LONG-TERM OR TRANSITORY INVESTMENT PROBLEM?

The depressed investment intentions of Hungarian companies may thus also be associated with country-specific factors that cannot be linked exclusively to the increase of financial burdens resulting from the austerity measures, as the unfavourable trend was also observed before the announcement of those measures. Consequently, we can

Figure 6

Investment, production and capacity utilisation in manufacturing, and developments in external demand and exports of goods



** Annual average volume indices.*

Sources: Hungarian Central Statistical Office, Economic Sentiment Indicators (European Commission) NIGEM database, MNB calculations.

elaborate on two hypotheses on the future evolution of investment: (1) a rapid, large-scale correction, in which case the investment problem only arose due to temporary uncertainties and merely prompted companies to "wait and see"; or (2) a mild, slow correction that only makes up for the missed investments of the past and may imply, even after the disappearance of the temporary problems, lower investment growth over the long term as well. If we wish to identify the long-term or transitional nature of Hungary's divergence from the region, we must investigate the nature of the country-specific factors. As already mentioned, companies' profits are also influenced by other factors than demand; productivity, competitiveness, the costs of production and investments and the uncertainties associated with them (i.e. costs of capital). Thus, we must seek an explanation among these factors.[23]

In addition to the technologies and efficient management techniques applied by companies, the quality of the domestic infrastructure, the perception of the operation of authorities and the quality of human capital all determine the level of current and expected corporate productivity achievable in the domestic business environment. In its 2006 convergence analysis, the MNB highlighted the fact that productivity

[21] The major international forecasting institutes all project higher growth in Europe for the years to come than in their earlier projections.

[22] The MNB's inflation report of December 2000 elaborates this hypothesis (page 41).

[23] Changes in share prices of the companies provide us with important information on the expectations of the companies' profit generating ability. But, as a relatively low number of companies of the Hungarian corporate sector are listed on the stock exchange, changes in the stock market indices do not give a true representation of general profit expectations.

Table 1

Growth and competitiveness indices of the World Economic Forum in the region's countries

	Hungary	Czech Republic	Slovakia	Slovenia	Poland	Estonia	Latvia	Lithuania
2001	4.87	4.41	4.36	4.70	4.30	4.87	4.19	4.27
2006	4.43	4.55	4.52	4.77	3.88	5.08	4.45	4.39

Source: Global Competitiveness Report, 2001-2002 and 2006-2007, Growth Competitiveness Index (World Economic Forum). Higher values indicate more competitive economies according to the index.

growth in manufacturing decelerated significantly and continuously up to 2004 (the analysis covers the period between 1995 and 2004). If this unfavourable tendency has continued and has become incorporated into long-term expectations, this may have also contributed to the unfavourable profit prospects in the Hungarian business environment.

The fact that the country is ranked in a worsening position in competitiveness and business environment rankigs of countries is a telling sign regarding productivity developments and, more generally, about the domestic business environment. In the growth and competitiveness evaluation of the World Economic Forum of Davos, Hungary was the country that saw the greatest deterioration in its positions between 2001 and 2006 from among the region's countries (Table 1). Last year, only Poland and Lithuania were ranked behind Hungary. The three groups of the aspects of the index are technology, public institutions and the macro-economic environment, and an absolute or relative worsening of Hungary's position has been noticed in all three of these categories. In another international assessment, in the World Bank's "Doing Business in …" ranking, which reviews mainly the institutional aspects of business environment of countries, Hungary dropped the most in the region during 2005 and 2006, and only Poland is ranked behind Hungary (Table 2). Hungary's position has worsened in nearly all determining factors, and the country was especially low-ranked in terms of protection of investors, costs of registering real estate property, and costs of establishing new enterprises.[24]

Surveys conducted among certain foreign investors may also provide a plausible explanation for the weak industrial investment activity in Hungary. The results of one of these, conducted by the German Chamber of Commerce and Industry in 2006, should be highlighted, especially bearing in mind the fact that Germany is Hungary's most important trading partner and is the main source of foreign investors at the same time. According to the findings of this survey, Hungary was in the lowest third in the rankings of the new EU member states and candidates in nearly every factor determining investments (e.g. productivity, availability of well-qualified labour force, or payment discipline).

The cost of capital is determined by the costs of production and investments, and the uncertainty (risk premium) associated with these. The change in these factors also had an investment-reducing impact: partly due to the fact that the purchase of investment assets has become more expensive as the construction and machinery prices accelerated starting from the second half of 2005 and lasting up to mid-2006, the background of which was the significant weakening of the exchange rate which can also be seen as a country-specific factor.[25] Furthermore, although there was no significant change in the financing costs of capital (as shown in the interest rates and yields of long-term bank loans and of the bond markets), the uncertainties surrounding the macro-economic and micro-economic expectations of future profit prospects may have increased the perceived risks of Hungarian investments. Hence, it increased the expected yield of investment projects, that is, ultimately, the discount

Table 2

Rank of the region's countries in World Bank's "Doing Business in …" business environment ranking

	Hungary	Czech Republic	Slovakia	Slovenia	Poland	Estonia	Latvia	Lithuania
2005	60	50	34	56	74	17	31	15
2006	66	52	36	61	75	17	24	16

Source: Doing Business in 2005, 2006 (World Bank).

[24] According to another widely recognised and often cited rating source, the Competitiveness Yearbook of the Swiss IMD institute, Hungary's relative position also deteriorated in the region between 2005 and 2006. However, in 2007, presumably due to the start of the government's fiscal measures, only Hungary could hold our its position in the region, whilst other countries slipped back.

[25] There was no general, significant price increase of the investment assets in the region and the developed European countries, unlike in Hungary.

rate of the projects.[26] The frequent changes in the business environment generate significant uncertainty in companies' planning and do not encourage long-term investments. It must also be taken into account that Hungary's tax system has undergone several changes over the last few years, and has not seen significant simplification. Moreover, the probability of further rises in companies' financial burdens was boosted by the increasingly unfavourable fiscal situation, and these factors have also had a negative impact on domestic investment plans.

All of these factors (signs of slowing down of productivity, significant macro-economic and micro-uncertainty, unfavourable business environment) can explain the weak investment activity which was already seen before the announcement of the fiscal adjustment, and they also increase the risk of Hungary having become a less attractive investment target than it used to be. This argument is supported by the preliminary figures of the rate of re-invested incomes to profits, which dropped significantly in 2006. It can be viewed as another sign of unfavourable perceptions among foreign investors on the Hungarian business environment.[27]

These factors may have a long-term negative impact on the investment climate if the government's conduct does not improve (e.g. through a more predictable legal and taxation environment), or in the absence of some positive measures (simpler, more efficient operation of authorities, better public services, etc.). The picture was improved somewhat by the announcement of the adjustment package and the start of its implementation, as it corrected the unsustainable fiscal developments and hence reduced part of the uncertainties. However, certain elements of the measures (solidarity tax, increase in statutory supplements) increased the costs of businesses directly, and not only were labour taxes raised, but also those associated explicitly with corporate profits. Taking into consideration that the companies probably understood the necessity of fiscal adjustments, the impact of these increased costs could have been partly considered in the investment decisions and consequently might have appeared in the figures prior to the announcement of the measures. The extent of this depends on whether the companies expected that they would have to bear this proportion of the burden of the adjustments. Taking into account the fact that the successful, growth-promoting fiscal adjustments of other countries in the past did not follow the pattern of the current Hungarian adjustment (MNB, 2006), it is quite conceivable that companies were negatively surprised by the growth in their burdens. Thus, the overall effect of the adjustment measures may even cause a further worsening of the perceptions of Hungary's competitiveness and the expectations of the achievable productivity in its business environment.[28]

Another explanation is based on less severe, non-structural reasons that lead to milder consequences than the long-term deterioration of Hungarian competitiveness. It emphasizes the temporary nature of different sorts of disadvantageous investment factors. According to this argument, the temporary, negative investment factors merely caused companies to wait and postpone investments in spite of the strong external economic activity. Although one negative factor, the uncertainty regarding external economic activity, more or less diminished towards the end of 2005, and the prospects have become significantly more advantageous, the role of other negative, domestic factors became increasingly strong in maintaining a bad investment climate. Such negative domestic factors were the price increase of investment assets, the run-up to the general election and also the deterioration of the fiscal situation; therefore, the companies stuck with their wait-and-see approach, and postponed their investments. It is likely that they perceived the unsustainability of the fiscal situation and saw that it was in need of adjustments, but they could not foresee its means, the expected changes in their burdens and that was still a source of uncertainty. The adjustment was finally implemented in such a manner that led to an increase in companies' burdens and affected them unfavourably. In summary, prior to the announcement of the adjustment package, the uncertainty and the ensuing "wait-and-see" behaviour in the corporate sector were the main factors restraining investment. This explanation thus supports the argument of the transitory nature of the poor investment performance that may turn for the better with the solution of the fiscal problems and with more stable macro-economic prospects.

It is hard to pin down the exact reasons and hence the expected duration of the investment problem on the basis of currently available data, because the increase in corporate burdens as well as other, still prevailing competitiveness problems may all have hindered investment activity since the announcement of the fiscal adjustment. The investment data of the manufacturing industry during the first quarter of 2007 is not unambiguous either: if one outstanding item is

[26] General economic uncertainty is well demonstrated in Hungary's 5-year EUR forward yield-differential which can be seen as an index of country-related risk premium. The movement of this index has been detached from the same index of the Visegrád countries since mid-2004, which can be viewed as a kind of "lagging behind the region" effect, similarly to the case of investment."

[27] One might argue that the still dynamic foreign direct investment (FDI) data of 2006 do not support this hypothesis, but one should not forget that FDI is not the only form of funding of investments and therefore the two time-series did not show a close relationship.

[28] MNB's 2006 convergence analysis also writes about the impact of the 4% so-called 'solidarity tax' on investment and capital expansion (Sub-chapter 4.2).

filtered out, the growth rate is around a level that can only be considered as making up for the missed investments from the past. Furthermore, external economic activity and the associated expectations became more and more favourable over the last year, the relative price of investment assets started to reduce, and the implementation of the adjustment package began. In spite of all of these developments, the export sector's investments did not improve for several quarters, and this highlights the role of factors related to competitiveness problems. As long as the corporate sector does not perceive substantial improvements in the domestic business environment and in its predictability, its expectations of future prospects of productivity and costs will not grow more favourable either, and hence it will not expand its capacity significantly.[29]

CONCLUSIONS

Overall, the investment data project unfavourable developments both from the aspect of future aggregate demand and future production possibilities. It cannot yet be said whether this is a transitory problem which will be automatically resolved after fiscal equilibrium is restored, or if deeper, structural causes are in the background, indicating a deterioration in Hungarian competitiveness.

What can be concluded safely is that the missed investments make it more difficult for Hungary to take full part in the present European recovery. This is a major problem since the external boom and the country's strong export performance should play a key role in counteracting the weak domestic demand caused by the fiscal adjustment. Furthermore, private economic actors' expectations about future prospects and the uncertainties around them are the most defining factors of investments. Therefore, a predictable regulatory and tax environment and a stable macroeconomic environment are of fundamental importance for the upturn of investments and fast economic growth and convergence.

REFERENCES

Benczúr, Péter and Attila Rátfai (2005): "Economic Fluctuations in Central and Eastern Europe – the Facts", *MNB Working Papers* 2005/02, Magyar Nemzeti Bank (the central bank of Hungary).

Bond, Stephen and Domenico Lombardi (2004): "To Buy or Not to Buy? Uncertainty, Irreversibility and Heterogeneous Investment Dynamics in Italian Company Data", *IMF Working Papers* 04/104, International Monetary Fund.

Carlsson, Mikael (2004): "Investment and Uncertainty: A Theory-Based Empirical Approach", *Working Paper Series* 2004:17, Uppsala University, Department of Economics.

Castle, Jennifer and Colin Ellis (2002): "Building a real-time database for GDP(E)", *Bank of England Quarterly Bulletin,* Spring, 2002.

Carruth, Alan, Andrew Dickerson and Andrew Henley (2000): "What Do We Know about Investment under Uncertainty?", *Journal of Economic Surveys,* Blackwell Publishing, vol. 14(2), April 2000, pp. 119-53.

Doms, Mark E. and Timothy Dunne (1998): "Capital Adjustment Patterns in Manufacturing Plants", *Review of Economic Dynamics,* Elsevier for the Society for Economic Dynamics, vol. 1(2), April 1998, pp. 409-429.

European Commission, Directorate-General Economic and Financial Affairs (2007): "Country Study: Raising Germany's Growth Potential", *European Economy Occasional Papers,* No. 28, February 2007.

Kátay, Gábor and Zoltán Wolf (2004): "Investment Behavior, User Cost and Monetary Policy Transmission – the Case of Hungary", *MNB Working Papers* 2004/12.

Kátay, Gábor and Zoltán Wolf (2007): "Driving Factors of Growth in Hungary – a Decomposition Exercise", manuscript.

Magyar Nemzeti Bank (2000): "Report on Inflation" December 2000.

Magyar Nemzeti Bank (2006): "Analysis of the convergence processes", December 2006.

Magyar Nemzeti Bank (2007): "Report on Inflation – Update", February 2007.

Magyar Nemzeti Bank (2007): "Report on Inflation", May 2007.

Reiff, Ádám (2006): "Firm-level adjustment costs and aggregate investment dynamics", (manuscript presented on) *Fifth Macroeconomic Policy Research Workshop on micro behavior and monetary policy*, 26-27 October 2006.

[29] GKI's (Economic Research Institute) business environment index explicitly captures corporations perceived uncertainty regarding the business environment as well as their view on the unreliability of the state's conduct, and this index was low for several consecutive quarters. It is an encouraging sign, however, that the latest, Q1 2007 data show an improvement.

Norbert Kiss M.–Klára Pintér: How do macroeconomic announcements and FX market transactions affect exchange rates?

In this paper we analyse the relation between the EUR/HUF exchange rate, economic fundamentals and FX market transactions. Our results are in line with international experiences: the effect of macroeconomic announcements is transmitted to the exchange rate partly directly, with an immediate change in the exchange rate, and partly indirectly, via the information revealed through the FX market transactions, triggered by the news. We found that macroeconomic news, as well as the buying/selling pressure originating from one-way transactions both affect the level of the exchange rate and volatility. Our results also show that around pre-scheduled data releases the one-way transactions move the exchange rate more than under normal circumstances. Furthermore we broadened the commonly used set of macroeconomic news, such as data on GDP, inflation etc., to include the communications of central bankers. The model including central bank communication can explain a considerable part of exchange rate changes.

INTRODUCTION

Several times during the last few years extreme events took place on the Hungarian FX market and focused attention on the EUR/HUF exchange rate. Extreme exchange rate movements made the importance of the exchange rate and its role in everyday life clear for the wider public too, as a result of which the exchange rate and the factors affecting it attract increased attention.

This paper describes the relationship between macroeconomic announcements, order flow[1] and the exchange rate on the EUR/HUF market. Over the last decade, there has been a generally observed tendency that central banks are moving towards greater transparency. As a result of these efforts to enhance transparency, central bank communication has become increasingly important and a new area of literature assessing and analysing central bank communication has emerged in recent years. Similarly, there has been a growing body of literature on the microstructure theory of currency exchange rates and special related areas. This paper is novel in that it represents the first attempt at a microstructure-based analysis of the effects of central bank communication and macroeconomic news in the Hungarian market.[2]

The relationship between news and the exchange rate, and a better understanding of the driving forces behind the currency markets are interesting for a broad audience. Practically everyone who follows the formation of the EUR/HUF exchange rates in some form is concerned with them. First of all, this group includes market participants directly involved in the operation of the currency FX (market makers, dealers, brokers, bank treasuries, mid-offices, risk management employees) whose daily work, profitability and efficiency are related to trading. Apart from them, corporates and most households are also affected by exchange rate fluctuations, even if they are less sensitive to it. The topic may also be of interest to foreign central banks, international financial institutions, academics and the Hungarian economic media, university lecturers and students.

The purpose of this study is to identify the mechanisms, through which recently published macroeconomic information on the future monetary policy stance or economic fundamentals influences the exchange rate and the trading process on the FX market. Our analysis shows that new information is only partly reflected in the prices directly and immediately, i.e. its effect is only partly shown by the change in the quotes of market makers without entering into any deals following the announcement. Macroeconomic news or MNB communications influence the trading and deals between FX market participants, may trigger a buying or selling wave, and therefore have an indirect effect on prices as well through the trading processes or, more precisely, changes in the order flow.

[1] The order flow is a key variable in the microstructure literature: it is a buying or selling pressure on a particular currency, the difference between the purchase and sales transactions during a particular period. According to the microstructure theory, the market processes the new information through the order flow and the order flow has a major role in the development of the exchange rate. For more details of the microstructure approach of currency exchange rates, see Gereben, Gyomai and Kiss M. (2005)

[2] The analysis presented in this article is based on the paper by Frömmel, Kiss M. and Pintér (2007), containing a more in depth analysis of the issues discussed here.

Our empirical analysis aims at identifying the impact of the disclosure of new information (in the form of central bank communication or macroeconomic news) on the quoted prices, orders and activity of the market makers and, indirectly, on the exchange rate, factors shaping the order flow, and whether or not the order flow has any information content in its own right or if it only transmits information about fundamentals.

NEWS, ORDER FLOW AND THE EXCHANGE RATE

Prices on the foreign exchange market are based on dealers' quotes. The main difference between the microstructure approach and traditional asset price models is that trading is considered as a substantial part rather than an auxiliary activity to price formation and therefore deserves particular attention. As dealers may revise their quotes based on news as well as on the quotes they receive from other dealers, the microstructure approach distinguishes three different relations between news, order flow and the exchange rate (Evans and Lyons, 2006). The relation between the various sources of the exchange rate variation are illustrated in Figure 1.

(1) The information content of announcements, which is publicly available and evaluated in a similar manner by at least most of the traders (the '*common-knowledge*' part of macro news), directly and immediately affects prices, with no role for the trading process in the price formation.

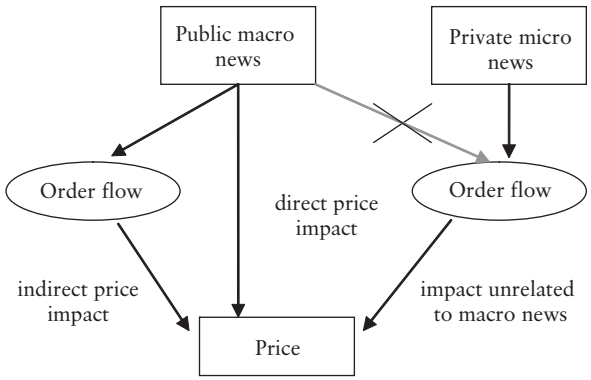
(2) There may be news which is not unambiguous and difficult to interpret or not publicly available. Accordingly, there can be a non-public information component of news – the so-called '*non-common knowledge*' part – in which case private information is dispersed and transmitted to prices via the trading process, more precisely via the order flow. This is called the indirect effect of the news, conveyed by the FX market transactions triggered by the news.

(3) There are some FX market transactions which are unrelated to macroeconomic announcements, but reflect information related to other exogenous factors (changing hedging or liquidity demands, or changing risk tolerances). This type of order flow is independent of the macroeconomic news, but may have an impact on the exchange rate.

Earlier work by the Magyar Nemzeti Bank (MNB, the central bank of Hungary), has shown the relevance of determinants of exchange rate movements from the field of

Figure 1

Determinants of exchange rate movements



traditional macroeconomics, as well as from the field of microstructure (see, e.g., Kiss M., 2004; Pintér and Wenhardt, 2004; Gereben, Gyomai and Kiss M., 2006). This analysis can be regarded as a proceeding of this research, as it combines these fields of research to some extent and attempts to reveal the joint dynamics of news, order flows and price movements.

DATA USED IN THE ANALYSIS[3]

FX market making banks can trade with each other in two ways: directly (on a bilateral basis), and indirectly (through brokers). Our database contains the trading data of the transactions for two years – 2003 and 2004 – conducted in an electronic brokerage system. The data originate from the Reuters D2000-2 system. We had access to all limit price and market price orders posted in the system, as well as all the actually executed trades, with the related information on quantities and prices.

Taking into account that this is the most important platform of inter-dealer trading, our database can be considered as representative of the entire market. As the time-stamp variables are accurate to the second decimal of the second, it is possible to conduct high-frequency analyses; in our study we have chosen to analyse exchange rate changes observed every 1 and 10 minutes.

One of the most important variables is the so-called order flow, which plays a key role in the microstructure literature. As we knew the size of the concluded deals, we could calculate the order flow, indicating the buying (order flow with a positive sign) or selling (order flow with a negative sign) pressure on a particular currency as the balance of the net *value* of the FX market transactions initiated by the

[3] The detailed description of the used data is contained in the study on which the article is based (Frömmel, Kiss M. and Pintér, 2007). Gereben, Gyomai and Kiss M. (2006) also describe in more detail the channels of FX market trading and the used exchange rate database.

buyers and the sellers.[4] During the calculation of the order flow, it is of key importance to identify the initiating and passive parties. Our database contains an entry type for each transaction too, which can be regarded as a buy/sell indicator and allows for identification of the initiating party without having to relay on assumptions about it.

Apart from the order flow, exchange rate changes are explained by certain macroeconomic news and monetary policy decisions. In addition to the interest rate decisions of the central bank, our database also contains announcements on the consumer price index, GDP growth, the budget balance and the current account deficit. We assume that market participants are rational, and therefore their expectations about the pre-scheduled announcements are reflected in the prices before the actual announcement is made. Consequently, in respect of macroeconomic news and interest rate decisions, only their deviation from preliminary expectations, their surprise component affects the exchange rate following publication.

However, for the various types of announcements the actual figures can differ from the expectations to various extents, therefore we rescaled ('standardised') the surprise components to be measured in comparable terms, i.e. in the case of each announcement type we compared the surprise at a given time to the "usual", average surprise in the given variable.[5] It is a common characteristics of these announcements and news that the exact time of their publication is known in advance and they reach all participants simultaneously. Therefore, in their case, the time of the announcement indicates the time precisely when the direct effect of the news can be first reflected in the exchange rate. Consequently, we were able to perform our analysis on 1-minute data in the case of this category.

The other group of the news we analysed consists of central bank communication related to the macro economy, inflation outlook and monetary conditions. An important characteristics of such news is that it is not announced at a pre-specified time and does not reach market participants directly, but is transmitted via news agencies (Reuters, Bloomberg). On the one hand, the individual pieces of news are not necessarily published everywhere at the same time, and there can be some minor time delay in the disclosure of the reports, on the other hand, the news is regularly updated and new details are added in a few minutes' time. Therefore, it is very difficult to clearly identify the time when their impact should be reflected in the exchange rate, therefore we used 10-minute data in our analysis focusing on the effect of communication.

Our database contained statements of Monetary Council members related to the economic outlook, the future path of the central bank interest rate and the exchange rate, as reported by Reuters, and any news items which were published several times were only used for the analysis once, when it was released first. There are no expectations about central bank communication; therefore, in this case, we registered the statement as news, but were unable to measure its surprise content.

We also distinguished 'positive' and 'negative' news in terms of both communication and macro news depending on whether we expect the news to imply appreciation or depreciation of the exchange rate based on the contents of the statement or the direction of its departure from expectations. In this way, we can analyse whether the phenomenon often described in literature, namely that market participants react to 'positive' and 'negative' news in an asymmetric way, can also be observed on the EUR/HUF market.

We must stress that the classification of news as "positive" or "negative" refers to the expected direction of the exchange rate change instead of the 'quality' of the news. The same piece of news could be favourable and unfavourable under different economic conditions, and the various theoretical models also vary according to the direction of the exchange rate movement they consider justified based on surprises in different directions. Where the assignment was not clear, we used an event-study analysis for the classification. Based on our experiences, strengthening of the exchange rate can be assumed when inflation is lower, growth is higher, the deficit is lower than expected, or the monetary policy decision is stricter than expected.[6]

[4] Consequently, the order flow is a variable with a prefix, and is not identical with the traded volume or the FX market demand. Gereben, Gyomai and Kiss M. (2006) describe in detail the role of the order flow in the microstructure models and its relationship with other indicators of market trading.

[5] Apart from the fact that a standardised surprise is based on the difference between the expectations and actual data in percentage, it also takes into account the average surprise related to a particular type of data. Its importance can be intuitively explained as for data where market participants generally can guess the actual data very accurately, a given percentual difference means a bigger surprise than in the case of those data where they usually make big forecast errors.

[6] The typical response to an inflation surprise (favourable inflation rate – stronger exchange rate, unfavourable figure – weaker exchange rate) is not absolutely intuitive in an inflation targeting regime. The result stems from the fact that most probably there was not a close relationship between the actual inflation figure and the next expected interest rate decision because of the special features of the inflation processes of the analysed period (several peaks and valleys), the central bank communication at that time and the monetary policy decision mechanism for the most part of the period (until the middle of 2004, interest rate decisions were made not only monthly, but even every two weeks, even before the release of the inflation figures). This and the other results, however, are consistent with the portfolio balance theory suggesting that the demand for HUF denominated assets increases as a result of any favourable news about the economy, such as, e.g., low inflation.

EMPIRICAL RESULTS

Our empirical analysis can be divided into two parts based on the applied methodology, the frequency of the time series used and the variables involved in the analysis. On the one hand, we have analysed the impact on the EUR/HUF market of five relevant Hungarian macroeconomic announcements at 1-minute intervals using an event-study methodology, focusing on an event window containing the announcement. In the second part of the analysis, we have included the central bank communication variables as well and analysed the effect of news on the exchange rate at 10-minute intervals using standard regression analysis.

Immediate effect of macroeconomic news and the order flow

In the first step, we analysed the impact on the exchange rate and the order flow of the surprise content of the five macroeconomic announcement types involved in the analysis, i.e. inflation, GDP growth rate, the current account deficit, the budget deficit, the interest rate decision of the central bank (Annex, equations 1 and 2). We could generally conclude from the results that most of the news has a statistically measurable (significant) immediate impact on exchange rate changes as well as the dominant direction of trading, which is reflected in the order flow.

In the majority of cases, the surprise can clearly be felt during the minutes that follow the announcement and the news drives the exchange rate and the dominant direction of the transactions according to its 'positive' or 'negative' nature. The only exception was GDP announcements, in which case the news did not have any impact on the exchange rate or the order flow that could be detected over a short time. On the other hand, the impact of an inflationary surprise is highly significant and concentrated. An inflation rate, which is 1 per cent higher than expected, generates – on average – almost half a per cent depreciation and net HUF sales-EUR purchases equivalent to EUR 17.2 million within a few minutes. It is interesting to note that even the 2 and 3-minute delays are significant, yet they work in the contrary direction indicating that there is an overreaction in the first minute, followed by some partial correction in the next few minutes.

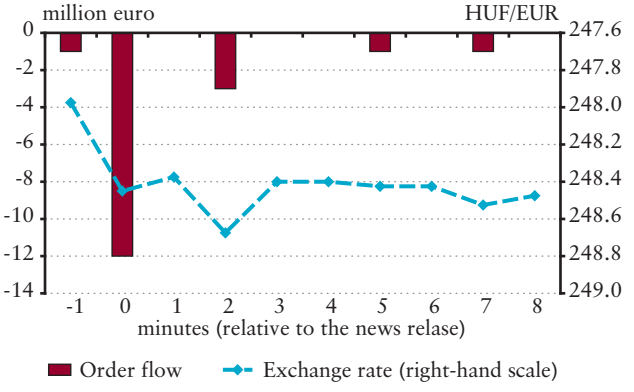
The results are also favourable for the budget deficit: any data which are more favourable than the expectations results in immediate appreciation and net HUF purchases. The correlation is not so strong, but it can still be detected within a few minutes after the announcement, without any statistically significant correlations before or after.

Regarding the current account figures, the results indicate slower transmission of any new information. No correlation can be detected one minute after the announcement, but then the information has a continuous impact on the exchange rate and order flow for several minutes. The delayed reaction may be caused by the relatively early announcement of the figure at 8.30 a.m., because at that time the trading activity is significantly lower than during the day.

Our results prove that any interest decisions of the central bank which differ from the expectations have a statistically significant impact on the exchange rate and the dominant direction of the transactions following the decision. A stricter-than-expected decision, i.e. a higher rate increase or smaller rate cut, typically results in immediate appreciation of the HUF, and generates net HUF purchases. This impact prevails not only immediately after the decision, but also during the subsequent minutes,. i.e. the decisions of the Monetary Council have both a concurrent and delayed impact on the order flow. Figure 2 illustrates the results with one specific example. On 16 August 2004, the interest rate was cut by 50 basis points, and the size of the interest rate cut exceeded the expectations of market participants. This negative surprise was accompanied by HUF depreciation and net HUF sales.

Figure 2

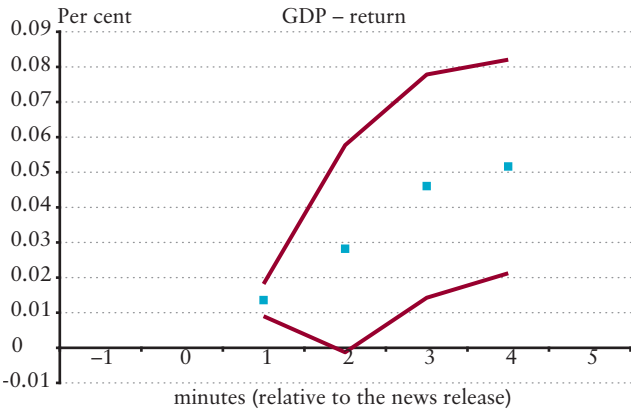
Impact of interest rate decisions on the exchange rate and order flow – example: 16 August 2004

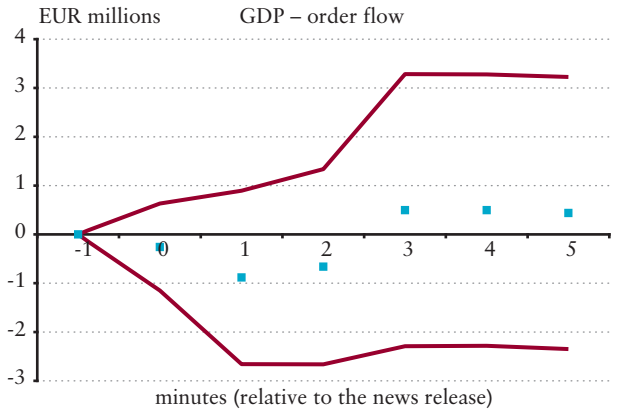


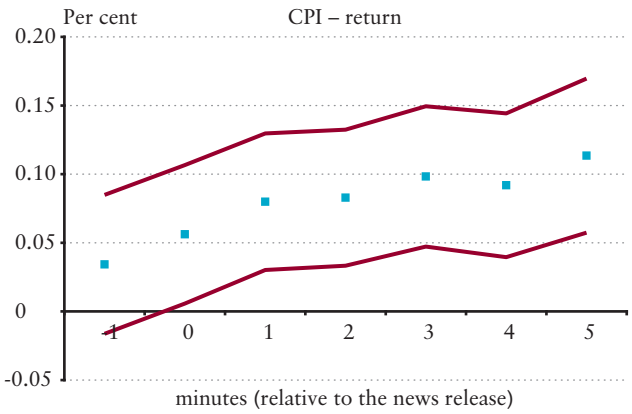
Rescaling the surprise content of the various news types expressed in different measurements to comparable units (standardising the news variables), we can compare the relative impact of the various news on the FX market (Figure 3). As it could be expected, the interest rate decisions and inflation data had the strongest impact on the FX market, i.e. their surprise value caused the biggest change in the exchange rate and triggered the largest number of transactions in the same direction. In terms of its impact on

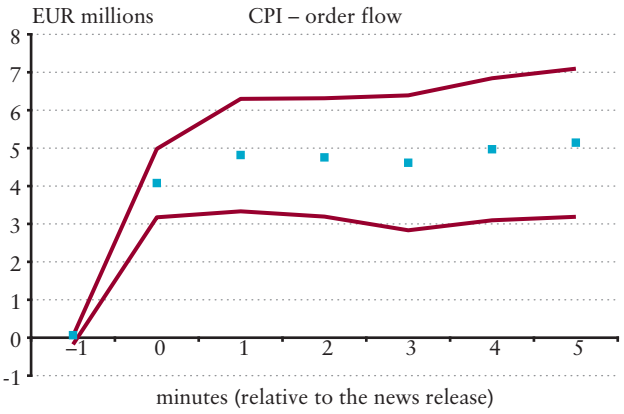
Figure 3

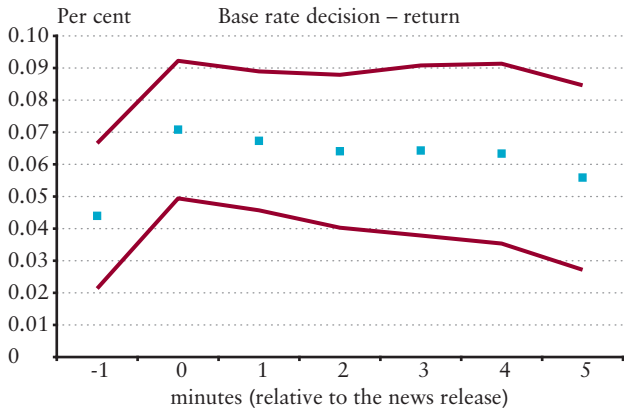
Impact of the announcements on the exchange rate and order flow
(standardised figures)

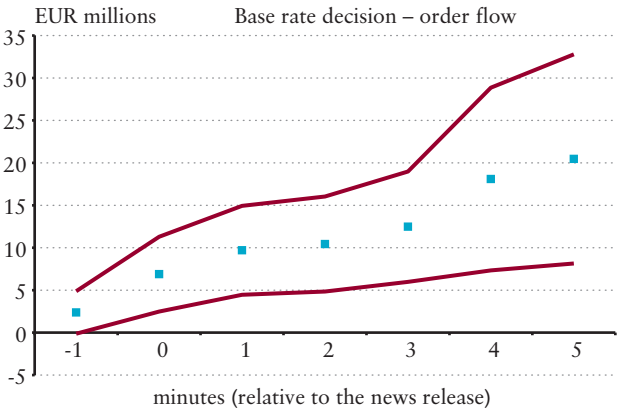


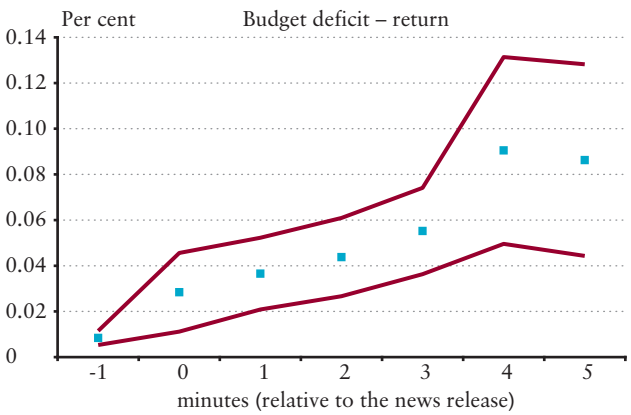












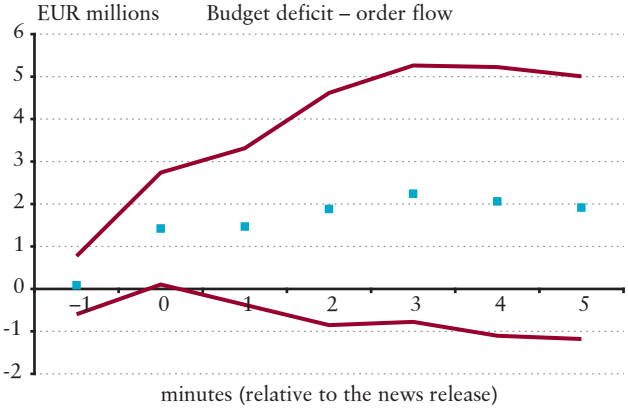
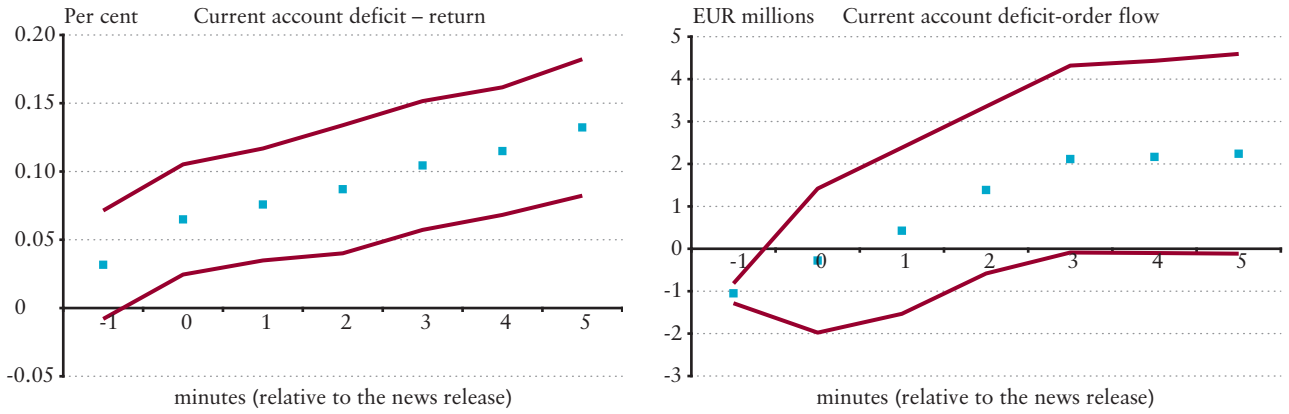


Figure 3

Impact of the announcements on the exchange rate and order flow
(standardised figures)



the exchange rate, the inflationary surprise stands out from the other variables: the impact of one 'unit' of inflation-surprise is almost three times as big on the exchange rate as the impact of one 'unit' of the surprise of an interest rate decision, which variable has the second strongest impact. Comparing the surprises caused by the budget deficit and the current account balance, they have similar impacts on the exchange rate, but their impact is only 50 per cent of the impact of the interest rate decisions.

In the next step, we analysed the sensitivity of the relationship between the exchange rate and the order flow to news announcements. To be more precise, we wished to see whether this relationship changes around data disclosures, whether the impact of the order flow on the exchange rate is stronger or weaker whenever any new public information hits the market. In theory, both outcomes are possible.

As soon as market participants learn about new data, they may adjust their expectations and exchange rate quotations according to this more reliable information, instead of looking at the noisy information conveyed by the trades. This behaviour may even temporarily break the correlation between the exchange rate and the order flow. On the other hand, assuming that well-informed market participants trade more actively when new information is released, the market makers may attach more importance to information in trading if initiatives in a particular direction dominate the trade. Under such conditions, the order flow may have a more pronounced impact on the exchange rate than at times when no macroeconomic announcements are made.

We estimated two regression equations for analysing the relationship between the exchange rate and order flow under various market conditions: in the basic regression equation, used as the basis of comparison, the order flow had the same impact on the exchange rate at every time, while in the other equation we divided the impact of the order flow into an 'ordinary' component and an 'additional' component, which only prevailed around the time of the release of data (Annex, equations 3 and 4). In this way we allowed the impact of the order flow on the exchange rate to be different around the time of release of new information than under 'ordinary' market conditions.

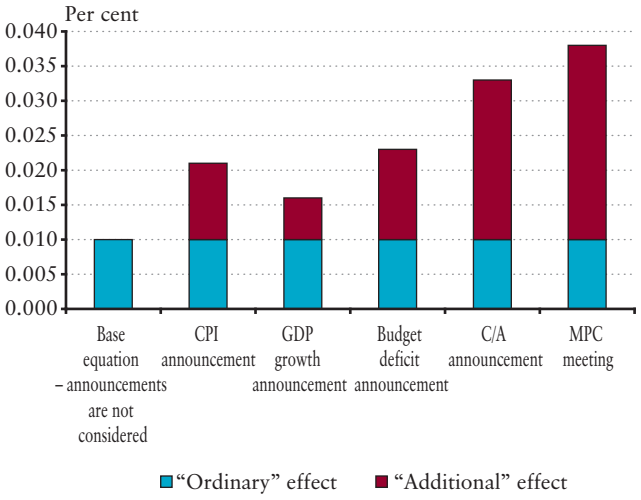
Our analysis performed on high-frequency data clearly proved and confirmed our earlier results based on daily data, namely that the order flow has a statistically significant and in economic terms important impact on the exchange rates on the Hungarian market. In addition, it also became obvious that the impact of the order flow on the exchange rate changes when macroeconomic data are disclosed. At the minute of the disclosure, the influence of the order flow on the exchange rate is stronger than usual, because it conveys additional information about the fundamentals. This additional impact depending on the type of the news doubles and quadruples the ordinary impact, with the interest rate decisions having the strongest additional impact (Figure 4). Comparing the models we see that the 'base' equation has moderate explanatory power (R^2=12%), but the inclusion of the additional variables into the model significantly improves the explanatory power of the specification (R^2=25-32%).

Long-term relationship between news, order flows and exchange rates

First we looked at the relationship between the factors affecting exchange rate volatility and the absolute volume of the order flow (Annex, system of equations [5]).

Figure 4

Impact of the order flow on the exchange rate



The meetings of the Monetary Council, especially when an effective change in the base rate happens have a clearly significant impact both on exchange rate volatility and the absolute volume of the order flow. In general, we can conclude that both volatility and one-way trading increase before the meeting, one possible interpretation of which is that the position-taking (sales or purchases on the FX market) based on the expectations of the market participants boost market activity before the decision. In case of interest rate changes, both increases and cuts, the buying or selling pressure on the HUF grows as the decision is announced, which is probably the result of positions taken or closed in response to the changed interest rate conditions. Interestingly, volatility seems to be falling after interest rate changes.

Macroeconomic news announcements do not cause aggressive one-way trading, but this result can also be attributed to the lower frequency of the time series used in this part of the analysis. As we saw earlier, the impact of data disclosures on the order flow emerges very quickly, therefore within 10 minutes the impact is most probably partly offset, and hence it can be detected less strongly. On the other hand, the announcement of the news has a very strong impact on volatility, especially if the surprise is 'negative'. Volatility is lower before the release of the data, and then increases significantly after the surprise hits the market. There are weaker reactions to 'positive' surprises, as volatility does not increase immediately, only 10 minutes after the announcement.

We can not draw general conclusions regarding the effect of central bank communication, as the impact varies widely according to the type of communication and the analysed time horizon. The intensity of trading, measured with the number of deals conducted, is positively related to both volatility and the absolute order flow volume. A strong intra-day pattern can be observed in the volatility. The explanatory power of the order flow equation is very impressive (R^2=65%), and our model explains volatility quite well too (R^2=16%).

Our other system of equations based on 10-minute data intervals looks at the factors affecting the exchange rate changes and the order flow (Annex, equation system [6]).

The interest rate decisions of the Monetary Council have a lasting effect on the exchange rate changes and the dominant direction of trading. Interest rate cuts typically involve HUF depreciation, but their impact on the order flow is not consistent over time: both selling and buying pressures can be observed at different lags. On the other hand, the impact of interest rate increases on the order flow is clear: the increases result in aggressive HUF purchases, and this effect lasts long in time. Consequently, in such cases the HUF typically appreciates. In summary, the market reactions to interest rate changes are in line with our intuition and indicate a close relationship between the surprise value of the announcement and the exchange rate change and order flow.

The majority of the results related to the announcement of macroeconomic news also correspond to the theoretical assumptions. The strongest reaction follows favourable news about the economy. Although there is a 10-minute delay, 'positive' news cause strong buying pressure, triggering HUF appreciation. Together with the results obtained when analyzing the effects of news at a 1-minute interval this indicates that news do not only have short-term influence which lasts for a few minutes after the disclosure, but may also induce a long-term effect on the FX market. Although the 'negative' news have statistically significant impacts as well, these are less strong. The order flow parameter shows significant net HUF sales following the announcement of 'negative' news, but the exchange rate change is moderate. Consequently, our results indicate strong asymmetric behaviour of market participants when reacting to favourable or unfavourable news.

The direction and strength of the impact of the central bank communication variables are different, and it is rather difficult to show clear tendencies in their impacts. This result may stem from the fact that very often it is more difficult to interpret these types of news and that their timing is typically not known in advance. Consequently, we cannot draw general conclusions about the impact of the communication, but it seems that 'positive' communication is more likely to induce exchange rate appreciation and HUF purchases, 'neutral' communication leads to selling pressure and

depreciation, while 'negative' communication triggers HUF sales. The explanatory power of the order flow equation is relatively low, but the fit of the exchange rate equation may be considered rather good (R^2=22%).

CONCLUSIONS

During recent years the analysis of order flow has become an important issue, which has been extensively debated in academia as well as by policy makers. Our study adds to this discussion by complementing earlier papers typically analysing the world's major FX markets. In addition to analyzing the exchange rate of a small open economy (Hungary), characterized by a less liquid market and comparatively high capital flows, we extend the analysis to include the relationship between the news, exchange rate and the order flow.

According to our results, the surprise content of macroeconomic announcements triggers very strong immediate reactions both in the exchange rates and the order flow. There is a strong positive relationship between the order flow and the exchange rates, i.e. strong one-way purchasing (selling) interest appreciates (depreciates) the exchange rate. The impact of the order flow on the exchange rate is stronger than usual around the macroeconomic announcements, and at these times the FX market transactions convey additional information and cause larger movements. The impact of the new information affecting the FX market is not only temporary or short-lived, and it does not only apply to macroeconomic announcements, but also remains valid if the analysis is extended to a longer time horizon and central bank communication is included as well. Our results indicate that the role of order flow seems to be independent from the size of the market: The EUR/HUF market behaves, in terms of the mean as well as the volatility of the exchange rate, more or less in a similar way as e.g. the EUR/USD market.

Our models, which include news on economic fundamentals, central bank communication and order flow as explanatory variables, have relatively high explanatory power in case of the exchange rate, volatility and order flow. This may lead to the conclusion that by combining traditional macro models and the microstructure approach, a considerable part of exchange rate movements and the characteristics of the trading processes on the FX market can be explained.

REFERENCES

Evans, Martin D.D. and Richard K. Lyons (2006): "How is Macro News Transmitted to Exchange Rates?", NBER *Working Papers* 9433.

Frömmel, Michael, Norbert Kiss M. and Klára Pintér (2007): "Macroeconomic announcements, communication and order flow on the Hungarian foreign exchange market", mimeo.

Gereben, Áron, György Gyomai and Norbert Kiss M. (2005): "Microstructure approach to FX exchange rates: review of the technical literature from the aspect of the central bank", *MNB Occassional Papers* 42.

Gereben, Áron, György Gyomai and Norbert Kiss M. (2006): "Customer order flow, information and liquidity on the Hungarian foreign exchange market", *MNB Working Papers* 2006/8.

Kiss M., Norbert (2004): "Impact of macroeconomic news on the money market", *MNB Occassional Papers* 2004/30.

Pintér, Klára and Tamás Wenhardt (2004): "Predictability of the interest decisions of the central bank and their impact on yields", *MNB Occasional Papers,* 2004/31.

Rime, Dagfinn (2003): "New electronic trading systems in foreign exchange markets", In Derek C. Jones (ed.) *New Economy Handbook,* Elsevier.

ANNEX

Impact of macroeconomic news on the exchange rate and order flow

Using the event study approach, we estimated the impact of the surprise content of the various macroeconomic news on the exchange rate and order flow based on the following equations:

$$\Delta p_{t,n} = \alpha^{p} + \sum_{i=k}^{l} \beta_{i,m}^{p} N_{t-i,n,m} + \varepsilon_{t,n} \qquad (1)$$

$$OF_{t,n} = \alpha^{of} + \sum_{i=k}^{l} \beta_{i,m}^{of} N_{t-i,n,m} + \eta_{t,n} \qquad (2)$$

where $\Delta p_{t,n}$ is the logarithmic change in the exchange rate on n day between t-1 and t times, multiplied by one hundred, $OF_{t,n}$ is the order flow in EUR million on n day between t-1 and t times, and $N_{t,n,m}$ is the surprise content of the news on n day for intervals ending at t time, for m news, while $\varepsilon_{t,n}$ and $\eta_{t,n}$ are the error components.

The equations were estimated separately for each individual macroeconomic variable used (CPI, GDP growth, current account, budget deficit, interest rate decision) at a 70-minute interval (k=60 and l =-10 minutes), i.e. the impact of the news can prevail for a period of 10 minutes before the

announcement for 60 minutes after the disclosure of the news.

Sensitivity of the relationship between the exchange rate and order flow on the announcements

We used a *dummy* variable for analysing the sensitivity of the correlation between the exchange rate and order flow in order to break down the impact of the order flow into an 'ordinary' part and an 'additional' part, which is related to the time of the announcement. We estimated the (3) equation as a basis of comparison, in which the impact of the order flow was not broken down into components.

$$\Delta p_t = \alpha^b + \beta^b \cdot OF_t + \varepsilon_t \qquad (3)$$

In the following (4) specification, we allowed the order flow coefficient to be different from its ordinary level if any new information is released.

$$\Delta p_{t,n} = \alpha + \beta \cdot OF_{t,n} + \sum_{i=-k}^{k} \gamma_{i,m} \cdot OF_{t,n} \cdot I(i)_{t,m} + \eta_{t,n} \qquad (4)$$

where $I(i)_{t,m}$ is a *dummy* variable, which takes the value of 1 if the announcement was made at t time. By using *dummy* variables under equation (4), we practically 'take out' certain intervals around the announcement and test whether the coefficient of the order flow changes compared to its ordinary level. For example, the order flow multiplied by $I(0)_{t,m}$ shows whether the order flow has a stronger or weaker impact on the exchange rate than otherwise one minute after the m announcement. The *'around the announcement'* definition means five minutes before and after the announcement, i.e. the m value was set to five. With this specification we can also test whether the explanatory power of the model can also be improved by any potential change in the order flow parameter around the announcement.

Analysis of the exchange rate volatility and the absolute value of order flow

For the analysis of the impact of news on volatility, we estimated the following set of equations, taking also into account the relationship between the order flow and volatility:

$$\begin{aligned} h_{t,n} &= \omega_1 + \alpha p(t) + \beta_0 \left|OF_{t,n}\right| + \sum_{h=1}^{2} \beta_h \left|OF_{t-h,n}\right| + \sum_{i=1}^{2} \gamma_i h_{t-i,n} + \sum_{j=1}^{4} \zeta_j day_j + \sum_{k=1}^{K} \sum_{l=-m}^{m} \delta_{k,l} N_{k,t-l,n} + \varepsilon_{t,n} \\ \left|OF_{t,n}\right| &= \omega_2 + \sum_{h=1}^{2} \beta_h \left|OF_{t-h,n}\right| + \sum_{i=1}^{2} \gamma_i h_{t-i,n} + \sum_{k=1}^{K} \sum_{l=-m}^{m} \delta_{k,l} N_{k,t+l,n} + \eta_{t,n} \end{aligned} \qquad (5)$$

where $h_{t,n}$ is the volatility of the EUR/HUF return observed in t interval on n day, $p(t)$ is the seasonality of volatility within the day, and day is the dummy variable grasping seasonality during the week, the $N_{k,t,n}$ variables indicate various types of macroeconomic news and central bank communication in accordance with the previous equations. As volatility is a one-way variable, in this set of equation we used the absolute degree of order flow as a variable.

Analysis of the exchange rate changes and the order flow

Apart from a few minor differences, the set of equations is similar for the return analysis.

$$\begin{aligned} r_{t,n} &= \omega_1 + \beta_0 OF_{t,n} + \sum_{h=1}^{2} \beta_h OF_{t-h,n} + \sum_{i=1}^{2} \gamma_i r_{t-i,n} + \sum_{k=1}^{K} \sum_{l=-m}^{m} \delta_{k,l} N_{k,t-l,n} + \varepsilon_{t,n} \\ OF_{t,n} &= \omega_2 + \sum_{h=1}^{2} \beta_h OF_{t-h,n} + \sum_{i=1}^{2} \gamma_i r_{t-i,n} + \sum_{k=1}^{K} \sum_{l=-m}^{m} \delta_{k,l} N_{k,t+l,n} + \eta_{t,n} \end{aligned} \qquad (6)$$

On the one hand, we use the order flow with a prefix, because the return change may also work in two ways like the order flow. On the other hand, there is no need to include the intraday and weekly seasonal variables into the model, because, contrary to volatility, no seasonal samples can be observed in the case of returns.

András Komáromi: The effect of the monetary base on money supply – Does the quantity of central bank money carry any information?

In discussing the transmission mechanism, basic macroeconomics textbooks focus on changes in money supply, which the central bank can control by manipulating the monetary base. Modern central banks, however, take a considerably more complex view of the transmission mechanism, and the operational target of most central banks is to set a short-term interest rate. Under such circumstances, the direction of the mutual effect of the monetary base and money supply is rather the reverse in today's practice, i.e. the results of the portfolio decisions of economic agents are reflected in the central bank's balance sheet, determining the size of the monetary base. The article explains the direction of the actual mechanism and argues the point that, contrary to the view still widely held in academic circles, a great deal of the factors affecting the monetary base are exogenous for the central bank. Accordingly, the growth rate of M0 (monetary base or base money) carries no direct information on either the intentions of the central bank or the outlook for inflation.

INTRODUCTION

Both the findings of economic theory and historical experience have shown that, apart from inflation, monetary policy is unable to exert lasting influence on macroeconomic real variables such as GDP, real wages or the level of employment. Consequently, over the past twenty years, an increasing number of professionals have taken the view that the primary objective of central banks is to control inflation. During recent years, *price stability* as the ultimate goal of the central bank has gained ground in the general consciousness in Hungary as well, primarily as the result of the communication efforts of the MNB, which have been aimed to ensure clarity.[1] While the ultimate goal is clear for many, there are frequent misunderstandings and misbeliefs even among economic professionals regarding the tools and mechanisms the central bank should employ in order to achieve this goal.

In a market economy environment, the central bank should utilise the available indirect (market conform) means at its disposal to encourage the economy to move towards the ultimate goal. In other words, it must define the chain of target variables that can be directly influenced by the central bank *(operational targets)* and the other economic variables, through which monetary policy can exert a genuine influence on its final target. This chain of economic variables and the system of relations between such variables are called the transmission mechanism. The transmission mechanism thus describes the relationships through which the monetary policy measures of a central bank affect the rate of inflation.

In the current *practice,* central banks attempt to achieve their ultimate goal through their respective interest rate policies, which means that their operational target is to set the short-term money market interest rate. However, the basic university textbooks used in macroeconomics and finance *education* (e.g. Mankiw, 2005) tend to suggest, sometimes quite unambiguously, sometimes by their general approach only, that central banks are influencing economic trends by directly controlling the money supply, which is achieved by controlling the quantity of central bank money (the monetary base). Under that approach, the transmission mechanism sets out from the quantity of base money as the operational target and moves toward inflation, the final target variable, through the money supply in the economy. This approach is based on the traditional monetarist theory of inflation, which argues that (over the long run) the price level is determined by the amount of money available in the economy and derives the central bank's operational target concerning the monetary base from the so-called money multiplier model.[2]

In order to understand the above argument, let us first take a look at the definition of money and base money and how their quantities can be measured in practice. In the light of these definitions, we can then discuss the way the textbook model links the central bank's control over the monetary base to the control of the broader money supply.

[1] According to a 2006 survey by Gallup, 60 percent of the population regards controlling inflation to be the responsibility of the MNB, and 20 percent believes this to be the primary duty of the central bank. 56 percent of the respondents felt that the rate of inflation would be higher without the MNB.

[2] In order to illustrate the above, let me include a few quotations from Mankiw's (2005) widely used macroeconomics textbook. 'The control of the money supply is called monetary policy.' (p. 183) 'In fact, the Fed indirectly controls the money supply through changes in the monetary base or the reserve-deposit ratio.' (p. 510) '… the inflation rate is ultimately determined by the growth rate of the quantity of money.' (p. 528).

DEFINITION OF THE MONETARY BASE AND MONETARY AGGREGATES

In practice, the classification of instruments as 'money' is far from being unproblematic. The various financial instruments differ according to their transactions costs, the range in which they can be used for payment and the extent to which they preserve their value, i.e. the extent they have the functions of money (Kiss et al., 2005). The narrowest subset comprises the financial instruments available for payment in the fastest way, at the lowest transaction costs and without restrictions *(M1 money aggregate)*. It includes currency, i.e. banknotes and coins and the demand deposits available for direct payment. In addition to the above, the broader categories of money *(M2 and M3 money aggregates)* also include the less liquid liabilities of monetary financial institutions (MFIs), i.e. financial instruments not available for direct payment (time deposits and certain types of securities), depending on the respective transaction costs, maturities and risk levels.

The currency in circulation, issued by the central bank, and the balance on the current accounts of credit institutions kept with the central bank, constitute the *monetary base* (M0). The latter means the bank accounts on which credit institutions keep the liquidity required for their day-to-day operation and which are used to meet their reserve requirements. They are collectively referred to as *bank reserves*.[3] The monetary base is not part of the money supply. The reason it is relevant for our discussion is that, in the textbook model, this is the basis of the so-called money multiplication process, i.e. the central bank modifies the quantity of the monetary base in order to influence the money supply. Let us now take a look at how this works.

THE STANDARD MONEY MULTIPLIER MODEL

The underlying idea behind the argumentation is that, proceeding from the monetarist theory of inflation, the central bank is responsible for controlling the growth rate of money, which, as a supply-side monopoly on the market of central bank money, it can achieve by controlling the monetary base. The money multiplier model tries to provide an explanation for the relationship between base money and the monetary aggregates. While the form of the model presented here can be most easily interpreted for the most liquid transaction money, the M1 money aggregate, the argumentation is similar for the broader money categories. There are three exogenous variables in the model:

- The **monetary base**, i.e. the sum of the amount of currency held by economic agents *(C)* and the amount of reserves deposited on commercial banks' accounts with the central bank *(R)*.

- The **reserve-deposit ratio** *(rr)* is the ratio of deposits the banks keep in reserve. This may be affected by the rules on reserve requirements imposed on credit institutions or, even in the absence of such rules, banks hold reserves to the extent required for their payment turnover.

- The **cash-deposit ratio** *(cr)* reflects the preference of economic agents as to how much money they should keep in cash *(C)* and in demand deposits *(D)*.

Using the definition of the monetary base and the M1 aggregate:

$$M1 = C + D$$

$$M0 = C + R$$

It follows from the two equations that:

$$\frac{M1}{M0} = \frac{C/D + 1}{C/D + R/D} = \frac{cr + 1}{cr + rr} = m \quad \Rightarrow \quad M1 = m \times M0$$

The equation shows the way the money supply, measured with the *M1* aggregate, is a function of the exogenous variables. According to the model, the money supply is in proportion with the monetary base; the proportionality factor *(m)* is called the 'money multiplier'.

The above formula, particularly in its latter 'reduced' form, is responsible for the (erroneous) view, held even by a great number of economists not specialising in monetary macroeconomics, that the central bank's operational duty is to manipulate the size of the monetary base. Under that understanding of the transmission mechanism, through the money multiplier, the operational target (the monetary base) affects the money supply, whose growth rate determines the rate of inflation. Obviously, that line of thinking is based on the underlying assumption that the money multiplier remains relatively stable.

[3] If required reserves are sufficient to cover the bank's everyday liquidity requirement, it will not keep any surplus. Otherwise, the difference between total bank reserves and required reserves is referred to as excess reserves.

THE MESSAGE OF THE STANDARD MODEL AND PRACTICE

This view of the transmission mechanism can essentially be broken down to two key steps, with a simple theoretical construction assigned to each (Bindseil, 2004):

1. through the active regulation of the monetary base, the central bank is able to set the development of money supply (money multiplier theory);

2. since the inflation process is related to the amount of money, it is practical for the central bank to influence the size of the monetary aggregates (quantity theory of money).

This paper does not discuss the latter (2) point of the argumentation in detail. The subject has a vast and extensive literature (see, for example, Woodford, 2007). We limit ourselves to stating that, as the various financial substitutes for money have gained increasing ground, the definition and the measurement of the quantity of money relevant for the transmission mechanism have raised an increasing number of questions and the short-term relationship between the monetary aggregates and inflation has become uncertain. Faced with that situation, central banks have stopped actively influencing the money supply and now try to achieve their goal by setting the interest rate of a base instrument. Thus, the role of monetary aggregates as an intermediate target[4] has gradually ceased to exist and been replaced by other nominal variables, such as the exchange rate or the inflation forecast itself (in the inflation targeting system). Since 2001, following the period of the crawling peg, Hungary has been operating with an inflation targeting regime, i.e. monetary policy utilises the available means in order to achieve the goal of forecasted inflation remaining close to a pre-defined target value (currently 3 per cent) over a time horizon of 5 to 8 quarters.

Therefore, these days hardly any modern central banks take on the task of directly influencing changes of monetary aggregates. Instead, they try to achieve their final target via their interest rate policies.[5] Despite the fact that most Hungarian economists are well aware that the National Bank of Hungary, like other central banks, uses other tools than the shaping of the money supply in order to influence economic trends, the changes in monetary aggregates and the monetary base have received a great deal of attention at times. For example, jumps in the growth rate of the monetary base are often interpreted as inflationary pressure, which has been generated by the central bank or at least as one that the central bank would have the opportunity to suppress by reducing the quantity of base money. This kind of argument leads us to the statement presented in point (1), i.e. the nature of the operational target of the central bank. The essentially quantitative approach of the money multiplier model suggests that the central bank is supposed to achieve a quantitative target concerning the monetary base in order to control the growth of the money supply. That approach, however, is the sheer opposite of the everyday practice of modern central banks, which focus on the short-term money market interest rate, the so-called overnight interbank interest rate.

By putting the emphasis on the interbank interest rate, the central bank renounces its control over the monetary base, and the causality between the base money and the size of the broader monetary aggregates turns to the opposite direction. In the following paragraphs we try to explain at more length that, in today's practice, many of the factors affecting the monetary base are exogenous for the central bank, given that the result of the portfolio decisions of the economic agents is reflected in the central bank's balance sheet, determining the amount of central bank money.

In order to delimit the issue under review with more accuracy and to emphasise the focus of the paper, two things must be noted in advance:

1. It should be emphasised that this analysis concerns the operational activity of the central bank. It seeks an answer to the question of whether, in day-to-day practice, the size of the monetary base carries any information content with respect to the current and/or future monetary policy intentions. This set of issues can largely be discussed separately from the question of whether the broader money aggregates are suitable for the role of an intermediate target and whether the monetary aggregates have suitable indicator properties concerning inflation or output.

2. The most important conclusion of the analysis is that, rather than by meeting any target set for the quantity of base money, the central bank influences the economy by affecting the overnight interbank interest rate. However, this obviously does not preclude the possibility of certain central banks taking advantage of their monopoly over central bank money in order to achieve their operational

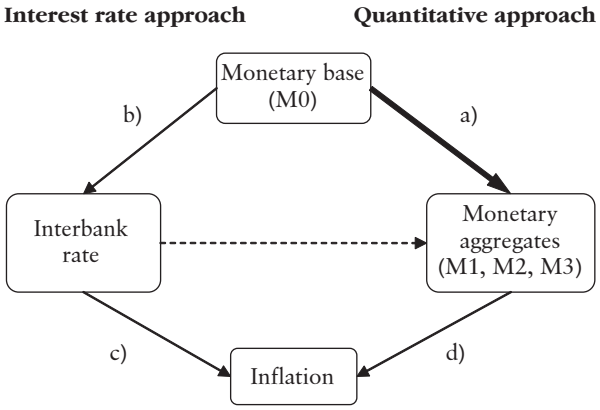
[4] The intermediate target is an economic variable, which has a relatively stable relation with the final target of monetary policy and can be regulated by the central bank at an acceptable level of accuracy.

[5] While the monetary pillar (the 4.5 percent target value for the growth rate of M3) is one of the components of the declared strategy of the European Central Bank, in practice it rather means the indicator role of monetary aggregates, which is completely subordinated to the primary goal of price stability.

target. The operations of the MNB are 'available' to its partners without limitations, i.e. at the actual interest rate conditions, it allows banks to decide on the amount of central bank money they wish to hold, and *passively* adapts to the situation so arising. However, a number of central banks – taking into account the so-called autonomous liquidity shocks affecting the banking system – provide a daily forecast on the demand for central bank money, and accept deposits from the banking system (or sell government securities) and offer credit to the banks (or purchase government securities) at the quantities required in order that the overnight interbank interest rate should approximate its operational target. This may be termed *active* adaptation. It is important to note, however, that even in the latter situation, central banks decide on the supply of base money subordinated to their interest rate target, i.e. without trying to achieve a quantitative target for the monetary base.

Figure 1

The focus of the analysis and the related issues



a) Monetary base as a quantitative operational target (money multiplier model); b) short-term money market rate as an operational target; c) channels of interest rate transmission; d) quantity theory of money

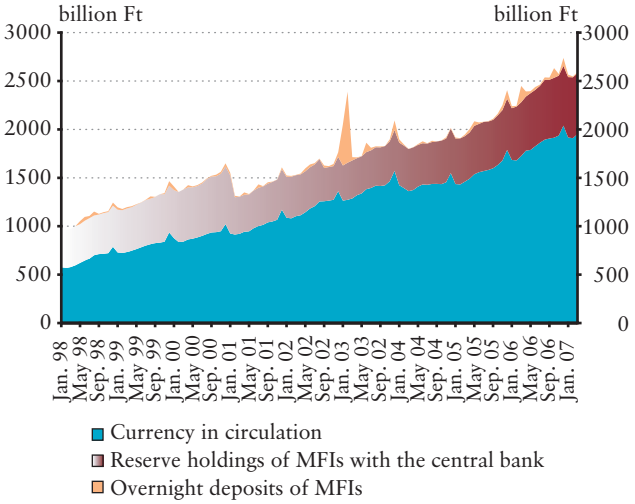
On the basis of Figure 1, the above two remarks can be summarised as follows: while the analysis argues that role (a) (bold arrow) of the monetary base is empirically untenable, it does not contest the important function of central bank money in mechanism (b). At the same time, it is outside the scope of our study to formulate statements concerning the economic relations marked with (c) and (d), as these issues can be interpreted independently of the operational target of the central bank.

FACTORS DETERMINING THE SIZE OF THE MONETARY BASE

It has been explained that the monetary base comprises currency in circulation and credit institutions' reserves, both of which are found on the liabilities side of the central bank's balance sheet.[6] Bank reserves are deposited on the current accounts of credit institutions kept with the MNB. Therefore, in order to identify the factors determining the size of the monetary base, one must examine the factors that determine the balance of the *current accounts of commercial banks* kept with the central bank and the amount of the *currency* in circulation.

Figure 2

Components of the monetary base



The *current account* kept with the central bank serves two fundamental purposes: it is used by credit institutions to manage their everyday payment turnover *(working balances)* and to comply with their reserve requirements *(required reserves)*.[7] Similarly to the practice of all modern central banks, the most important function of the compulsory reserve system among the monetary policy instruments of the MNB is currently that it helps in the smoothing of overnight interbank interest rates.[8] The goals

[6] In Hungarian practice, in accordance with the monetary statistics classification of the European Central Bank, the overnight deposits of credit institutions with the central bank are added to the former items. During 'normal' periods, however, the amount of overnight deposits is negligible. Any significant surge in their amount is an indication of some irregularity, such as the speculative attack against the forint's band in early 2003, when the central bank refused to fully sterilize the excess liquidity arising from the sudden influx of foreign currency, which thus flowed into overnight deposits (Figure 2).

[7] Under the effective Hungarian regulation, the reserve obligation concerns deposits maturing in up to 2 years, the loans and securities embodying a credit relation received by banks unless they arise from a transaction with another credit institution or the MNB.

[8] The averaging mechanism of reserve regulation enables the smooth flow of liquidity management by credit institutions, and thus helps in smoothing interbank interest rates. It means that the reserve requirements must be met over the average of one month, i.e. the balance of the current accounts may temporarily be lower or higher than the required level. In accordance with that, however, the published monthly amount of the monetary base is also an average stock, which means that the averaging mechanism is irrelevant in terms of our subject.

of the reserve system do not include the diversion of income from banks or the influencing of the volume of the money supply. The rate of interest paid on the reserves equals the central bank's base interest rate, i.e. financial institutions are not burdened with the diversion of income through the reserve system. Also, the central bank does not actively modify the reserves rules in order to achieve any money quantity-related target.

In Hungary, the 5-percent reserve ratio combined with the averaging mechanism ensures the liquidity required for the operation of the entire banking system. Since the reserve rate represents an effective lower bound for banks and the MNB does not pay any interest for the excess balance on top of required reserves, on a monthly average, credit institutions keep exactly the required amount on their accounts. Any excess liquidity on the level of the entire banking system will automatically 'precipitate' in the main monetary policy instrument of the MNB, currently the two-week central bank bill. Consequently, the balance of the current accounts is dependent on the amount of liabilities falling under the reserve obligation, which in turn essentially reflects the type and maturity of instruments in which the private sector wishes to keep its financial savings.

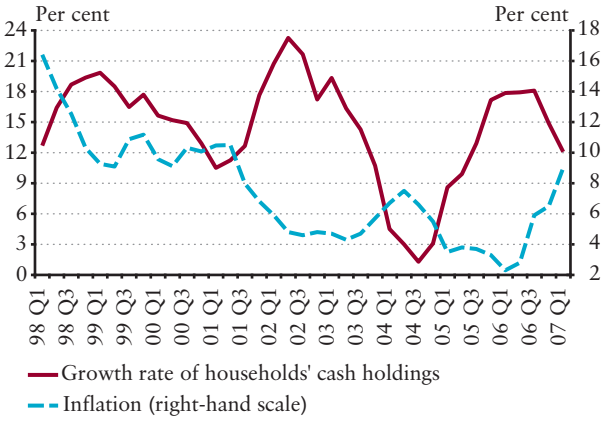
Similarly, the MNB does not exert any influence on the amount of currency in circulation through any direct means. To the debit of the amount kept on their current account, commercial banks can obtain banknotes and coins without restriction at any time. Banks do not keep more than the minimum amount of currency required for daily operations, as lost interest represents an opportunity cost for them. Therefore, the banking system withdraws no more currency from the MNB than is required in order to satisfy the currency requirements of customers (e.g. demand typically surges before public holidays and long weekends). Thus, the stock of currency in circulation is again determined by the demand of the private sector.

The stock of currency held by households and the rate of inflation

One of the most important factors affecting the currency demand is inflation, as the alternative cost of keeping currency, a non-interest-bearing instrument, can increase significantly when prices increase at a fast rate. The currency demand of households, one of the crucial factors of the monetary base, is particularly sensitive to inflation trends. Looking at the time series of the last near ten years, it is apparent that a decrease in the rate of inflation in Hungary has been accompanied by an increase in the growth rate of households' currency stock, while rising inflation has generally gone together with lower currency growth (Figure 3). This correlation is an example for a mechanism, which, *ceteris paribus* increases the amount of the monetary base at a low rate of inflation. Therefore in that situation, the growth of central bank money is the consequence of decreasing inflation rather than an indication of inflation pressure.

Figure 3

The annual growth of the amount of currency held by households and inflation



In summary, it can be concluded that the central bank does not exert direct influence on the size of the monetary base. Instead, the latter depends on the portfolio decisions of the private sector. Households and non-financial corporations have a choice between a wide range of financial assets when making the decision on the form in which they wish to keep their financial wealth. While the central bank's base interest rate obviously plays a role in these decisions, it is ultimately the structure of the portfolio (e.g. the proportion of currency, the distribution of short-term and long-term deposits or the weight of investment units) which will determine the quantity of base money on the liabilities side of the central bank's balance sheet. Consequently, the correlation suggested by the traditional money multiplier model, which traces the changes in the broader money measures (M1, M2, M3) back to the increase of the monetary base, cannot be justified either theoretically or empirically.

THE REAL DIRECTION OF CAUSALITY

These days, most central banks intend to achieve their monetary policy goals by setting some kind of short-term interest rate. On the basis of the relationships presented above, it becomes clear that, in these economies, the growth rate of the monetary base is an endogenous variable, i.e. it is determined simultaneously with the rate of employment, output, prices, interest rates and other financial market variables. In addition to the real economy equilibrium, the

equilibrium is thus also achieved on the market of financial assets, i.e. private sector agents make the decision on the range of instruments in which they wish to keep their financial savings under the given circumstances.

Apart from the liquidity, the expected return and the risk of the available financial instruments, these portfolio decisions are affected by a number of other factors, such as the regulatory environment or technical innovations related to payment systems.[9] While some of the above are (indirectly) affected by the base interest rate, that relationship is difficult to forecast and may be highly volatile over time. Consequently, rather than subordinating its interest rate decisions to controlling the money supply, the central bank builds on far more complex channels of the transmission mechanism (see, for example, Vonnák, 2007). However, it thus has to accept that the monetary base is shaped by mostly exogenous factors:

1. households and corporations decide what portion of their financial assets they wish to keep in non-monetary instruments (e.g. shares and government securities) and the portion to be kept in instruments having the functions of money;

2. economic agents decide on the instruments they want to keep their money in on the basis of their respective liquidity, interest rate and risk, thereby shaping the size of the money aggregates (M1, M2, M3);

3. the structure of instruments brought about by the portfolio decisions determines the quantity of reserves and the currency in circulation, i.e. the monetary base.

On the basis of the above, it is clear that the direction of the mechanism suggested by the money multiplier model is precisely the reverse, i.e. it is the broader money aggregates that determine the monetary base, to which the central bank, either passively or actively, adapts! Thus, on the determination of the quantity of base money, the essence is in the very factors which were 'enclosed' in the coefficient *m* in the money multiplication formula. In the example illustrated above, the latter also includes the currency-deposit ratio *(cr)*, which represents the portfolio decisions of the private sector in this largely simplified model.

The relationship between the monetary base and money supply

Our statement on the direction between the base money and monetary aggregates can be illustrated by a simple statistical test. The Granger causality test serves to determine whether the historical changes in a variable carries any information as to the future value of another variable, i.e. whether it helps in forecasting the latter. Table 1 shows that M0 does not Granger-cause either the M1 or the M2 aggregates, while the historical values of the broader money aggregates significantly explain the changes in the monetary base. That result confirms again that there is no express correlation between the quantity of central bank money and the money supply.

Table 1

The Granger causality test of the monetary aggregates

Null Hypothesis	Number of observations	F-Statistic	Probability
M0 does not Granger Cause M1	101	1.49	0.189
M0 does not Granger Cause M2	101	0.65	0.691
M1 does not Granger Cause M0	101	3.49	**0.004***
M2 does not Granger Cause M0	101	2.44	**0.031***

*Note: * indicates significant results at 5-percent level. The tests were carried out with seasonally adjusted monthly data for each time series between May 1998 and March 2007. The number of lags included was 6 (half a year). The estimates, however, appeared to be robust in that respect. The results show a similar picture when stated for the first difference of the variables.*

[9] A good example for the effect of the changing regulations is the imposition of the interest gains tax in September 2006, diverting a great deal of the savings of households into long-term time deposits and investment units. (It should be noted, however, that investment trusts again placed a substantial part of their new funds in bank deposits, which means that the overall reserve obligation did not change significantly.) Amongst other things, the decrease of the currency demand as a consequence of the growing availability of ATM's and bank card-based payment is an example of the results of technological development.

CONCLUSIONS

Rather than a quantitative target concerning the monetary base, in today's practice the *operational target* of the central bank is to determine the short-term *money market interest rate*. However, in that environment, many of the factors affecting the monetary base are exogenous for the central bank, given that the result of the portfolio decisions of the economic agents is reflected in the central bank's balance sheet, and determines the quantity of central bank money. Consequently, the growth rate of M0 (monetary base) does not carry any information on either the intentions of the central bank or the prospective rate of inflation.

REFERENCES

ANDERSON, R. G. (2006): "Monetary Base", *Federal Reserve Bank of St. Louis Working Paper,* No. 2006-049A.

ANTAL, J., GY. BARABÁS, T. CZETI AND K. MAJOR (2001): "Liquidity management operations at the National Bank of Hungary", *MNB Occasional Papers,* 2001/9.

BINDSEIL, U. (2004): "*Monetary policy implementation: Theory, past, present"*, Oxford University Press.

HORVÁTH, ÁGNES (ED.) (2006): "*Monetary Policy in Hungary"*, (3rd edition), MNB.

KISS L., E. KURUC, B. SULYOK SIMONNÉ AND SZ. VERES (2005): "*Monetary Statistical Handbook"*, MNB, (only in Hungarian).

HUNGARIAN GALLUP INSTITUTE *(2006): "The image of the MNB and the expectations of the population concerning the introduction of the Euro"*, Research report, Budapest, September 2006, (only in Hungarian).

MANKIW, N. G. (2005): "*Makroökonómia"*, Osiris Kiadó, Budapest. (Macroeconomics, Fifth edition, Worth Publishers, 2002.)

MNB (2005): MNB Decree 10/2005. (June 11) on the calculation of required central bank reserves and the method of its formation and placement.

MNB (2005): MNB Decree 11/2005. (June 11) on the reserve ratio.

VONNÁK, B. (2007): "The Hungarian Monetary Transmission Mechanism: an Assessment", *MNB Working Papers,* 2007/3.

WOODFORD, M. (2007): "How important is money in the conduct of monetary policy?", *CEPR Discussion Paper Series,* No. 6211.

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MNB Bulletin

June 2007

Print: D-Plus

H–1037 Budapest, Csillaghegyi út 19–21.