MAGYAR NEMZETI BANK

MNB Bulletin

NOVEMBER 2007

MNB Bulletin

November 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)

Contents

Summary 5

Ágnes Csermely–András Rezessy: The theory and practice of interest rate smoothing 6

Anna Delikát: Role of financial markets in monetary policy 16

Dániel Holló: Household indebtedness and financial stability: Reasons to be afraid? 23

Lívia Sánta: The role of central banks in crisis management – how do financial crisis simulation exercises help? 31

Máté Barnabás Tóth: Monetary policy rules and a normative approach to the central bank's objective function 39

Balázs Zsámboki: Impacts of financial regulation on the cyclicality of banks' capital requirements and on financial stability 47

Appendix 54

Summary

DEAR READER,

The Magyar Nemzeti Bank assigns great importance to making available for the wider public those central bank analyses which deal with various current economic and financial developments of general interest. This volume, which contains six studies, is the second issue of the MNB Bulletin, in its second year of publication. It contains theoretical articles (central bank objective functions, interest rate smoothing), analyses of international topics (crisis simulation exercises, cyclical effect of new banking regulations) as well as studies expressly relating to Hungary (financial market information used by the MNB, risks of household indebtedness).

The study by Ágnes Csermely and András Rezessy describes the theoretical background of the interest rate smoothing behaviour, which is widely observable in central bank practice. The practice of interest rate smoothing means that the interest rate steps of central banks are usually characterised by gradual change, i.e. central banks avoid sudden, significant changes in interest rates, and are averse to reversing interest rate cycles too frequently. It is typical of the MNB's interest rate policy as well that usually several smaller steps in the same direction follow one another. In addition to the theoretical background, the article also discusses considerations important in terms of conducting monetary policy in Hungary.

The article by Anna Delikát presents a survey of important financial market information taken into account by the MNB in its monetary policy decisions. When formulating the attitude towards the inflation forecast based on fixed conditions, the Monetary Council's risk perception may be influenced by what economic agents and, in particular, financial market participants think of monetary policy. Thus, for example, short-term market expectations regarding interest rates can be determined on the basis of the estimated yield curve and market quotations. In addition, important information is also gathered by mapping the relationship between rates and yields, and how risk appetite and default risk move within the risk premium.

The article by Dániel Holló analyses the risks of Hungarian households' dynamically growing indebtedness and the sustainability of banking portfolio quality. The analysis relies on survey material conducted by the MNB among indebted households in January 2007. Building on the findings of this survey, the article presents the structural distribution and riskiness of indebted households, as well as the effect of various unfavourable macroeconomic events on banks' portfolio quality and capital adequacy. The findings suggest that the shock absorbing capacity of the banking sector is sufficient and that the capital adequacy ratio of the banking system would not fall below the current regulatory minimum of 8 per cent even if the most extreme stress scenarios were to materialise.

The article by Lívia Sánta deals with crisis simulation exercises performed for banks and banking groups. Central banks play a prominent role in developing these exercises. They facilitate the development of co-operation between authorities, and prior to a crisis, central banks can identify those points of decision and potential conflict situations between authorities, the consideration of which is essential for efficient crisis management. Creating a crisis management framework aimed at efficient co-operation between authorities has become necessary within the EU because, through the interrelationships within the group, a crisis which affects a banking group may jeopardise the stability of the financial intermediary system in several countries.

The article by Barnabás Máté Tóth deals with the central bank objective function from a theoretical aspect. It establishes that striving for low inflation is not an end in its own right, as it ultimately serves the interests of social welfare. In support of this, the article presents the loss functions which contain relevant variables from a welfare aspect and the interest rules which minimise them. It points out that in terms of welfare, those decision-making rules are favourable, which, on the one hand, attach great importance to the projected departure of inflation from the target and, on the other hand, also take real-economy considerations into account. Inflation targeting can be considered a strategic framework, in which these theoretically formulated expectations can be translated into practice.

In his study, Balázs Zsámboki analyses the expected international consequences and possible financial stability effects of the application of the new Basel capital standards (Basel II). Examining the corporate loan portfolio of internationally active large banks, he points out that in times of unfavourable economic conditions, as a result of the cyclicality of capital requirements, banking regulations cannot necessarily support financial stability. The underlying explanation is that, due to restrictions in lending, the expected strengthening of the cyclicality of capital requirements may contribute to the deepening of economic problems and the instability of the banking system, if the latter is inadequately capitalised compared to the risk undertaken.

The Editorial Board

Ágnes Csermely–András Rezessy: The theory and practice of interest rate smoothing

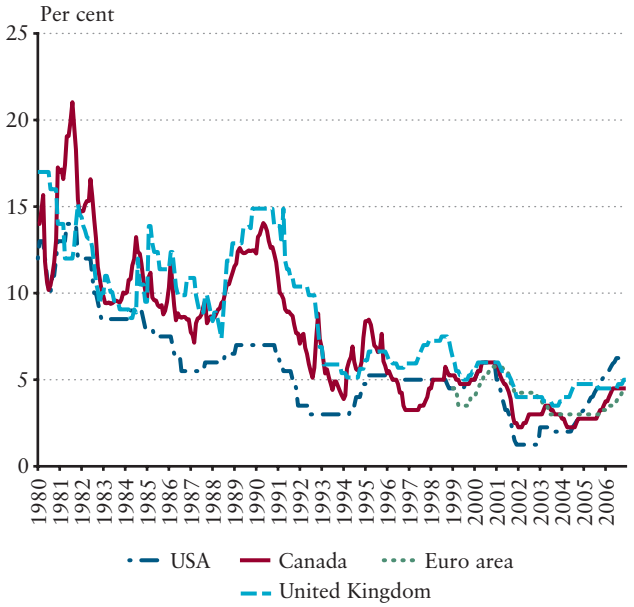
The interest rate policy of the Magyar Nemzeti Bank typically consists of taking several smaller steps in one direction. Other central banks follow similar practices. Their interest rate policy actions are characterised by gradual changes: in other words, they avoid sudden, major changes in interest rates and are wary of reversing interest rate cycles too frequently. This study will present the theoretical background of the practice of such interest rate smoothing, the motivations of central banks as revealed by their communication, and some important considerations for Hungarian monetary policy.

INTRODUCTION

International monetary policy practice shows that central banks attempt to avoid extreme interest rate changes. Looking at the past tendencies in the key interest rates of major central banks (Chart 1), it is apparent that prime rates – especially in the past decade and a half – have been fairly stable over the short term, while interest rate changes have been gradual over the long term, and that central banks have aimed to change the direction of the interest rate cycles as seldom as possible. While the Federal Reserve (Fed), which serves as the American central bank, has always followed this kind of strategy in the past, the Bank of England and the central bank of Canada, for example, only adopted this type of behaviour in the past decade and a half. Today, changes of 25 basis points have become prevalent, but from time to time, when economic developments feature a sudden reversal, a larger interest rate change is also possible. As Table 1 illustrates larger steps were taken more frequently to cut interest rates which suggest that the growth of the economy is more often affected by unpredictable events of great importance (e.g. the capital markets crisis, 9/11).

Chart 1

Changes in central bank prime rates



Sources: International Financial Statistics, Bank of England.

The statistical properties of the interest rate series also reflect the gradual approach taken by central banks. In most countries, the autocorrelation of central bank interest rates is considerable. This suggests that at any given time the interest rate will be affected by the interest rate of the previous period. Another interesting fact is that after an interest rate change in a particular direction, the interest rate is 3-4 times

Table 1

Statistical characteristics of central bank rates (1996-2006)

	Interest autocorrelation	Probability of a cycle reversal[1]	Average interest rate hike	Average interest rate cut
Federal Reserve	0.98	0.17	0.30	0.38
Bank of England	0.98	0.19	0.25	0.29
Bank of Canada	0.98	0.24	0.30	0.33
ECB (1999–2006)	0.98	0.18	0.31	0.39

Sources: International Financial Statistics, Bank of England.

[1] This indicator is the ratio of interest rate changes that reverse a cycle compared to all interest rate changes.

more likely to change in the same direction, rather than in the opposite direction. This indicates that central banks attempt to avoid reversals in the interest rate cycle.

THEORETICAL CONSIDERATIONS OF INTEREST RATE SMOOTHING

The theoretical literature identifies four major reasons for gradual changes in interest rates, in other words interest rate smoothing (see for example Bernanke, 2004; Blinder, 2005; Rudebusch, 2006).

1. Macroeconomic uncertainty requires a more cautious and a gradual approach to interest rate policy.

2. Interest rate smoothing and less frequent reversals in interest rate cycles help make monetary policy more understandable and underscore the competence of the central bank.

3. Interest rate smoothing contributes to financial stability.

4. As expectations regarding future interest rate changes have an impact on the decisions that economic agents make today, the economy may be stabilised with the help of smaller, but more lasting interest rate changes.

The most important reason for interest rate smoothing is macroeconomic uncertainty. Economic data are inaccurate, data revisions are frequent, and the available analytical tools are not sufficient to identify the economic shocks that drive the behaviour of economic agents in 'real time'. On the other hand, monetary decision makers do not know in advance the impact of an interest rate change on other macroeconomic variables such as, for example, the exchange rate and the price of assets, and therefore constant learning is required until the optimal degree of monetary restriction or relaxation can be determined. A seminal study by Brainard (1967) demonstrated that if a decision maker is unsure about the model that describes the economy and the impact its decision will have on the economy, then – under certain parameter restrictions – the optimal decision is to take smaller steps in response to the information received, compared to when circumstances are not uncertain.[2]

It is important to note, however, that uncertainty does not always justify a gradual change. If the uncertainty concerns the persistence of inflation, for example, an optimal policy would tend to take more aggressive steps than in the absence of uncertainty. The reason is that this is how the central bank reduces uncertainty about inflation in the future (Söderström, 2000). In addition, increased inflation persistence may indicate that market players are not fully convinced by the central bank's commitment to price stability. The later the central bank responds, the higher the real costs the central bank will incur when it attempts to re-establish its credibility.

The second advantage of interest rate smoothing is that it helps to reduce the frequency of cycle reversals. If cycle reversals are too frequent, communication becomes more difficult and public opinion may call into question the competence of the central bank.[3] Frequent changes in interest rate cycles are also undesirable if we wish to understand how the economy operates (see, for example, Ellison, 2006), as they prevent the central bank and other market participants from learning about the monetary transmission mechanism.

The third advantage of interest rate smoothing is that it enables monetary policy to have a stronger impact on interest rate expectations and on long-term yields. Interest rate policy affects economic activity – including decisions to invest, consume and save – primarily by way of long-term interest rates rather than the prime rate. The relationship between the two is based on the expectation hypothesis of the yield curve according to which long-term yields are an average of short-term yields that are expected in the future. Therefore, if an interest rate change is considered to be long-lasting or if additional changes are expected in the future, long-term yields will change to a greater extent because the interest rate change is understood as the first step in an interest rate cycle.

The impact on long-term interest rates may lead to a more favourable economic trajectory via two channels.

One is based on the assumption that interest smoothing can achieve the desired macroeconomic effect via lower fluctuation in the prime rate. This is because different shocks often change inflation in opposite directions. In such cases, a monetary policy featuring interest rate smoothing does not have to complete interest rate cycles on the basis of newly received information; however, long-term interest rates undergo the necessary changes. Smaller fluctuations in short-term interest rates are of value primarily for the purpose of stability. Banks' funds usually have shorter terms than their placements. Therefore, a gradual change in short-term interest rates has a stabilising effect on banks' profits because it enables them to adapt to changes in their financing costs (Cukierman, 1991).

[2] This consequence of uncertainty, and the fact that uncertainty requires gradual action, was later also demonstrated in a different model framework. Martin (1999) had similar results in the new Keynesian model framework. Martin adds that those parameter values in respect of which Brainard's results are not valid do not appear to be realistic on the basis of empirical evidence.

[3] According to Meyer (2004), for example, this consideration was of key importance for Greenspan, the previous chairman of the Fed.

According to the second consideration, described by Woodford (1998), it is not interest rate smoothing but the long-term nature of changing of interest rates that matters. Due to forward expectations, inflation and output do not depend on current monetary conditions alone, but also on future monetary policy action. Therefore, a more favourable result will be achieved if the central bank is capable of influencing long-term interest rate expectations as well. If market players expect the currently optimal interest conditions to be lasting, a smaller initial interest rate change may be sufficient to stabilise the economy.

However, the central bank can only influence expectations if it is credibly committed to an interest rate trajectory. This means that the central bank cannot re-optimise its policy at each moment, as it must take into account its past decisions (history-dependent). Accordingly, a commitment may narrow the central bank's options over the short run, but overall the central bank will be more successful in stabilising the economy, because expectations can be managed more effectively.

MODELLING THE CENTRAL BANK'S ACTIONS: IS INTEREST RATE SMOOTHING INTENTIONAL?

If we wish to model the actions of the central bank, it is important to decide why interest rate smoothing occurs and whether or not it is intentional. If the central bank's actions are influenced by financial stability considerations, after a larger shock the central bank will execute only a portion of the necessary interest rate change and finish up – provided that the central bank's outlook is not modified by new information – later, in several smaller steps. If the central bank's objective is to influence expectations and to formulate a persistent interest rate trajectory (à la Woodford), the central bank will respond to a shock immediately, but will take into account its previous commitments when determining the optimal approach. Therefore, interest rate smoothing is not a result of future action, but rather of past action. Finally, some people believe that interest rate smoothing is not intentional but is caused by the dynamics of the economic variables and/or uncertainty as described by Brainard and a constant learning process about economic processes. In this approach the central bank, in every one of its decisions, immediately changes the interest rate to what is considered to be the optimal level at the time. However, the unfolding of macroeconomic processes and a better knowledge of their nature results in a more persistent interest rate trajectory.

Empirical studies of the central bank's interest rate smoothing are generally based on the logic of financial stability: a new argument is added to the central bank's traditional loss function[4] to penalise interest rate fluctuations. The logic of estimating the central bank's so-called reaction functions or the interest rate rules is similar. These studies are based on the primary hypothesis that the central bank adapts to the fundamentally justifiable interest rate level only gradually. Most often the fundamental interest rate is a function of inflation and the output gap (in the literature this is referred to as the 'Taylor rule'). The actual change in the interest rate can be estimated on the basis of a partial adjustment equation, as a function of the fundamental interest rate and the lagged interest rate. The coefficient of the lagged interest rate *(ρ)* was regarded as the parameter of interest rate smoothing. Most of these studies were written to describe the actions of the Fed and resulted in a rather high smoothing parameter of approximately 0.7-0.9.[5] Hidi (2006) performed similar calculations in respect of Hungary, the results of which indicated a similar level of interest rate persistence (0.6-0.8).

The above approach was widely criticised, because in practice the high autocorrelation of interest rates can be caused by several factors in addition to intentional smoothing. Rudebusch (2002 and 2006), for example, called attention to the fact that the results are similar if the central bank, when making its decision, takes into account criteria other than growth and inflation and for a longer period of time (e.g. stability considerations). Rudebush also proposes an alternative method for measuring intentionality on the basis of money market information. If the central bank's gradual changes were intentional, forward yields would be easy to predict. In the case of the USA, the prime interest rate cannot be predicted with sufficient certainty for a period longer than 3 months; consequently, interest rate smoothing is not intentional in the interpretation based on money markets.

With regard to the Bank of England, Goodhart (2004) also came to the conclusion that smoothing is not intentional. In the study he estimated the reaction function of the Bank of England and found that the central bank does not react to current inflation, but to a deviation from the target of the inflation forecast, that is, $\tilde{\pi}_{t+2}$. In this approach, interest rate changes do not exhibit smoothing. However, we must underline that in most cases the central bank's forecasting practice contains smoothing. As forecasters face the same uncertainty as decision makers when evaluating freshly received macroeconomic variables, they too only gradually incorporate the impact of new information into their forecasts.

[4] The most popular form of the central bank's loss function can be expressed as the discounted present value of the square sum of the deviation from the inflation target and the fluctuation in the output gap. In certain models this corresponds to the welfare function of the representative household.

[5] See Amato and Laubach, 1999, Clarida et al., 2000.

The latest method of modelling the central bank's behaviour is based on estimates by the so-called stochastic dynamic general equilibrium models.[6] These models do not assume the central bank's target function which penalises interest rate volatility and but do take into account the persistence of shocks to the economy. Nevertheless, the estimated parameter of the lagged interest rate in the central bank's target function is high. In this model framework the welfare impact is primarily caused by the 'Woodford' channel that pertains to the predictability of future interest rates.

INTEREST RATE SMOOTHING AND COMMUNICATION BY CENTRAL BANKS

In the previous chapter we have seen that empirical approaches cannot accurately grasp the motivation behind the generally observed interest rate smoothing behaviour of central banks. Therefore, in this chapter we will examine communication by central banks in order to explore the assumptions behind gradual interest rate changes. This study will only focus on tools that guide longer-term interest expectations and will not analyse communication aimed at smoothing market interest rates over the very short term.[7]

The direct statements of central bank chairmen are not equivocal. In an earlier study Bernanke, the current chairman of the Fed, claimed that American monetary policy smoothes interest rates intentionally (Bernanke, 2004). However, according to Poole, another member of the Fed's decision-making body, future interest rate changes are based almost exclusively on newly received information, that is, if interest rate changes are gradual, it is not because of intentional interest rate smoothing (Poole, 2003). Similarly to Poole, King, the chairman of the Bank of England, claims that the central bank always makes a new decision in light of new information (King, 2006). Goodhart, a former member of the decision-making body of the Bank of England, denies having regularly voted together with his colleagues on smaller steps than were necessary to attain the inflation target (Goodhart, 2004). Despite this statement, we have found evidence of intentional interest rate smoothing in the minutes of the Bank of England. The minutes of the interest rate decision often point out that uncertainty requires cautious measures in monetary policy. In one case, the minutes specifically state that although a 50 basis point increase would have been necessary due to the inflation forecast, yet they decided to take several smaller steps due to the uncertainty and to the danger of sending the wrong message by changing the size of a step.

In addition to the statements made by central bank officials, the forward communication of central banks may also yield information about expectations concerning future interest rates and therefore about the assumptions that underlie interest rate smoothing. In the inflation targeting system, one of the key tasks of monetary policy is to influence expectations; therefore, the practice of each inflation targeting central bank has forward components. An accepted tool for orienting interest rate expectations is the so-called fan chart[8] which, in addition to the basic trajectory of inflation forecast, also indicates the uncertainty faced by decision makers in respect of future developments in inflation and growth. The fan chart sends a message about future interest rate changes: if the likelihood of inflation in excess of the target is high, monetary tightening can be expected. At the same time, it also demonstrates the 'Brainard' uncertainty: decision makers need additional information and learning to be able to formulate a more accurate picture of the future trajectory of the economy and to determine the appropriate monetary policy.

A policy bias or code words regarding the nature of future interest rate changes may fulfil a similar function. This type of forward communication is also exercised by non-inflation targeting central banks as well. Similarly to the fan chart, the policy bias is generally preceded by enumeration and evaluation of the risk factors impacting inflation ('verbal fan chart'), as a result of which the direction of future interest rate changes is determined. In this communication framework, the policy gradualism is also motivated by learning and uncertainty, which highlights that the commitment to the bias is always contingent.

Some inflation targeting central banks only use the fan chart (e.g. the Bank of England), while others help interpret the fan chart by making direct references to the direction, or perhaps the pace, of expected interest rate changes. The central bank may help calibrate expected interest rate changes if the inflation forecast and/or the fan chart are based on the assumption that the prime rate will follow the trajectory set by forward market rates. In this case, the fan chart and/or the bias can be evaluated by comparing them to the interest rate changes that are expected by the market, which allows much more freedom in fine-tuning expectations.

The practice of inflation targeting banks that also publish an interest rate trajectory which is considered acceptable by the central bank (so-called endogenous interest rate

[6] See e.g. Smets and Wouters, 2003.

[7] The most widespread type of short-term tool is verbal intervention, used by several central banks, which attempts to orient money market expectations about future interest rate changes especially between interest decision sessions. In these cases, the purpose of communication is to help the markets evaluate the events that occur between sessions and the responses of the central bank to these events. In respect of verbal intervention see Pintér et al., 2006.

[8] This interpretation of the fan chart is possible only if the inflation forecast and the inflation report reflects the assessment of the Monetary Council.

trajectory) in respect of the time period for which a forecast is made (e.g. the central banks of New Zealand, Norway, Sweden and Iceland) represents a higher level of orienting interest rate expectations. These interest rate trajectories are generally 'smooth' and change monetary conditions in slow, gradual cycles. The Norwegian central bank has been most specific in what it regards as a 'good' interest trajectory.[9]

1. The interest rate should be set with a view to stabilising inflation close to the target over the medium term. The horizon will depend on the disturbances to which the economy is exposed and the effects on the prospects for the inflation path and the real economy.

2. The interest rate path should provide a reasonable balance between the path for inflation and the path for capacity utilisation.

3. Interest rate developments should result in acceptable developments in inflation and output also under alternative, albeit not unrealistic assumptions concerning the economic situation and the functioning of the economy.

4. Interest rate adjustments should normally be gradual and consistent with the Bank's previous response pattern.

5. As a cross-check for interest rate setting, it should be possible to explain any substantial and systematic deviations from simple monetary policy rules.

Criterion 4 clearly states the need to change the interest rate gradually. At the same time, based on Criterion 2, it is clear that the future developments in inflation and the output gap must also be taken into account when determining the interest rate trajectory, therefore the persistence of macro variables enhances the gradual changing of interest rates. Criterion 5 also enhances interest rate smoothing because the endogenous interest rate trajectory is also compared to the Taylor-type rules, which contain explicit interest rate smoothing.

Finally, we would like to note that sometimes central banks are also expected to ensure a low volatility of interest rates. For example, according to the definition by the New Zealand central bank, the objective of monetary policy is to ensure the stability of prices in general and to avoid unnecessary fluctuations in output, interest rates and the exchange rate.

Overall, on the basis of the forward communication of central banks, gradual interest rate changes are based primarily on the 'Brainard' uncertainty, i.e. continuous learning about economic processes, while at the same time the intention to moderate interest rate volatility sometimes appears to be genuinely beneficial. However, we do not have any information as to whether it is based on the 'Woodford' type persistent interest rate policy or considerations related to financial stability.

INTEREST RATE SMOOTHING IN HUNGARY

In this chapter, we examine the interest rate policy of the Magyar Nemzeti Bank in the period after inflation targeting was introduced. First, we wish to describe the past 6 years in respect of the gradualism in interest rate changes and the prevalence of smoothing the prime rate. We then examine the motivation behind keeping interest rate changes gradual on the basis of the central bank's forward looking communication.

The extent of interest rate changes made by the Hungarian central bank and the changes in interest rate cycles are greatly determined by the structural characteristics of the Hungarian economy:

1. Transitional economies experience more frequent and greater shocks than developed economies (Benczúr and Rátfai, 2005), while the mechanisms that facilitate smooth adjustment of the economy are weaker (large share of liquidity constrained households, weak automatic stabilisers in the budget).

2. The Hungarian economy has a long history of inflation, and due to the legacy of high inflation expectations, interest rate smoothing may have been constrained by weaker credibility of the central bank's disinflationary policy.

3. The MNB, similarly to central banks in other transitional economies, has faced high macroeconomic uncertainty. Due to the short span of the available data series and the structural changes in the economy, the uncertainty of models describing the economy is greater than usual.

4. The exchange rate plays an important role in monetary policy, because the most important real effect of monetary policy action comes through the exchange rate channel.

[9] These criteria are always listed in the Norwegian report on inflation as a framed message within the section that describes the Monetary Council's interest rate trajectory.

Table 2

Autocorrelation of the central bank's interest rates and the likelihood of cycle reversals in small inflation targeting economies (1999–September 2007)

	Autocorrelation of interest rates	Likelihood of cycle reversals
New Zealand	0.98	0.13
Chile	0.96	0.33
Israel	0.98	0.12
Hungary (2001–September 2007)	0.96	0.17

Sources: Central bank websites.

The first two criteria, the extent of shocks and the issue of credibility, point towards lower scale interest rate smoothing, while Criterion 3 supports interest rate smoothing on the basis of the Brainard logic. The importance of the exchange rate is not unequivocal for interest rate smoothing. On the one hand, for inflation processes, only permanent changes in the exchange rate count; and the central bank must only respond to permanent changes in the risk premium. Because – ex ante – it is very difficult to say how permanent exchange rate changes will be, the key role of the exchange rate may provide an incentive for a gradual monetary policy reaction. Smaller changes in the interest rate may also moderate exchange rate and interest rate speculation. This is because money market players with considerable market weight can build speculative positions if the central bank reacts to exchange rate fluctuations quickly and with considerable interest rate changes. On the other hand, however, we can also argue for a more aggressive response to the exchange rate. If on the basis of their past experience market players expect exchange rate changes to be lasting, this may enhance the pass-through of exchange rate changes to inflation. Consequently, the central bank will be able to moderate the tightness of exchange rate management only gradually as market players learn to live with exchange rate fluctuations. This is the assumption behind the fact that in small, open, inflation targeting countries a decrease in the exchange rate pass-through parameter has become an important indicator of the central bank's credibility.

Due to the specific aspects of the Hungarian economy, small, open and less developed countries provide a better basis for comparison than large, developed countries. We selected three countries that are leaders in the practice of inflation targeting and have extensive experience in this respect (New Zealand, Chile and Israel). According to Table 2, the autocorrelation of the interest rates in these countries are somewhat lower than in large, developed countries. In respect of the likelihood of cycle reversals, results are only partially comparable because we do not have available a time series of the same length as in the case of developed countries. Overall, in these countries cycle reversals are not more frequent.

Another indicator of the importance of interest rate smoothing is the average size of interest rate changes. Table 3 shows that in small inflation targeting countries, the average extent of interest rate change is somewhat larger than in more developed countries (Table 1). It should be underlined that the asymmetry in this case is the opposite. While the central banks of developed countries make faster and more resolute interest rate correction moves downward, small countries tend to do the same in an upward direction. A higher-than-average increase in interest rate may be explained by an outstanding interest rate hike or a series of hikes due to a sudden weakening in exchange rates or a crisis-like situation. However, in quiet periods the normal extent of

Table 3

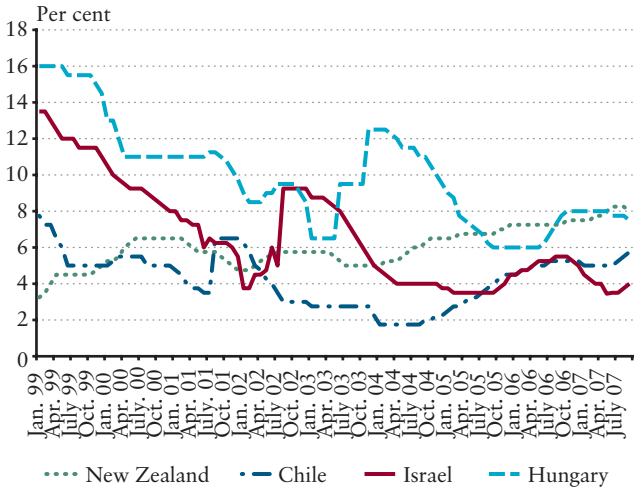
Extent of interest rate changes by the central banks of small inflation targeting economies (1999–September 2007)

	Average interest rate change	Interest rate hike		Interest rate cut	
		average	mode	average	mode
New Zealand	0.27	0.28	0.25	-0.25	-0.25
Chile	0.42	0.39	0.25	-0.44	-0.25
Israel	0.40	0.60	0.25	-0.35	-0.25
Hungary	0.56	0.90	0.50	-0.44	-0.50

Sources: Central bank websites.

Chart 2

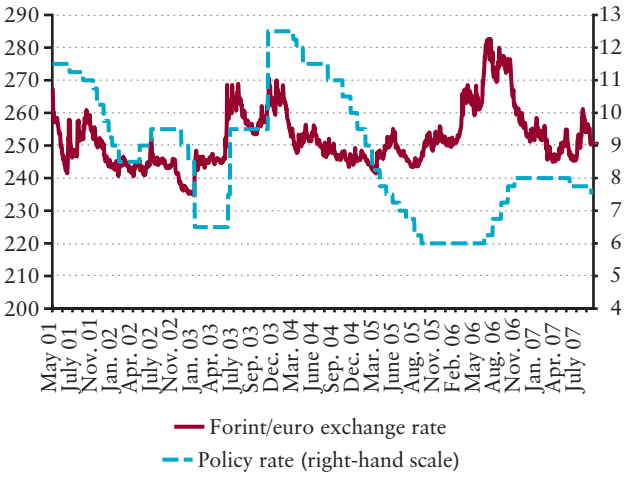
Changes in central bank prime rates in the small economies under review (1999-2007)



Sources: Central bank websites.

Chart 3

Changes in the central bank's prime rate and the exchange rate 2001-2007



Source: MNB.

interest rate change, similarly to developed countries, is 25 basis points[10] (see Chart 2).

During the past 6 years the persistence of the Hungarian prime rate has been rather similar to that of peer countries. The largest changes in the interest rate occurred in 2003 in response to a speculative attack against the exchange rate band and in relation to the exchange rate drops in the course of the year. This is in line with the experience of other small, open countries and the conclusions of the theoretical literature according to which the optimal response to a weakening of the central bank's credibility is a firm reaction by the central bank, and smoothing of interest rates is not an option (Söderstorm, 2000). At the same time, for the MNB the normal step was also larger. While in the other small countries the typical extent of the change was 25 basis points, in Hungary it was 50 basis points.

In the first years after inflation targeting was introduced, the lessening of exchange rate fluctuations played a key role in the interest rate policy of the MNB. Up until 2001-2003 the central bank attempted to orient short-term exchange rate expectations by announcing exchange rate comfort zones which were compatible with the attainment of the inflation target. Starting from 2004, the central bank no longer commented directly on changes in the exchange rate, but the effect of exchange rate changes that proved to be long-term were incorporated into inflation forecasts and therefore interest rate policy was indirectly impacted.[11]

An increase in the central bank's exchange rate tolerance created an opportunity for a more extensive smoothing of interest rates. This change is also apparent in yield and exchange rate volatility changes. The fluctuation of the exchange rate grew, the fluctuation of short-term yields fell

Table 4

Exchange rate and interest rate volatility*

	Exchange rate	3 months	6 months	1 year	3 year	5 year
2001–Sep. 2007	0.46	0.35	0.36	0.37	0.37	0.30
2001–2002	0.39	0.36	0.35	0.34	0.33	0.27
2004–Sep. 2007	0.47	0.24	0.26	0.30	0.31	0.27

** Average of 90 day volatilities.*

Source: MNB.

[10] The optimal extent of exchange rate changes is also affected by the frequency of interest rate decisions. International practice is not uniform in this respect. The European Central Bank has a rate-setting meeting every month, while the central banks of other developed countries typically meet less often (the Fed: 8 meetings, the Swedish central bank: 6 meetings). In less developed countries, the Monetary Councils meet more often; in Chile and Israel interest rate decision meetings are held on a monthly basis similarly to Hungary, in New Zealand, however, there are only 8 such meetings.

[11] In addition, when the exchange rate was close to the edge of the band, the announcements started to include statements related to the risk premium due to the direct management of the exchange rate.

considerably, but there was no significant change in the behaviour of the time series over longer horizons. This indicates that the reason for the changed tendency of interest rate changes is not only a change in the nature of the shocks, but stronger interest rate smoothing activity by the central bank as well.

In the period since inflation targeting was introduced there were two longer interest rate reduction periods which were followed by two shorter interest rate hike periods. Currently, the market is expecting interest rate cuts again. The reasons behind the gradual changes in the interest rate can be further explained by the central bank's forward communication. Over the past six years, most interest rate changes were preceded by an indication by the central bank, either in the form of a fan chart or a policy bias. However, there were periods when in the series of interest rate changes of a particular direction were motivated by a series of shocks of the same direction.

As to forward looking communication, the past six years can be broken down into two periods. The first one lasted until the end of 2003 during which time the MNB published its inflation forecast on a quarterly basis. The fan chart in the forecast reflected the risk perceptions of the Monetary Council, and in connection with the fan chart the Council also formulated a policy bias in respect of the direction of interest rate changes. In those decision-making sessions where there were no inflation report publications, the Council only provided an uninformative statement on the rate decision.

Between the middle of 2001 and the end of 2003, 10 inflation reports and related statements were published. On six of these occasions the direction of interest rate change indicated by the Council and the actual interest rate changes until the next report were of the same direction. In the rest of the cases the exchange rate change, which is not listed among the risks in the conditional forecast prepared by the MNB, altered the intended direction of monetary policy.

From 2004, the inflation report was issued as a staff report and the Monetary Council did not provide a regular policy bias related to the fan chart. At the same time, the announcements issued by the Monetary Council became more substantive, giving a detailed description of the Council's assessment of economic processes.

In this period, we can only compare the skewness of the fan chart and the interest rate changes which were made in the following quarter. During this period, the skewness of the fan chart and the direction of the interest rate change was in harmony for 9 out of the 15 inflation reports.[12] There must have been a series of surprises that caused such conflicting messages in 2005. During this period, international risk premiums fell considerably, and stronger competition in the product market and the persistently low level of core inflation may have contributed to the series of interest rate cuts.

On the other hand, in 2004 and starting from the end of 2006, there was a foreseeable discrepancy between the fan chart and the forthcoming interest rate changes. Both of these were related to the fact that the market harboured different expectations regarding the simultaneous change in interest rates and the exchange rate than was indicated in the assumptions of the inflation report with respect to the interest rate and exchange rate, which were fixed at the previous month's level.

In 2004, while preparing the inflation forecast, the staff did not take into account that entry into the EU will result in considerable disinflation due to increasingly strong competition; therefore it forecasted higher inflation than eventually occurred. At the same time, considerable strengthening of the forint resulted in a significant tightening in monetary conditions and therefore there was no need for additional interest rate hikes. Starting from 2004, the Monetary Council did not provide a policy bias, but reference was made to the expected interest rate trajectory in the form of 'code words.' The typical message of the period was a reference to the need for 'cautious' interest policy: the fragility of consolidation and the macroeconomic imbalance justified only a gradual decline in interest rates. In the first half of 2004, market players in fact priced in steeper interest rate cuts than actually happened, and the message of the central bank helped the market learn about the interest rate smoothing behaviour of the central bank.

At the end of 2006, the situation was similar to the beginning of 2004: while the inflation fan charts indicated an upside risk, the market planned for an interest rate cut. This was in line with the Council's opinion that, due to an improvement in macroeconomic equilibrium, the interest premium expected from investments in forint would gradually fall and consequently the monetary conditions of a disinflation trajectory may be ensured even if the prime rate is lower. The Council also indicated this to market players in the form of an interest rate policy bias. However, these assumptions – which were proven ex post – did not find their way into the

[12] We interpreted the fan chart as an indicator of interest rate hike/interest rate cut if compared to the target the fan chart was oblique, that is, the probability of a higher/lower inflation than the target was higher/lower.

fan chart, which was based on the technical assumption of a fixed interest rate and exchange rate. Nevertheless, the fan chart provided useful information for the market in respect of the expected interest rate change. The upside risk to the baseline scenario may have indicated to the market that the interest rate decline will be much slower than expected.

CONCLUSIONS

In summary, in the past six years the uncertainty related to the nature and course of the shocks and the impact of monetary decisions on the economy called for gradual interest rate changes by the MNB, and this is primarily what caused the interest rate cycles which were observed. In addition to continuous learning about economic processes, the projected interest rate trajectory was most often altered by changes in the exchange rate.

Despite the uncertainty and the unforeseeable shocks, inflation forecasts and the Monetary Council's interest rate indications helped form interest rate expectations. The fan chart indicated the risk factors which influenced the decisions of the Monetary Council, facilitating the learning process amongst market participants. At the same time, however, when there was a significant discrepancy between the exchange rate and the interest rate trajectory expected by the market on the one hand and the presupposed fixed interest rate and fixed exchange rate in the inflation report on the other hand, the information content of the fan chart's message regarding the interest rate was significantly reduced. In such cases, the Monetary Council's forward communication regarding expected developments in the exchange rate and the interest rate trajectory is of key importance.

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Anna Delikát: Role of financial markets in monetary policy

For central banks, it is very important to know what economic agents, and more specifically financial market participants, think about monetary policy. Consequently, understanding financial market information represents an essential aspect of the MNB's monetary policy decisions, because it is an influential component of risk perception in terms of the opinion of the members of the Monetary Council in relation to the inflation forecasts adopted on the basis of fixed conditions. Short-term interest rate expectations can be defined relying on the MNB's estimate of the yield curve and market quotations. On the other hand, the analysis of long-term forward yields helps in drawing conclusions regarding the central bank's credibility and market agents' perception of the convergence process. For the assessment of foreign exchange market developments, the MNB relies on surveys concerning the equilibrium of the foreign exchange market and findings of the micro-structure theory. In order to identify the relation between exchange rates and yields, as far as the risk premium is concerned, shifts in risk appetite and default risks provide essential information, although the MNB frequently examines other factors as well.

FOREWORD

For central banks, it is very important to know what economic agents, and more specifically financial market participants, think about monetary policy. On the one hand, this is important because unforeseen monetary policy actions can alter expectations, while on the other hand, expectations provide a reliable reflection of economic agents' opinion on monetary policy in terms of credibility. Furthermore, analysis of financial markets is an important tool for central banks, as it helps to identify the relation between exchange rates and yields. The analysis of financial market indicators also influences the Monetary Council in its risk perception, which in turn has an effect on monetary policy.

In the first two chapters, we describe the key indicators the MNB uses to examine yields and exchange rates. The third chapter contains an overview of the relationships between exchange rates and yields through an examination of the risk premium.

Due to the space limitations, this article is restricted to showing only the framework of the analysis. Within the dimensions illustrated here the MNB frequently reviews numerous other factors to understand yields and exchange rates, and their relationships.

YIELD CURVE

The central bank's ability to directly assert influence through its short-term (overnight, two-week) instruments is limited to the shortest section of the yield curve. As durations grow longer, more emphasis is laid on the interest rate expectations of market agents and on the factors influencing the required premium. According to the expectation hypothesis, among spot yields, the forward yields derived under arbitrage-free conditions coincide with interest rates expectations. Consequently, market yields offer a good instrument for estimating the expectations of market agents in terms of the base rate path. As each market operates under different conditions (liquidity, turnover, agents, risks), different instruments are likely to result in different interest rate paths as well, according to which the MNB monitors changes in the prices of several different assets in its estimation of expectations.[1]

The cornerstone of any analysis of interest rate expectations is formed the government securities market. Relying on the prices quoted by dealers of primary government securities, the central bank constructs a (so-called zero coupon) yield curve each day with the distorting effects of bond coupon redemption payments duly eliminated.[2] In the process of construction, the resulting parameters may be used to produce the forward yield of any term. Of these, the MNB examines the series of two-week forward yields that shows the base rate path integrated into the market prices of government securities, meaning that it contains information concerning the expectations of market agents regarding the central bank base rate.

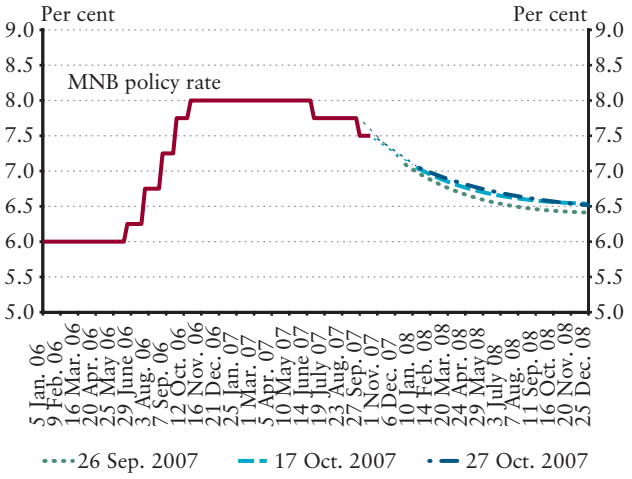
To define interest rate expectations the MNB uses other – directly observable – market yield indicators as well, such as

[1] For more information on the yield curve the MNB uses, see Gyomai–Varsányi (2002).

[2] Bonds are paid off in one lump sum, upon maturity.

Chart 1

Policy rate expectations



Notes: MNB estimated yields by the Svensson method.

Sources: MNB, ÁKK.

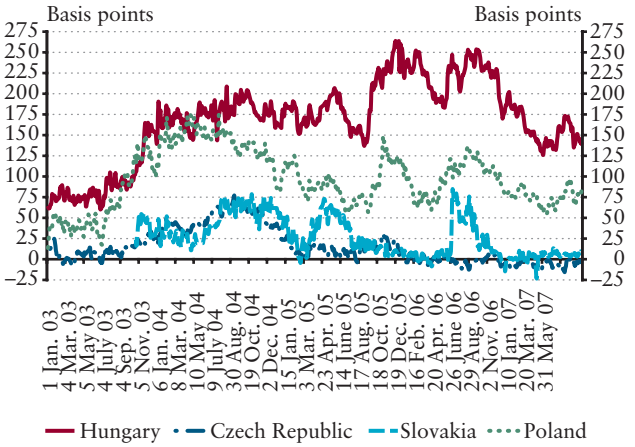
the three-month (discount Treasury bills) benchmark yield, and the three-month BUBOR offered on the interbank market, which is considered somewhat riskier than the government securities market. As this method does not provide information on developments in the interest rate path within a three-month period, using forward rate agreements (FRA)[3] to define the interest rate expectations offers a more accurate picture.

Central bank interest rates do not have an impact on long-term yields, and hence they are determined in principle by the expectations of market agents. As long-term yields are calculated as the result of expected real interest rates, expected inflation and the risk premium, any changes in these yields also function as a mirror, reflecting the credibility of monetary policy. Measures of lesser credibility usually result in higher long-term inflation expectations and surging long-term yields.

On the other hand, foreign investors tend to pay more attention to the premium of the financing currency (e.g. the euro) relative to the yields (extra yield), rather than to the nominal level of forint yields. Foreign investors play a major role in the liquidity status of the Hungarian government securities market (meaning that they are engaged in trading in Hungarian government securities), which also means that any shift in the yield levels in the major markets tends to influence forint yields, even if the premium remains unchanged. Therefore, the impact of local factors is better reflected in spot and forward premia than in nominal yields.

Chart 2

Long-term forward interest rate premia in the region



Source: Reuters.

Long-term forward premia reflect the long-term interest rate and premium expectations of market agents. For Hungary, the anticipated introduction of the euro constitutes a unique factor. After the introduction of the euro, short-term interest rates in Hungary will be the same as the interest rates in the euro area and, since foreign exchange risks will not exist any longer, no significant deviation is expected in long-term yields, as also indicated by previous events. In other words, the level of long-term forward premia could imply the horizon of market agents' expectations in terms of the introduction of the euro, and may also incorporate fundamental risks (e.g. budget, external balance risks) as well. To estimate the sustainability of external and internal balance, and the prospective date of introduction of the euro, most analysts tend to rely on the 5-year forward premium 5 years ahead relative to the euro forward yield rate, as this offers an indication of the position of the 5-year ahead 5-year yield of Hungarian government bonds compared to the same indicators in the euro area.

FOREIGN EXCHANGE MARKETS

Apart from future expectations of market agents, changes in foreign exchange rates are also influenced by existing demand for forint and by the structure of *equilibrium of the foreign exchange market*. For this reason, the MNB closely monitors Hungary's external financing requirement.

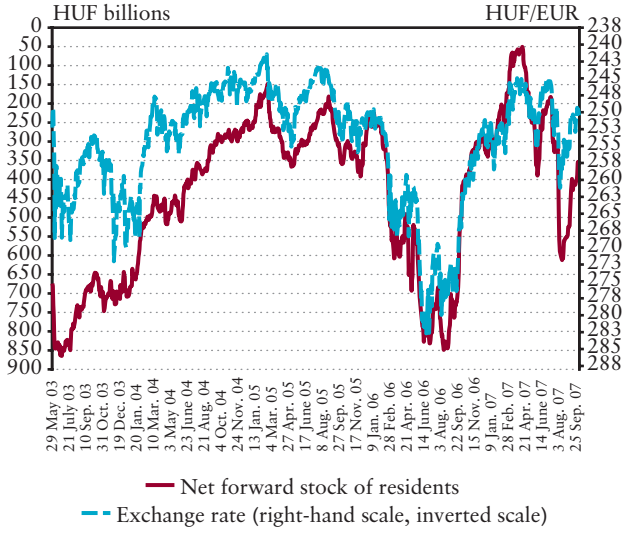
Reduction in the foreign indebtedness of domestic participants results in increasing demand for forints on the part of foreign participants. If the rate of demand for forints remains behind this type of exposure, it commonly results in lower exchange rates.

[3] Forward rate agreement means when the parties agreement on the amount of interest payable on a specific sum at a future date.

This observation is also supported by the *micro-structure* principle of exchange rates. Based on previous findings, the central bank is of the opinion that movements in the forint exchange rate depend to some extent on the dimension and direction of order flows (quantity of currency traded) between the quoting banks and their customers. In response to forint purchases by foreign participants, banks quoting currency market prices tend to move toward a stronger forint rate. As any movement in the overall exchange rate position of Hungarian banks is usually insignificant, the forint purchases or sales of foreign participants are offset by opposite transactions conducted by domestic participants. When the exchange rate rises, domestic non-bank participants (mostly export companies) are willing to cut back on their forward positions covering appreciation of the forint, and move to realise the profits on their hedging positions in anticipation of somewhat lower future gains. In consequence of this mechanism, the volume of derivatives held by domestic non-bank participants is usually closely related to the forint exchange rate.[4]

Chart 3

Changes in exchange rates and in the exchange rate risk of domestic non-bank participants relating to their derivative holdings



While the above fundamental analysis is suitable in principle for examining long-term movements in exchange rates, in order to describe short-term movements in exchange rates a technical evaluation is required, focusing on a geometrical analysis of trading in terms of prices and volumes.

The purpose of the technical analysis is to identify regular episodes (trends, formations, technical levels) in the exchange rates charts. Naturally, technical analysis has its limitations. As fundamental shocks cannot be predicted, neither can the exchange rates movements which they tend to induce be foreseen. However, technical analysis can be used to describe movements in exchange rates between two fundamental shocks. As market participants use technical analysis to forecast exchange rate levels, the MNB also monitors developments in the key technical indicators of the exchange rate.

RISK PREMIUM

The link between exchange rates and yields is created by the correlation of uncovered interest rate parity, according to which the interest on two investments of the same term, one domestic and the other foreign, in a risk-free environment differs inasmuch as can be compensated by the expected movement in the exchange rate of the local currency. Expressed in terms of an equation:

$$R(HUF) - R(EUR) = E(\Delta S),$$

where R(HUF) is the interest rate on the domestic investment, R(EUR) is the interest rate on the foreign exchange investment and E(ΔS) is the change in the exchange rate forecast for the period in question.

In reality, however, investors are facing numerous other risk factors as well, and they anticipate extra profit in exchange for the risks they take in their investments made in other currencies. Investors set the price of actual risks consistent with their willingness to take risks. Risk aversion indicates the size of the premium investors would like to see in exchange for a specific risk. Consequently, changes in the willingness of investors to take risks have the potential to alter the size of the required premium even if the risks remain unaltered. Hence, in an environment which is not free of risks, the equation of uncovered interest rate parity is supplemented with risks, and with risk aversion reflecting the perception of risk factors:

$$R(HUF) - R(EUR) = E(\Delta S) + (\text{actual risks} \times \text{risk aversion factor})$$

Changes in the interest rate premium can be measured accurately, and although of the variables situated in the right side of the equation the expected change in the exchange rates cannot be measured directly, its direction and dimension can be identified nonetheless from various surveys and from the strike prices of currency options. However, there are numerous factors which can have an impact on risks and risk aversion factors, in respect of which the information we have available is indirect at best.

[4] For more information on the micro-structure approach to foreign-exchange rates, refer to Gereben–Gyomai–Kiss M. (2005).

Therefore, the spread of a currency relative to other currencies depends on the exchange rate movements forecast by investors, on the magnitude of risks and the willingness of investors to take risks. There are different types of risks, such as default risk, exchange rate risk and liquidity risk. In the following we attempt to explain these risks and to demonstrate the methods the MNB uses to measure the various types of risks.

Definition of risks

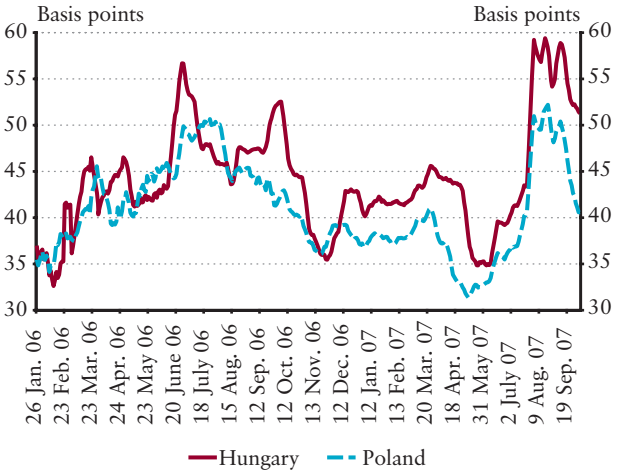
'Default risk' is when a debtor becomes insolvent, and hence becomes unable to repay to the investor the funds invested, including interest and principal, in part or in full. Although the state, as a debtor, is considered risk-free in connection with debts denominated in the local currency, where a foreign currency is involved there is always a risk for the state to default on its foreign exchange liability. There are rating agencies whose business is to monitor the default risks of different states. The credit rating of Hungary by major international rating agencies, in terms of investment category, is 'A2' (Moody's), and 'BBB' (Standard & Poor's), indicating that the default risk of the Hungarian state is low compared to several countries which are deemed riskier. Accordingly, the premium paid for the risk of insolvency represent only a few basis points. This premium is seen also in the premium of domestic foreign currency bonds relative to German and American bonds of similar maturity, and in the prices of credit default swaps (CDS, Chart 4), which are rapidly gaining popularity on the interbank markets.

The risks of foreign exchange assets, apart from default risks, are greatly influenced by *exchange rate risks*. As investors who are keen on risk aversion tend to choose the payment of a return with a lower level of volatility from among two similar ones, they expect to see a higher interest margin in return for tolerating a greater degree of uncertainty. Uncertainties may originate from the width (volatility) of the potential variance in the exchange rates, and from its asymmetry (skewness). The best source for obtaining the most information in these parameters of the exchange rate spread expected by market participants is the London options market on the forint-euro exchange rate.

In addition to default risk and exchange rate risk, investors face liquidity risk as well. A market is deemed liquid when large volume transactions can be executed on the spot without exerting any significant impact on prices. If an investor keeps assets in a market that is not sufficiently liquid, he may face the risk of being unable to close his positions at market prices at the time of his choosing.[5]

Chart 4

Long-term euro-denominated Hungarian and Polish government bond spreads



Notes: Bonds mature in 2016; 5-day moving average.
Source: Reuters.

The liquidity of a market depends on a great many factors, which means that it cannot be described properly through only one indicator, as liquidity has to be measured along several dimensions to get a more accurate picture. The dimensions of market liquidity are either static (tightness, depth) or dynamic (resiliency, immediacy). These indicators should be treated collectively, as the various liquidity indicators may well emit contradicting signals about the liquidity of the market to which they pertain.

The so-called *tightness* dimension of liquidity means the transaction costs of trading. This particular dimension pertains to the ability of a market to bring together supply and demand, and the costs involved. The most typical factor is the difference between the purchase price and the selling price of the instrument in question, also known as bid-ask spread. The word 'tightness' signifies that the narrower this difference, the more liquid the market is.

Apart from tightness, the other key dimension of liquidity is the *depth* of the market, that is typically indicated by market turnover. The greater the turnover on a particular market, the more an investor can expect that his opening or closing of a position will not generate any significant exchange rate impact.

For all practical purposes, it is more difficult to comprehend the dynamic factors of liquidity by comparison to the static indicators. *Resiliency* offers an insight as to how fast prices are able to recover their 'balanced' value after being deflected

[5] For more information on the liquidity of Hungarian financial markets, see Csávás–Erhart (2005).

by a major transaction. On the other hand, the immediacy dimension focuses on how well the *immediacy* of a transaction is implemented on a particular market. Although an analysis of liquidity in these dimensions is not a simple undertaking in practical terms, nevertheless market turnover, the frequency of transactions, and the analysis of past developments from the standpoint of transactions offer some support from this perspective as well.

Risk aversion

Investors usually weigh specific risks relative to their own *willingness to take risk*, meaning that, in addition to the instrument's specific risk, the price of a specific financial instrument depends to some extent on the investors' willingness to take risks. As investors' investment time horizon and risk management capabilities differ, any change in the composition of investors could have an impact on the price of a specific instrument. One example is what has happened in the market of Hungarian government securities, where since 2003 the previous dominance of long-term convergence investors has been largely replaced by a new breed of investors with a preference for short-term investments. These new investors change their exchange rate and interest rate positions more frequently, thus amplifying fluctuations in the prices of financial instruments.

Risk aversion is analysed in terms of global and regional impact. Changes in risk appetite on a *global* scale are determined mainly by the liquidity prospects of major markets and their outlook relating to the business environment. The most important are changes in the exchange rates, the central bank base rate, and the long-term yield of the currencies (dollar, euro, yen, pound sterling) used to finance forint-denominated instruments. Furthermore, the investment climate is also influenced by the business outlook indices of these economies (economic data, confidence surveys), as well as the prices of the most important minerals (oil, gold).

Another factor in setting the prices of instruments is the different approach toward certain geographical regions, apart from the global risk appetite in the wake of substantial movements of capital in the international investment sector, or toward groups of assets that may be compiled under a similar risk profile. This theory is supported, for example, by the correlation in the process of assets at the *regional level* or by the correlation between sovereign and corporate bond premia, which are of relevance from the perspective of Hungary in terms of credit risk rating. Therefore, with a view to understanding and predicting market trends, it is very important to be able to identify changes in risk appetite.

The best indicator of the global liquidity environment[6] is the yield level of American government securities. This also explains why global markets react so sensitively to any changes in the levels of American yields, irrespective of whether they are directly related to risk perception or not. For the most part, the flood of sales triggered recently in the emerging markets can be attributed to the higher American yields.

Global risk appetite is difficult to measure, and therefore, the complex hypothetical and empirical risk appetite indices calculated by investment banks and international institutions often convey different signals. Indicators reflecting the risk perception of a certain market segment or a homogenous group of assets tend to perform better. There are three different types of such indicators, a summary of which is contained in Table 1 below.

The first group of risk appetite indices relies on the price of the specific group of assets, more precisely, from the premium related to yields which are considered risk-free, such as those of the American government securities. If the premium increases, it means that risk appetite has declined for the group of assets in question. Although the higher premium could also signify an increase in asset-specific risk factors, the multitude of instruments covered by the indices

Table 1

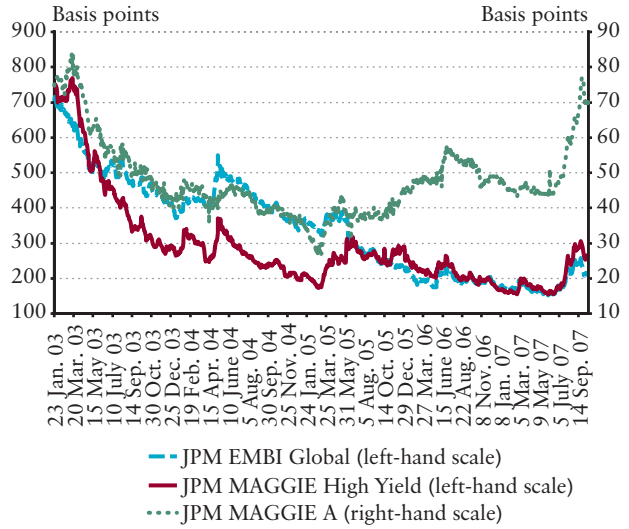
Relevance of risk appetite indices for the MNB broken down by markets

	Major markets (USA, EU, Japan)	Emerging markets	Region
Premium		X	X
Volatility	X	X	X
Surveys (allocation of assets)		X	X

[6] For the purposes of risk appetite, 'liquidity' commonly means – by way of derogation from the definition used in the previous chapters – the average yield level of the major markets. It is a risk-free rate of return serving as the basis for comparison as to the expected yield of all other investments. If the risk-free rate of return is too high, (tight liquidity) it generally results in lower demand for risky instruments. On the other hand, if the risk-free rate of return is too low, it enables market operators to reduce the costs of financing their investments, which in turn results in a better investment atmosphere and in lower costs of risks.

Chart 5

Major bond index spreads

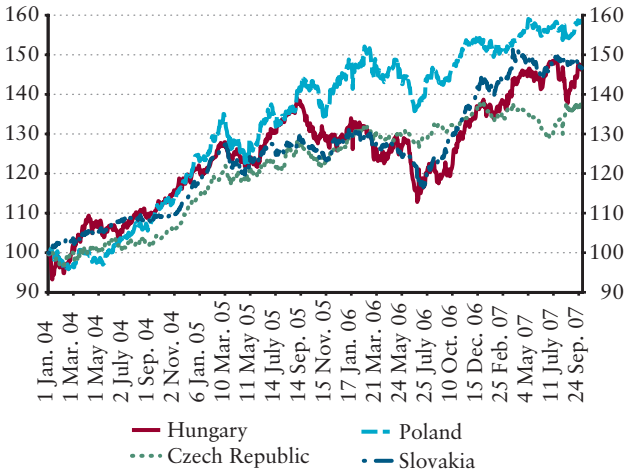


An increase indicates declining risk appetite, or increasing risk aversion.

Sources: Datastream (http://www.thomson.com/financial); JP Morgan.

Chart 6

CEBI indices



Notes: 1 January 2004 = 100; in euro.

Source: DrKW.

tend to diminish the weight of specific risks. The most commonly used indicator for the premia of emerging markets is the EMBI Global index. This index covers the debts of 33 emerging countries denominated in dollars. As for the Maggie indices, the one known as High Yield shows the premium on high-risk euro-denominated corporate and government bonds, while Maggie A indicates the risk appetite euro debts rated 'A' by credit assessment agencies. (Chart 5).

The second category includes the indices used for measuring the historic or expected volatility of asset prices. Notably, because the *volatility* of asset prices is likely to rise in cases when market uncertainties are also on the rise and risk appetite is declining. The volume of options deals provide an insight as to the degree of volatility expected by market participants, which could indicate foreseeable changes in risk appetite. Hence, for example, the projected increase in the volatility of the American stock market is shown by the VIX index, whereas the growth in the implied volatility of the American government securities market is conveyed by the MOVE index. The VXY group of indices show the implied volatility of G7 nations and currencies of emerging markets.

The third group of indices rely on surveys in an attempt to capture the mood of market participants. Certain surveys contain questions aimed directly at the expectations of market participants, while others draw their conclusions from the portfolio allocation of investors concerning risk appetite. This latter survey is commonly conducted by large investment banks among their own clients. The under- or over-weighting of certain groups of assets well demonstrates the assessment of certain groups of assets in terms of risks, or in terms of relative changes in such risks.

As for the indices providing an overall picture of certain market segments, one relevant indicator for the MNB is the CEBI index (Central European Bond Index) which reflects changes in the prices of foreign exchange and government bonds of the Visegrád Four, and shows the performance of the countries involved on the bond market in both euro and in local currency.

Recent developments in the CEBI index support the presumption that the yield expectations of foreign participants are a dominant factor in the prices of local instruments. Chart 6 shows that the bond markets of the Visegrád Four provided similar earnings to foreign investors over a period of several years. The lower nominal yield levels of certain countries were properly balanced out by decisive appreciation of foreign exchange rates. Due to the dominant role of foreign participants, changes in the required premium are characteristically accompanied by a drop in foreign exchange rates and higher bond yields.

CONCLUSIONS

With a view to higher efficiency in monetary policy, it is essential for central banks to learn as much as possible about the financial markets and to analyse exchange rates and yields on a regular basis. This is especially true in the case of central banks operating in small, open economies, such as the MNB, since developments on global financial markets have a substantial impact on the local economy as well.

Furthermore, regular, routine analysis of the financial markets is essential as the structure of the markets changes rapidly in emerging markets, such as Hungary.

As exchange rates and yields are typically influenced by a variety of factors, it is necessary to examine a range of factors and indicators for the purposes of analysis. In order to be able to use market information properly, it is necessary to learn as much about the market in question as possible: therefore, the MNB routinely monitors developments in those markets in terms of efficiency and liquidity, as well as the behaviour of main market participants.

In the process of analysing market developments a broad spectrum of indicators must be reviewed by the central bank to obtain a better outlook on short-term market movements and long-term processes. This makes it easier to judge whether specific market information can be considered reliable, and which market segments deserve more attention.

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Dániel Holló: Household indebtedness and financial stability: Reasons to be afraid?

The dynamic increase in household indebtedness seen in Hungary in recent years has raised a number of questions relating to the risks of this growth and the long-term sustainability of banking portfolio quality. The continuous monitoring of risks is a task of the MNB, which stems from its supervisory role over financial stability. In order to explore the extent and structure of household indebtedness, the central bank conducted a questionnaire-based survey among indebted households in January 2007. In this article, we present the structural distribution and riskiness of indebted households as well as the effect of various unfavourable macroeconomic developments on banks' portfolio quality and capital adequacy, based on the findings of the survey. Our findings suggest that the shock absorbing capacity of the banking sector is sufficient (i.e. the capital adequacy ratio of the banking system would not fall below the current regulatory minimum of 8 per cent) even if the most extreme stress scenarios were to occur.

INTRODUCTION

One of the main tasks of financial stability analysis is monitoring the shock absorbing capacity of the financial system. In this context, the question we wish to investigate is the manner in which low probability but nevertheless plausible extreme macroeconomic events would impact the banking system, and to what extent the capital position of the sector would be affected.[1]

Analysis of the shock absorbing capacity of the financial system is important both from the viewpoint of the financial sector and other economic agents as well. Financial institutions can gain insight into what type and how strong an adverse macroeconomic event would significantly influence their profitability and capital position. For other economic agents, the importance of this information is based on the fact that the stability of real economic developments depends strongly on the stability of the financial system. Namely, as a result of various real economic shocks, banks' losses may increase considerably, and banks may react by curtailing credit supply, which could deepen an ongoing recession even more, due to a further decline in consumption and investment expenditures. Accordingly, there is a strong relationship between financial and macroeconomic stability as a stable financial system cannot exist without the stability of macroeconomic developments and vice versa.

Developments in household credit risk are one of the key elements of financial stability. A deeper analysis of credit risks was particularly justified by the banking sector's ever increasing exposure to households, and the effect on households' solvency resulting from the fiscal package announced in the summer of 2006.

As a result of significant credit growth dynamics, between 1999 and 2006 the total debt outstanding in nominal terms rose more than tenfold, and a shift towards foreign currency loans can be observed in the composition of debt by denomination, which has made Hungarian households' balance sheet position more sensitive to exchange rate fluctuations as they do not have a natural hedge. In terms of product structure, a continuous increase in mortgage type products has been seen, which can provide considerable security for banks in case of default, thus reducing risks significantly.

Nonetheless, current economic developments call into question the sustainability of households' solvency. Despite the negative effects of the fiscal consolidation package announced in the summer of 2006, a dynamic increase of debt outstanding is still being observed. However, due to the decline in real income and the resulting deterioration in resistance to other shocks (e.g. exchange rate depreciation, increase in interest rates), the sustainability of solvency may be questionable, even in the medium term. Deteriorating solvency may lead to a large number of households defaulting, to which banks may react by curtailing credit supply (tightening credit standards), which may also result in a slump in retail lending market growth, and economic growth may continue to decelerate.

The remainder of the article is organized as follows. In the second chapter we briefly present those two methods – the

[1] There is no generally accepted definition of financial stability, but there is a wide consensus that bank crises pose the greatest threat to the stability of the financial system, as banking activities cover almost all areas of the financial system. In this article we focus on the stability of the banking system, while the stability of the banking system and the stability of the financial system are treated as synonymous terms, despite the imperfect congruence.

macro and micro approaches – which constitute the framework for the analysis of household credit risk. The third chapter analyzes risk concentration in various dimensions using the data from the questionnaire-based survey[2] conducted by the MNB amongst indebted households in January 2007. In chapter four, using the survey data we present the main findings of household stress tests and the ramifications for financial stability. Finally, chapter five presents the conclusions.

POSSIBLE METHODS OF ANALYSING HOUSEHOLD INDEBTEDNESS

Several indicators are used for the quantification of household indebtedness and the resulting risks. Some of these analyze the sustainable size of loans outstanding (the ratio of loans outstanding to annual disposable income), while other indicators evaluate the magnitude of credit risks on the basis of instalments paid by households (estimation of the repayment burden, i.e. the amount spent by households on loan repayment in a year as a proportion of annual disposable income). A comparison of total debt and financial assets gives a picture of households' financial position, i.e. it indicates to what extent savings cover the amounts borrowed. The reflection of risks in banking portfolio quality can be measured by the ratio of non-performing loans within total loans and developments in loan loss provisions.

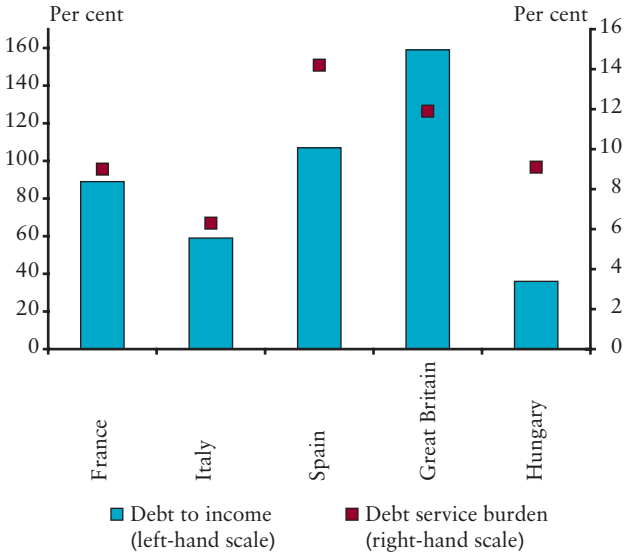
Based on the above indicators, depending on the aggregation level of the available data, the analysis of households' indebtedness and the resulting risks can be carried out within a macro or micro framework.

According to the macro approach, the developments in risks and the related banking system portfolio quality are analysed using macro variables and variables generated from the aggregate household sector data, which may affect households' income position and/or repayment burden at the sectoral level. By contrast, the micro approach concentrates on indebted households, uses individual data and takes account of the structure of indebtedness, thus allowing a more precise measurement of risks and developments in portfolio quality.

Despite the relatively rapid increase in the debt to disposable income ratio, the indebtedness of Hungarian households is still far below the level of developed economies, i.e. in parallel with the real convergence there is further room for the 'catching-up process'. However, due to the unfavourable term structure of loans (loans with shorter maturity), the value of the repayment burden is close to the Western European level; accordingly, in international comparison, despite their relatively low level of indebtedness, Hungarian households spend nearly the same proportion of their income on loan repayment (Chart 1). Total debt as a proportion of financial assets increased from 6 per cent in 1999 to 26 per cent by the end of 2006, also reflecting growing risks. The lower growth rate of financial savings compared to the increase in total debt represents a risk, because less financial reserves are accumulated which could mitigate the impacts of shocks in the event that macroeconomic developments become unfavourable.

Chart 1

Hungarian household indebtedness based on various indicators, in international comparison at end-2006



Sources: OECD, MNB.

If we calculate the aforementioned indicators on the basis of the questionnaire-based survey only for the indebted households (micro approach), a much more refined picture emerges. Among indebted households, the ratio of debt to annual disposable income is 94 per cent on average, borrowers spend on average 18 per cent of their income on repayment, while the amount of loans outstanding is 7.5 times higher than that of financial savings. As only 18 per cent of debtors have savings, it can be established that savers and borrowers are typically different, i.e. the household sector shows a significant heterogeneity.

[2] Commissioned by the MNB, a questionnaire-based survey examining the characteristics of indebted households was conducted in January 2007. 1046 household with some sort of credit were surveyed. The survey provided detailed information on the indebted households' financial and income positions as well as other personal characteristics. See detailed information on the questionnaire-based survey on pages 35-36 of the publication titled Report on Financial Stability, April 2007, http://english.mnb.hu/Engine.aspx?page=mnben_stabil&ContentID=9555.

Overall, although the indicators generated from aggregated, i.e. sectoral-level data, indicate the direction of the developments in risks quite well, they may be misleading in terms of the magnitude, as they considerably underestimate it due to disregarding the structure of indebtedness. In the financial sector, the potential loss resulting from credit risks depends on the extent to which total debt is concentrated at households with stretched financial and income positions. Considering all this, we decided to analyse micro level data more thoroughly, and in the following chapters, the magnitude of credit risks is quantified based on these data.

MAGNITUDE OF CREDIT RISKS IN TERMS OF VARIOUS DIMENSIONS

Indebted households' resistance to shocks is determined by the size of their income reserve, financial savings and real assets. In the calculations, we disregard the roles of both financial savings and real assets.[3]

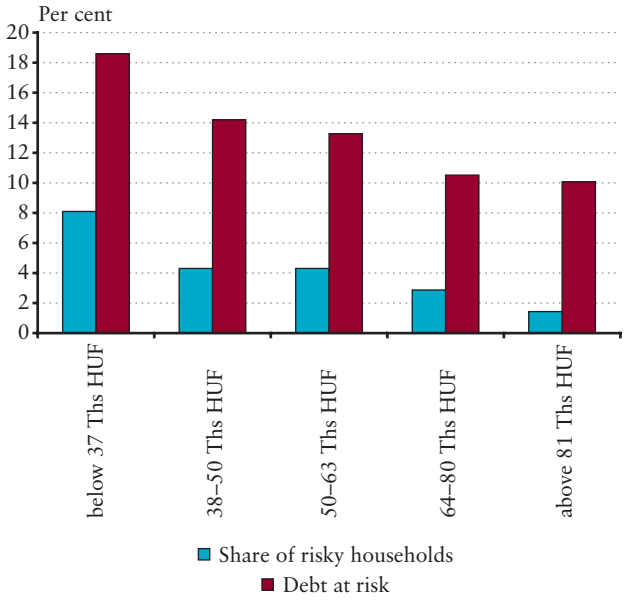
Household income reserve (or shock absorbing capacity) is the amount which remains from the monthly net disposable income after the deduction of consumption expenditure and loan repayments. If the indicator is negative, the given household is considered risky, as due to the extent of its stretchedness it would not be able to withstand the effects of various shocks for a longer time without loan repayment problems.[4] In this case, households are either eating up their financial savings, or have to reduce their consumption in order to be able to keep up repaying the loan. At present, approximately 2.2-4.2 per cent of indebted households can be considered risky, but 5.7-12.9 per cent of the total debt belongs to them.[5] These are the loans outstanding ('debt at risk') which may be the source of potential losses from the perspective of the financial sector, if we suppose that risky households become insolvent and in case of households with positive income reserves the probability of default is zero.

The distribution of risky households and risky debt can be examined in terms of various dimensions. We considered income as the basic dimension, and beyond that we also analysed developments in risks according to two other features: domicile (region) of the household and the age of the head of the household. However, it should be noted that the household's disposable income is not independent of the latter two factors, as on the one hand, the size of the income is determined by the region where the household is located, and on the other hand, in the initial period of one's career individual incomes are typically lower. Therefore, income is more or less a condensate of information stemming from the given household's sociodemographic features.

Classifying indebted households in income quintiles according to their per capita disposable income shows that, in parallel with the increase in income, the probability of default steadily decreases (Chart 2). The results suggest that in those indebted households where per capita income is less than HUF 37,000, the average odds of having payment difficulties is 8 per cent. In those households, in turn, where the per capita monthly disposable income exceeds HUF 81,000, the average default probability is 1.4 per cent.

Chart 2

Share of risky households and debt at risk according to quintiles calculated on the basis of per capita income



Source: Author's calculations.

As there are considerable differences in households' incomes across regions, households' resistance to shocks (the size of income reserve accumulated monthly, labour market prospects), and hence their ability to repay loans, is strongly influenced by the region where they live. In terms of the magnitude of risks, there are significant differences across

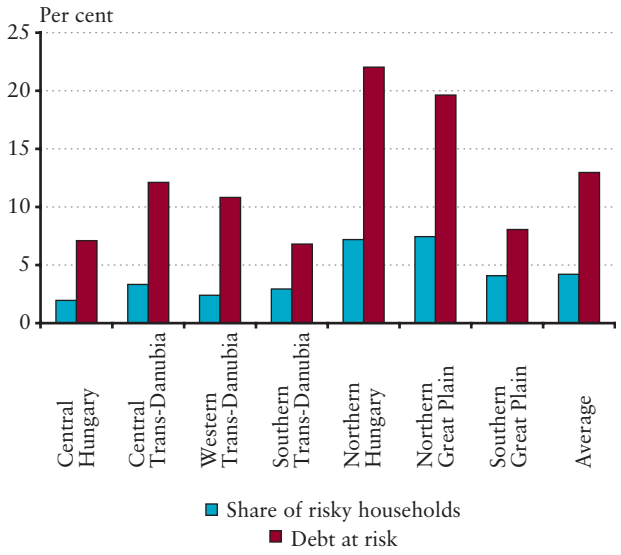
[3] These two seemingly strong assumptions probably do not distort the results considerably, partly because in the sample both the ratio of those who have financial savings (18 per cent) and the average financial savings volume are low, i.e. in the event of permanent unfavourable economic developments it can be assumed that financial reserves run out fast, while real assets are less liquid, i.e. their prompt use in case of payment problems is limited.

[4] The aforementioned risk definition is restrictive in the sense that, on the one hand, households with positive income reserves may also have payment problems, and on the other hand, the size of income reserve at which payment problems may come up may be different for each household.

[5] Because of income uncertainties (black incomes and mistakes made in reporting income information) we prepared the calculations with 10 per cent higher disposable income as well, which resulted in the two (presumably extreme) values of the ratio of risky households and risky loans outstanding.

Chart 3

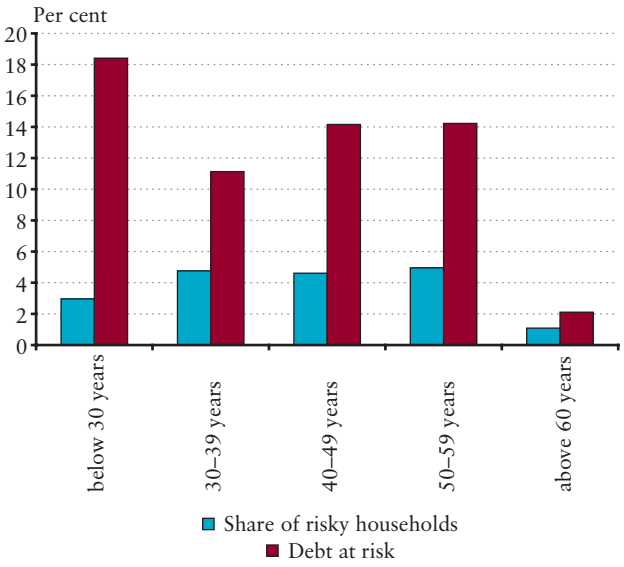
Share of risky households and debt at risk in individual regions



Source: author's calculations.

Chart 4

Share of risky households and debt at risk based on the age of the head of the household



Source: author's calculations.

areas of different levels of development. In the Northern Great Plain and Northern Hungarian regions, which can be considered less developed, the share of risky households and risky loans outstanding is higher, while the situation is much more favourable in Central Hungary which also includes Budapest and Western Trans-Danubia (Chart 3).[6]

Categorising the indebted on the basis of the age of the head of the household shows that in the case of households with a head between 30-60 years of age the average default probability is nearly the same, around 4.5 per cent, and the situation is more favourable only in case of the heads who are younger or older than that. Despite the low level of differences across average default probabilities according to age, the volatility of debt at risk within individual categories is considerable (Chart 4). It is important to emphasise that in the case of households with a head below the age of 30, in the given category more than 18 per cent of the loans outstanding can be considered as risky. The underlying reason may be that those young households who are not liquidity constrained, relying on the higher expected income in the latter stage of their life cycle, can increase their current consumption level by borrowing, and their investment (housing) is also mainly financed from credit. However, as their income in this part of their lives is relatively low, this temporarily results in a high repayment burden, which gradually becomes lower as they grow older and their income steadily becomes higher. Accordingly, despite the fact that within the group of households with heads of various ages average default probabilities do not show significant differences, in the case of repayment problems of young households, banks' losses may be higher compared to the other age groups as a consequence of the much higher average size of the loan per household.

IMPACT OF VARIOUS SHOCK SCENARIOS ON THE STABILITY OF THE BANKING SYSTEM[7]

The analysis of indebted households' shock absorbing capacity requires identification of those major risk factors which significantly influence solvency. We have identified two macroeconomic factors of this nature. One is a risk premium shock triggered by unfavourable external and internal macroeconomic developments, which may result in an increase in the forint yield and/or in depreciation of the exchange rate of the forint. This affects households' solvency through an increase in instalments. The other factor, the

[6] Central Hungary: Pest, Budapest; Central Trans-Danubia: Fejér, Komárom-Esztergom, Veszprém; Western Trans-Danubia: Győr-Moson-Sopron, Vas, Zala; Southern Trans-Danubia: Baranya, Somogy, Tolna; Northern Hungary: Borsod-Abaúj-Zemplén, Heves, Nógrád; Northern Great Plain: Hajdú-Bihar, Jász-Nagykun-Szolnok, Szabolcs-Szatmár-Bereg; Southern Great Plain: Bács-Kiskun, Békés, Csongrád.

[7] In this article, the developments in default probabilities and risked exposures with respect to various shocks are analysed using a simple method (income reserve calculation). Despite the simplicity of the method, its conclusions proved to be stable even in comparison with the results gained from more sophisticated models. For more details on the calculations and simulations as well as the other alternative approaches see: Dániel Holló and Mónika Papp (2007): Assessing Household Credit Risk: Evidence from a Household Survey (manuscript).

impact of which was examined, is a decline in employment affecting indebted households. For those concerned it affects the magnitude of credit risk through a decline in disposable income.

In the course of the stress tests, we determined the default probabilities belonging to the various shocks, then, assuming a given loss rate (LGD), we drew quantified conclusions with regard to the stability of the banking system. We examined the effects of individual risk scenarios on banks' capital adequacy ratio separately, and we also analysed this when the risk scenarios took place simultaneously. In the calculations, we quantified the effects developing through the credit risk channel. Our simulations are static, i.e. in case of the risk scenarios we assumed that neither the volume, nor the structure of households' consumption change, households' labour supply remained unchanged, and there was no banking adjustment, i.e. banks did not react to the increasing losses by curtailing credit supply and/or restructuring their portfolios. We also assumed that individual banks' customers are not different from a risk perspective, i.e. in terms of quality, all banks' household portfolios are identical to the representative household portfolio used in the course of the calculations.

Based on this latter assumption, as no information on household default probabilities from individual banks is available, when calculating the losses, we use the same default probability for each bank (the share of households with negative income reserves within the sample). The difference between banks is constituted by the composition of their portfolio and the product specific loss rates (LGD), which, however, adequately reflects the differences in quality across individual banking portfolios. This means that if the average default probability of two banks' respective household portfolios are identical, but one's portfolio is dominated by mortgage loans then the developments in losses of this bank may be more favourable compared to another bank, in whose portfolio mortgage loans represent a relatively lower share.

DEVELOPMENTS IN DEBT AT RISK ON THE BASIS OF TWO RISK SCENARIOS

The effect of the risk premium shock

Several scenarios were analyzed: 100, 300 and 500 basis point increases in forint yields as well as 10, 20 and 30 per cent depreciation of the forint exchange rate.[8] The increase in forint yields and the depreciation of the exchange rate of the forint lead to an increase in credit risk through an increase in loan instalments. However, the former and the latter directly influence only the magnitude of the burdens of forint and foreign currency loans, respectively.

With regard to households' loans outstanding by denomination, the ratio of forint and foreign currency denominated credit within the total retail portfolio was around 50 per cent each at end-2006, but now 80-90 per cent of new loans are denominated in foreign currency. As the ratio of forint loans repricing within a year is relatively low, an increase in yield affects only approximately half of the forint loans outstanding. Exchange rate depreciation, in turn, appears in the monthly instalments of foreign currency loans immediately and directly. Consequently, portfolio quality reacts to exchange rate depreciation in a more sensitive manner than to an increase in forint yields. Accordingly, as a result of the steady growth of the share of foreign currency loans, the exposure of the loan portfolio to exchange rate risk is increasing continuously. However, in connection with the effects of the exchange rate risk it is important to mention that it represents a real risk, if the exchange rate depreciation is significant and long-lasting. The underlying explanation is that households can more or less withstand the effects of a temporary significant exchange rate depreciation by reducing consumption expenditure, which may denote a restructuring of consumption (substitution effect, shift towards consuming cheaper products) or a reduction of the volume of consumption and the use of financial reserves, while maintaining an unchanged structure of consumption.

In preparing the calculations, we assumed the permanent presence of the shock, since this ensures that the risky loans outstanding calculated in the cases of the individual shocks surely become non-performing. Based on the data, it can be established that at least one year is needed in the sample for all households considered risky to become insolvent (to use up all their financial reserves).[9]

If there is no shock, approximately 2.2-4.2 per cent of households can be considered as threatened; they account for 5.7-12.9 per cent of the portfolio. In the most extreme scenario (500 basis points forint interest rate increase, 30 per cent exchange rate depreciation), the share of risky households nearly doubles, while debt at risk increase by

[8] During stress tests, the effect of shifts of 3-8 standard deviation in a given risk factor is often analysed (the tails of the distribution), as they can be considered adequately extreme developments. The values of the examined risk premium shocks are the tails of the historic distributions calculated from the data of the HUF/EUR exchange rate and the 3-month forint yields between January 2001 and May 2007 (in case of the exchange rate 3, 6 and 8 standard deviation, in case of the interest rate 1, 2, 3 standard deviation).

[9] Depending on the magnitude of shocks, households' average resistance is between 1 and 3 months, i.e. this is the average period of time in which they eat up their financial reserves, provided that there is no change in their behaviour (consumption habits, restructuring of expenditures, and increase in labour supply).

Table 1

Debt at risk in case of various risk premium shock scenarios

(one-year horizon)

Forint yield increase (basis point)	Based on original income				Based on income increased by 10 percent			
	Depreciation of forint exchange rate							
	baseline	10 percent	20 percent	30 percent	baseline	10 percent	20 percent	30 percent
Baseline	12.9	15.5	18.1	21.5	5.7	7.8	9.0	10.6
100 bp	13.2	15.5	18.1	21.5	5.7	7.8	9.0	10.6
300 bp	14.3	16.5	19.2	22.6	5.7	7.8	9.0	10.6
500 bp	14.9	17.2	19.8	23.2	6.6	8.8	10.0	11.6

Source: author's calculations.

approximately 6-10 percentage points compared to the shock-free case.

Impact of a decline in employment

If one of the family members in an indebted household becomes unemployed, the decline in the household's disposable income affects developments in solvency.

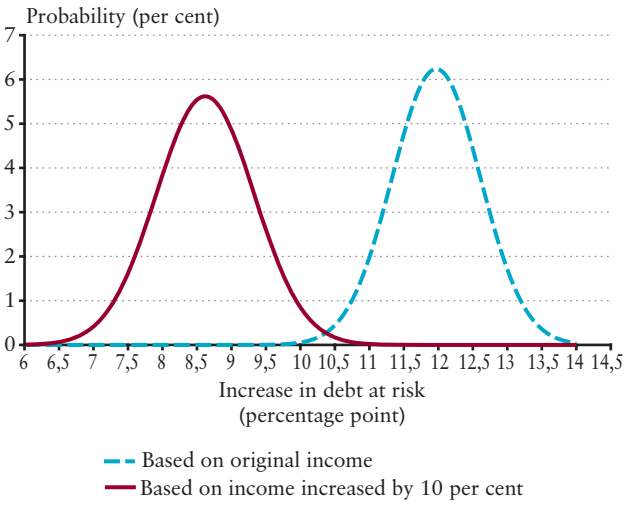
In the simulation, we calculated a 3 per cent[10] decline in employment, using several simplifying assumptions. On the one hand, in the case of each randomly selected household we assumed the job loss of 1 employee, and supposed that within the one-year period under review the person would not find a new job. In the simulations we did not take into account the personal factors behind becoming unemployed, i.e. that there may be differences between the probabilities of becoming unemployed depending on the various characters of individuals. On this basis, we determined the proportion of cases when the decline in income and substituting it with unemployment benefit leads to income reserves' becoming negative, and how much it adds to the risky loans outstanding.

We examined the effect of the decline in employment on the proportion of risked portfolio along two scenarios. First we assumed that the probability of becoming unemployed is identical in each sector, independently of macroeconomic developments, and thus we analysed the effect of the simultaneous occurrence of the most extreme risk premium shock (500 basis point interest rate increase and a 30 per cent depreciation of the exchange rate) and the 3 per cent decline in employment on the increase of the share of risky debts. Then, in the second case we assumed that lay-offs affect a given sector (services, agriculture, industry, trade); in this case we did not take into account the simultaneous occurrence of the risk premium shocks, interrelationships between sectors and pass-through effects. The relevance of this latter scenario is provided on the one hand by the fact that, the exposure of individual sectors to cyclical fluctuations of the economy may differ significantly, and as a result the developments of employment also show sectoral fluctuations and may be more dominant in certain sectors. On the other hand, there may be differences between sectors in terms of the composition of loan portfolio extended to those working in the given sector, which may also affect the developments in losses considerably.

According to the first scenario, as a result of the simultaneous occurrence of the decline in employment and the risk premium shock, the expected increase in debt at risk is

Chart 5

Increase in debt at risk in the event of a simultaneous occurrence of the most extreme risk premium shock and a 3 per cent decline in employment



Source: author's calculations.

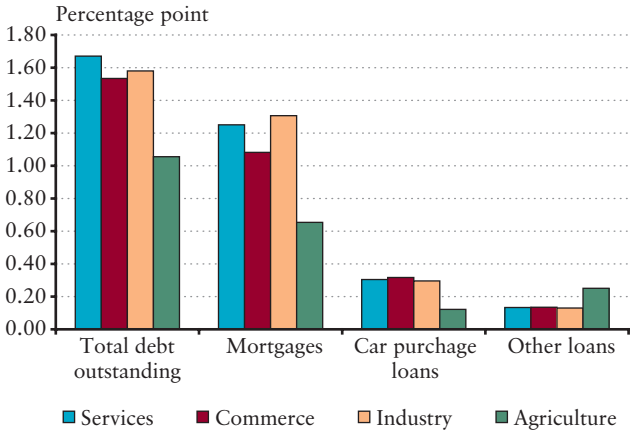
[10] Between 1998 and 2006 the average employment rate was 56 per cent, with a 1.12 per cent standard deviation. Accordingly, a 3 per cent decline in employment corresponds to shift of approximately 3 standard deviation.

between 8.6 and 12 percentage points, which denotes that the expected risky loans outstanding would range between 14.3 and 24.9 per cent (Chart 5).

Assuming that the decline in employment is sector-specific, compared to the case when there is no shock, the effect of a 3 per cent lay-off on debt at risk would probably be the greatest if the lay-offs affected the services sector. This is followed by the industry, then trade and finally by agriculture (Chart 6).

Chart 6

Expected increase in debt at risk in the event of a 3 per cent decline in employment



Source: author's calculations.

ASSESSING THE EFFECTS OF SHOCKS FROM A FINANCIAL STABILITY ASPECT

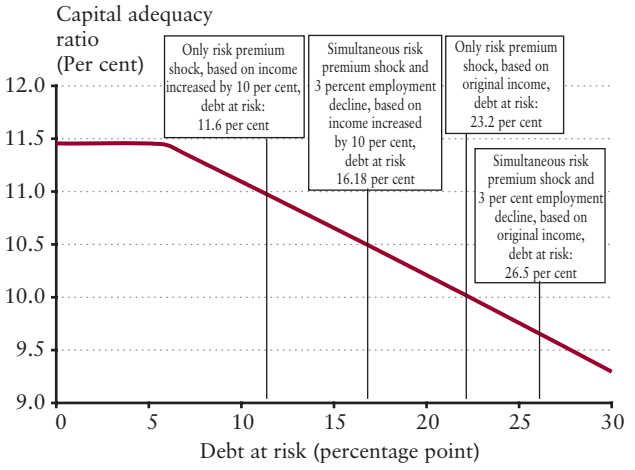
The effects of various shock scenarios can be assessed in light of how debt at risk and the share of risky households increase compared to a scenario with no shocks. Assuming that in the case of debt at risk calculated in line with the individual scenarios non-performance takes place in any case, with given loss rates (LGD), the magnitude of losses can be determined.[11]

Loss rate is that part of the value of non-performing loans which is not recovered during the collection process and enforcement of collateral. Assuming the non-performance of a HUF 10 million loan, the 10 per cent loss rate means that the lender suffers a HUF 1 million loss. Determining the loss rate is not simple because, on the one hand, no data for Hungary is available and, on the other hand, its value also varies by products. In case of mortgage loans, as a result of selling the collateral, the probability of recovery is much higher than in the case of uncollateralized loans. Accordingly, for each product we calculated using different loss rates (LGD), which can be considered conservative in international comparison. For mortgages, car purchase loans and other (uncollateralised) loans we assumed 10, 30 and 90 per cent loss rates (LGD), respectively. It is important to emphasise that when determining loss rates it is justified to take account of the differences between products, as applying a uniform loss rate may significantly distort (improve or deteriorate) the results in case of some 'specialised' banks.

Based on the stress test results we analyzed how losses affect banks' capital position. We used end-2006 data in the calculations, in which we also took into account the profit/loss of the previous year and the size of the already formed loss provisions. The profitability and the capital strength of the banks are influenced by the stress event only in those cases when the losses exceeded the size of the loss provisions. We examined the extent of capital adequacy not only at the banking sector level, but also with regard to individual banks. Where a bank belongs to a banking group – assuming group-level capital allocation – we evaluated group members' results together. We considered it risky, if a bank's

Chart 7

Developments in the capital adequacy ratio of the banking sector in the event of the most extreme stress scenarios



Source: author's calculations.

[11] The loss is the product of the default probability, the risked exposure and the loss rate (LGD). The proportion of the risky debt in the event of the most extreme risk premium shock, in case of the original and 10 per cent higher income is 23.2 and 11.6 per cent, respectively. If the most extreme risk premium shock and the 3 per cent decline in employment take place simultaneously, the risked debt in case of the original income and 10 per cent higher income is 26.5 and 16.18 per cent, respectively. These latter two values are the sums of the shock-free risked debt and the extreme values of the risked debt distributions (99th percentile values of the distributions in Chart 5). Accordingly, the unexpected losses: 26.5=12.9+13.6 and 16.18=5.7+10.48. In our calculations, we use the extreme values of the distribution. The underlying reason is that while banks covered expected loss by pricing and provisioning, unexpected losses have to be covered from the capital.

capital adequacy ratio declined below the current regulatory minimum of 8 per cent.

Our findings suggest that the capital position of both individual banks and the banking sector as a whole can be considered stable even if the most extreme scenarios take place. The main underlying reason is that banks' portfolios are dominated by mortgage loans, in respect of which, as a consequence of the internationally conservative loan to value ratio, losses can be reduced considerably by selling the collateral.

CONCLUSIONS

As a result of the steadily increasing household indebtedness, the analysis of the developments in households' exposure and the effect of potential shocks on the quality of the household loan portfolio is of special importance in the examination of the banking sector's resilience to shocks. When quantifying the extent of risks and the effects of banks' losses, one must strive to take into account the structure of indebtedness, for which detailed data on indebted households' financial and income positions are required.

According to the findings of the study, the magnitude of risks varies according to regions, the age of the head of the household and the household's disposable income. It can also be mentioned that risk concentration among the indebted is of an unfavourable direction, as a significant amount of loans is held by households with stretched financial and income positions (the ratio of risky loans to total loans exceeds the share of risky households within the sample). However, the risks are somewhat mitigated by the fact that banking portfolios are dominated by mortgage loans, which are able to provide considerable security for banks in the case of default.

Based on the shock scenarios, the default probability of the household portfolio would increase particularly significantly as a result of an extreme and permanent risk premium shock. However, the banking system shows resilience both on the individual and on the aggregate level, i.e. in any of the scenarios the capital adequacy ratio would not fall below the current regulatory minimum of 8 per cent.

Finally, it is important to note that the resultant of two effects must not be disregarded when evaluating the results. One of them stems from the static behavioural assumptions applied in the calculations (consumption expenditure, labour supply and banks' unchanged behaviour over the medium term); its dissolution may have a favourable effect on the magnitude of risks as a consequence of the agents' adjustment. The other one is that in the calculations we disregard the effects of shocks passing through to other segments of the economy and the effects of shocks on asset prices, which may generate additional losses through the deterioration of other banking portfolios and through the decline in the value of collaterals.

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Lívia Sánta: The role of central banks in crisis management – how do financial crisis simulation exercises help?

The fundamental task and responsibility of central banks is to maintain and promote the stability of the financial system. In order to achieve this, central banks strive to prevent crises using all the instruments at their disposal. If a crisis occurs, central banks play a significant role in efficient crisis management and the crisis resolution process. In spite of the crisis prevention activity of the authorities – including central banks – crisis events can not be avoided.

The crises potentially emerging in modern banking systems are basically the consequence of the imperfect functioning of financial markets. In addition, external shocks can trigger crises as well. In order to support the stability of the financial intermediary system and to help restore market confidence, there may be a need for central banks to carry out aggregate liquidity increasing measures which affect the market as a whole and for emergency liquidity assistance based on individual consideration, in line with the 'lender of last resort' function. Continuous development of crisis management work and the related instruments is needed in order to ensure quick and efficient central bank decisions. One of the most important elements of crisis management is the organisation of crisis simulation exercises.

Within the European Union, special emphasis has been placed on the development of a crisis management framework aimed at promoting more efficient co-operation between the competent authorities, since a significant number of cross-border banking groups have been formed throughout Europe recently. A potential crisis in a parent bank's country affecting a larger banking group may jeopardise the stability of the financial intermediary system in the countries of subsidiary banks as well, through the interrelationships within the group. This article outlines the significant assistance that these exercises can provide for central bank decisions and for the development of co-operation between authorities.

INTRODUCTION

Over the last 20-30 years there have been numerous crises which have affected the entire financial intermediary system and/or individual financial institutions. The reasons behind these crises have been varied: some were brought about by macroeconomic, or structural/institutional factors (e.g. inadequate regulation during financial liberalisation), whilst others can be traced back to microeconomic causes (e.g. excessive growth, inefficient risk management methods).

The basic underlying reasons for the crises potentially emerging in modern banking systems are the inefficient and imperfect functioning of financial markets and the asymmetrical information emerging in markets. Financial crises can be triggered by external shocks as well. The fact that a significant number of cross-border banking groups have come into being throughout Europe may also increase the probability of a crisis situation. A crisis can affect a particular country, but through the ownership and funding channel, the crisis can easily spread to the financial intermediary system of other countries as well. Furthermore, the occurrence of crises can be facilitated by the recent strengthening in the integration of financial markets and the appearance of increasingly complex financial products, as risk management cannot always keep pace with the complexity of the products.

Although the probability of the emergence of crises is lower in a balanced economic environment, the negative effect of such crises may be more serious as a result of markets and products becoming more complex. In the event of a general lack of confidence in the money market and/or if the crisis at the credit institution(s) concerned jeopardises the stability of the financial intermediary system,[1] aggregate liquidity increasing measures by central banks and emergency liquidity assistance to individual banks on the basis of the 'lender of last resort' function may become necessary,[2] in order to restore confidence and support financial stability.

The importance of central banks' role in crisis management and solving liquidity problems is highlighted by the fact that

[1] A crisis jeopardises the stability of the financial intermediary system if it triggers a significant negative effect among credit institutions, at financial markets, in the financial infrastructure or in the real economy.

[2] 'According to the Magyar Nemzeti Bank Act, in the event that circumstances arise which jeopardise the stability of the financial system due to the operation of a credit institution, the MNB may extend an emergency loan to the credit institution, observing the prohibitions on monetary financing.

the crisis on the US sub-prime mortgage market also affected the European money and capital market. As a result, in addition to central bank measures which increased aggregate liquidity and affected the market as a whole (e.g. European Central Bank, Bank of England), central bank intervention for individual bank also became necessary (e.g. emergency liquidity assistance by the Bank of England to the Northern Rock credit institution).

On the one hand, this article explores central banks' role in crisis management, and on the other hand it shows how crisis simulation exercises facilitate and strengthen the efficient resolution of liquidity problems and crisis situations. In addition to describing the general objectives, successes and lessons drawn from simulation exercises, this article also discusses the MNB's prominent role in developing and organising such exercises.

CENTRAL BANKS' ROLE IN CRISIS MANAGEMENT

In recent years, financial markets have become strongly integrated, and increasingly complicated, complex financial products have come to existence. Furthermore, with the creation of banking groups pursuing cross-border activities, increased attention has been paid to risk and crisis management work.

Complex financial products facilitate a more flexible, efficient distribution of risks among the participants of the money and capital market, but they also contribute to the more rapid spread of emerging new risks. Regarding the risks at banking groups, subsidiaries significantly rely on the parent bank's financial resources in general, and as a consequence a shock affecting the parent bank may cause serious financial problems at the subsidiaries as well. On the other hand, a crisis at a major subsidiary can also have a negative influence on the parent bank through the contagion channel within the group.

As a consequence, the development of risk management tools as well as the preparation of stress tests and 'emergency scenarios' for solving unexpected situations has gained special importance, both for market participants and individual authorities.

In terms of risks, a wide range of changes have taken place recently in the evolution and management of *liquidity risks*. For participants in the financial intermediary system, including credit institutions, it is primarily the responsibility of the institution's management to take steps to provide for the liquidity required for operations, and to continuously develop the techniques and instruments employed to reduce and manage liquidity risks. It is important to emphasise that in the event of a crisis or liquidity problems,[3] the primary task and responsibility of the management and the owners (parent bank) of the credit institution is to take the measures necessary for solving the liquidity problem. This can include a wide range of measures, e.g. additional source of funding from the owner or another member in the banking group, using central bank standing facilities, borrowing with collateral on the money market, etc.

In addition to the authorities (such as central banks, supervisory authorities and ministries of finance), which are responsible for supporting the stability of the financial intermediary system, it is a primary task of central banks to prevent crises. Supervisory authorities and ministries of finance contribute to the achievement of this target through their prudential supervisory activities, focusing on risks and the formulation of regulations which facilitate the efficient operation of money and capital markets, respectively. Central banks, in turn, using various macroeconomic scenarios analyse the resilience of the financial intermediary system to macroeconomic shocks, and, using stress tests, examine market participants' vulnerability to various risks. In addition, central banks inform the participants in the financial intermediary system about current issues regarding financial stability in their various publications, in order to increase the risk awareness of those concerned. In the event of a crisis, however, the authorities are responsible for ensuring efficient management, i.e. solving the problems within the shortest period of time possible and at the lowest cost for society.

Central banks usually play a prominent role in solving crises emerging on the money market, at credit institutions and in the financial infrastructure, since the first signs of a crisis usually appear as significant liquidity troubles. By monitoring developments in money markets and developments of problems in payment and clearing transactions, non-payments and 'queuing' it is possible to draw conclusions regarding the seriousness of the potential danger of contagion. In other words, this makes it possible to determine whether a liquidity problem is unique or the troubles emerging in the interbank market may generate a general liquidity shortage, and whether the liquidity problem of the credit institution concerned can result in serious troubles in the payment transactions of other credit institution(s), due to non-payment.

In the event of a general confidence crisis in the money market and liquidity problems affecting the market as a whole, the central bank can apply – in addition to the normative monetary policy instruments – general liquidity increasing

[3] Liquidity trouble: short-term payment problem. A credit institution is illiquid if it does not have sufficient funds to be able to meet its obligations over the short run.

measures which help the whole market. If the crisis appears as an individual credit institution problem, it is important to emphasise the absolute priority of crisis solution within the private sector. This means that if the credit institution turns to the central bank for emergency liquidity assistance, the central bank primarily insists that the crisis be solved by the owners and the creditors. Beyond this, it can undertake an active mediatory role in the organisation of a solution within the private sector, e.g. in the organisation of a syndicate providing the additional liquidity.[4] In the event of an incident in the financial infrastructure, the central bank can also extend the working hours of the settlement system.

The emergency liquidity assistance which the central bank can grant is really the last of the central bank's crisis solution instruments. It is the central bank's discretional right and depends solely on its assessment and decision whether to grant such credit, and if so, on what conditions, in order to maintain and support the stability of the financial intermediary system and to restore the confidence of the money market.

Of course, crisis management and solving liquidity and solvency problems[5] require close co-operation between the responsible authorities and efficient co-ordination of the necessary measures, including market solutions as well. In order to maximise the efficiency of crisis management, the authorities also formulate internal rules of procedure to be applied in the event of a crisis. As central banks, supervisory authorities and ministries of finance have different instruments at their disposal in a crisis situation and they can take different measures at the various stages of a crisis: thus, it is very important to ensure the flow of information between the authorities and to clearly delineate the scope of duties, responsibilities and decision-making powers. Laying new foundations for co-operation between authorities and creating a framework for crisis management have gained special importance recently, both at the national level and between the authorities of individual countries.

CREATING A CRISIS MANAGEMENT FRAMEWORK WITHIN THE EUROPEAN UNION

Recently, a significant number of banking groups pursuing cross-border banking activities have been formed in Europe. A potential crisis in a parent bank's country affecting a larger banking group may also jeopardise financial stability in countries where subsidiary banks are located, through the interrelationships within the group. In addition, a broader crisis may significantly weaken the efficiency of the central bank's monetary policy measures as well.

Despite the increasing activity of cross-border banking groups, the supervisory structure and central banks' emergency liquidity assistance activities have remained at the national level. Furthermore, the practices in the regulations governing the financial intermediary system differ somewhat from country to country, despite the steps towards legal harmonisation within the EU. In order to eliminate the resulting problems, within the EU greater emphasis is being placed on co-operation between authorities and the creation of frameworks which facilitate more efficient crisis management. This purpose is served by the provisions regarding crisis management of the EU directives,[6] as well as national-level, bilateral, regional and EU-level voluntary agreements – in the form of Memoranda of Understanding – between the authorities of individual countries to be applied in the event of a crisis, and also by simulation exercises which test these co-operation frameworks.

Voluntary agreements which set out procedures for co-operation between authorities constitute a prominent element of the crisis management framework. As the tasks and interests of individual authorities are different, conflicting interests may emerge during crisis management. Therefore, it is important that the authorities determine the scope of duties, responsibilities and decision-making powers in the form of preliminary agreements, define the processes for the flow of information, and clarify issues which require co-operation between authorities.

Within the European Union, two Memoranda of Understanding have been adopted which determine the basic principles and establish a practical co-operation framework for cross-border crisis management.[7] An example of regional co-operation is the agreement between the central banks of some North European countries (Denmark, Finland, Ireland, Norway and Sweden), aimed at strengthening co-operation in the event of a crisis. As for bilateral co-operation, e.g. the Dutch and Belgian authorities have concluded an agreement to increase the efficiency of their supervisory and crisis management activities.

[4] In the USA, the Fed coordinated among the market participants during the LTCM crisis.

[5] Solvency problem: if the regulatory capital of the credit institution declines below the level required by the relevant provisions of law. A credit institution is insolvent, if it is unable to meet the claims outstanding vis-à-vis it, as the market value of its assets does not reach the value of its obligations.

[6] The CRD (Capital Requirements Directive: 2006/48/EC, 2006/49/EC) and the FCD (Financial Conglomerates Directive: 2002/87/EC) also contain provisions regarding crisis management and co-operation between the authorities of the countries of the parent bank and subsidiary banks.

[7] Memorandum of Understanding on high-level principles of co-operation between the banking supervisors and central banks of the European Union in crisis management situations (2003). Memorandum of Understanding on co-operation between the Banking Supervisors, Central Banks and Finance Ministries of the European Union in Financial Crisis Situations (2005).

A crisis at a banking group pursuing cross-border activities and the management of such a crisis raises a number of questions, both for the authorities which supervise the parent bank and for those responsible for supervision of the subsidiaries (branches). Due to the high level of foreign ownership, this is an important aspect for Central East European (CEE) countries, including Hungary as well. In the region's banking sector, except for Slovenia, the ratio of foreign ownership ranges between 59% and 83%. In the Central East European region, several large banking groups operate with parent banks which have their respective seats within the EU and significant subsidiaries in at least two CEE countries.

Most probably, a potential credit institution crisis in a regional banking group will not remain an isolated problem within a single country, as the crisis may have a negative impact on the financial intermediary systems of several countries and on the real economy as well, due to the ownership and financing channels. In the event of a crisis, solving the problem and taking the necessary measures is primarily the responsibility of the owners (the parent banks).

If the owners are not able or willing to provide for the measures required for averting the crisis, and according to the authorities' assessment the crisis may jeopardise the stability of the financial system, the efficient management of the crisis may require intervention by the authorities and co-operation.

In the event of a crisis at a cross-border banking group, the EU-level crisis management framework lays out certain basic principles for the co-operation between the authorities of the countries of the parent bank and the subsidiary/branch. Accordingly, the main responsibility of the authority of the parent bank country, i.e. the authority performing consolidated supervision, is the co-ordination of crisis management and decision-making, as well as supplying individual authorities with adequate information, and also, if necessary, involving the relevant countries affected by the crisis in the process of crisis management. In the event of a liquidity crisis, the central bank of the parent bank country, while in case of a solvency problem the ministry of finance, may also become active players in co-ordinating the crisis solution.

In addition to the primary responsibility of the national authorities responsible for the parent bank, the authorities of the country where the subsidiaries/branches have their seats also have to prepare for taking the necessary measures, if they are of the opinion that the crisis jeopardises the financial stability of the given country. This preparation is facilitated by the simulation exercises.

GOALS AND TYPES OF CRISIS SIMULATION EXERCISES

Creation of the aforementioned agreements which set out procedures for co-operation between authorities is an important step towards more efficient crisis management. However, when there is no crisis situation, the most efficient and practically only tool to test the operation of the framework is to carry out financial crisis simulation exercises.

The basic goal of such exercises is to test in the period preceding a crisis those areas affecting co-operation, based on which individual organisations' demand for information, the scope of duties, responsibilities and decision-making powers as well as the issues which require co-ordination between individual authorities can be defined. A preliminary clarification of all this greatly contributes to more efficient, faster decision-making, i.e. to crisis resolution resulting in the lowest cost for society.

Accordingly, the goal of the exercises is to maximise the efficient management of a potential crisis, and to facilitate the preliminary formulation of rules of procedure, information channels, decision-making mechanisms and communications tactics, which allow the restoration of confidence in the financial intermediary system and the strengthening of financial stability.

Central banks usually play a prominent role in the organisation of simulation exercises. This also stems from the fact that it is central banks which encounter the first signs of a crisis, through troubles emerging in the money market and the problems arising in payment and settlement transactions. In addition, on the basis of taking account of the circumstances and the negative effect of the crisis, the central bank can provide temporary liquidity assistance until further steps, if any, are taken by the supervisory authority or the ministry of finance. The central bank must make such decisions in a short time and very often in an ambiguous solvency situation. Moreover, it is also a very complex task to decide to what extent the crisis jeopardises the stability of the financial intermediary system. Simulation exercises provide valuable assistance for considering and answering all these questions and for identifying decision points and alternatives.

There are several types of exercises, depending on the area of crisis management which the authorities intend to test.

- Exercises *within the central bank* can concentrate on testing central bank steps to be taken in the event of a crisis, the process of emergency liquidity assistance and the communication necessary in a crisis. If the given country is an important financial centre, the central bank

concentrates for example only on the testing of troubles emerging in the payment and settlement system and in the money market in a special exercise for each case. In other central banks' practices, these latter issues are embedded among the other goals intended to be tested.

- At the *national level,* the basic objective of exercises carried out with the involvement of the central bank, the supervisory authority and the ministry of finance is to test the co-operation, flow of information and decision-making mechanisms between authorities as well as to strengthen all these by exploring any deficiencies which are identified.

- A *regional* exercise – held for example by Scandinavian countries – tests co-operation in the event of a crisis of banking group members present in the member countries.

- *At the European Union level,* the first simulation exercise was held in 2003, with the involvement of the representatives of the central banks and supervisory authorities of all member countries. Ministries of finance were also represented in the second exercise held in 2006. The objective of the EU-level simulation exercises was to evaluate the flow of information, co-ordination and decision-making mechanisms between authorities, the systemic implications of the crisis, sharing of costs, if any, as well as to test the efficiency of the voluntary agreements concluded, in the event of a cross-border crisis.

- During the two simulation exercises (management of a complex financial crisis) held by the central banks belonging to the *Eurosystem,* the Eurosystem's crisis management activity and ways to harmonise the common monetary policy decision-making with the emergency liquidity assistance belonging to the decision-making powers of national central banks was tested.

CRITERIA FOR THE SUCCESS OF SIMULATION EXERCISES

Organisation and performance of such simulation exercises poses significant challenges for both the experts who prepare the exercise and the participating decision-makers.

On the one hand, the success of an exercise depends on the design of the crisis scenario. The majority of exercises comprise fictive countries, credit institutions, financial markets and payment systems. It is a trend that scenarios strive to be increasingly realistic. Experts who prepare the exercises need to carefully consider what factors may trigger a crisis at the national, regional and EU levels and what so-called channels of contagion may be relevant. Stress tests may help in highlighting the vulnerable points. In national-level simulations, actual banking data modified in accordance with the goal of the exercise are often used.

Depending on the objective, crisis scenarios can vary widely. A crisis can be triggered, for example, by fraud at a credit institution, the bankruptcy of an important client that has representations in several countries, which results in considerable losses for the bank(s), and sudden, unfavourable money market developments as well. Furthermore, as a consequence of interrelationships within the group, a crisis within a banking group may start both from the parent bank or any of the subsidiaries. For example, a sudden reputation loss at a member of the group and the resulting external financing problems can easily spread to the other group members as well. In more complex scenarios, in addition to crises at credit institutions, negative impacts appearing in the infrastructure and in real economy also play a prominent role.

A scenario is good, if it poses the greatest challenges possible for the decision-makers, i.e. for example, if the crisis evolves quickly, an unforeseeable contagion effect develops, the systemic implication of the crisis is very complex and difficult to assess in advance, and if the solution of the crisis may have various outcomes. A further difficulty for decision-makers is if it is not clear whether the bank(s) concerned has (have) a liquidity or a solvency problem. (Although it should be noted that in the event of a crisis, in most cases it is the solvency situation of the bank affected by the crisis which is questionable.) The challenge is increased, if decision-makers must make their decisions on the basis of imperfect and insufficient information, as well as under significant time pressure and pressure from the media.

In the course of the exercise, decision-makers continuously receive news and updated information on the developments in the crisis. Those preparing the exercise have to consider decision-makers' potential reactions, and corresponding outcomes have to be planned. The general practice of preparing a simulation is that the expert staff prepare all theoretically necessary information and materials for the preparation of the decision, and hand them over at the decision-makers' request. (This also includes the case when the experts want to present insufficient information deliberately.)

On the other hand, the success of an exercise depends on the reactions of the decision-makers. It is essential that those high-level executives of authorities participate in the exercise who actually make the necessary decisions during a crisis. It is also necessary that they enter fully into the spirit of the exercise, and behave as in a real crisis. To a great extent, success depends on whether the decisions made under significant time pressure are indeed realistic.

In addition to the decision-makers and the experts running the simulation, spokespersons for the authorities may also participate in the exercise when testing external communication, and other players as well, who for example represent the bank in trouble, journalists or foreign authorities.

LESSONS AND FINDINGS OF SIMULATION EXERCISES

A simulation exercise is successful and fulfils its objective if it provides a lesson and highlights the weaknesses, deficiencies and potential conflicts in the co-operation of authorities. Furthermore, if based on the above, the decision-makers specify tasks to remedy the deficiencies and if the problems that arise are resolved.

In the simulation exercises at various levels, numerous problems and deficiencies with many different aspects have cropped up, and identification and/or solution of these problems and shortcomings has significantly contributed to improving co-operation between authorities. The main issues can be summarised as follows:

- In the event of a crisis, in order to provide the necessary information for decision-making and to reduce the data supply burdens of the bank affected by the crisis, the authorities (central banks and supervisory authorities) harmonised the scope of extraordinary data supply. The authorities also harmonised who contacts foreign authorities and the parent bank, if such measures become necessary. Based on the exercises, the scope of all relevant pieces of information – available only at one of the authorities – was identified, the provision of which is absolutely indispensable for the other institution's decision-making. Timely information flow with adequate contents and efficient communication between the authorities is absolutely necessary for rapid decision-making which involves the smallest possible burden for society.

- It can be considered as a significant result that the co-operation agreements to be applied in a crisis were refined upon on the basis of the experience of simulation exercises, and in several cases the agreements were formulated after the exercise. The exercises contributed significantly to the refinement of the scope of duties and responsibilities to be discharged by central banks, supervisory authorities and ministries of finance as well as of the areas which require co-ordination, even if the fundamental principles of co-operation were previously included in the framework of an agreement.

- The experiences gained in simulation exercises called attention to the necessity to formulate systemic assessment criteria, i.e. to elaborate the factors based upon which the systemic implication of a crisis can be evaluated. As a result, a common framework for systemic assessment was formulated at the EU level, the adoption of which by member countries allows the comparability of evaluations prepared on the basis of the common methodology. The exercises also showed how important it is that authorities discuss – and if possible, harmonise – their assessment regarding the systemic implication of a crisis, and inform one another about the measures planned and the impacts thereof. Harmonising these issues is extremely important for efficient crisis management, both between the national authorities of a country affected by a crisis and between the authorities of individual countries in the event of a cross-border crisis.

- Basic principles to provide guidance for the authorities of the EU member countries for the management of cross-border crises with systemic implications were formulated on the basis of exercises simulating banking group crisis management. These exercises also allowed the identification of all potential problems stemming from the differences in regulations and practices between countries, the elimination of which is indispensable for efficient crisis management. Simulations facilitated the consideration of various crisis solution possibilities as well as the development and refinement of the relevant instruments and techniques and also clarification of the areas where costs can be shared between individual authorities.

- Exercises highlighted that in the event of a crisis the formulation of adequate external communication and its harmonisation between authorities is extremely important for the restoration and strengthening of market confidence. Based on all of the above, individual authorities formulated the external communication strategies to be applied in the event of a crisis.

- In the course of the exercises it was demonstrated that it is necessary to formulate the basic principles determining the measures of authorities and relating to crisis management in advance, but it is very important to apply the available instruments in a flexible manner, depending on the developments in the crisis. As a result of the simulations, internal procedures and regulations became more concrete and practice-oriented, and the relevant contact persons for crisis situations were also specified at the specific authorities.

- In the course of the exercises and their evaluation, decision-makers at the various authorities discussed the

issues which caused problems, the conflict situations which emerged, and thus became more aware of one another's reactions and ways of thinking, which may greatly facilitate crisis management during a real crisis.

- Based on the experiences of the exercises they also determined all of the future tasks both at national and EU levels, the fulfilment of which is necessary for the development of crisis management. In various committees of the EU, work is in progress in order to make the co-operation between competent authorities more efficient, and to enable EU-level co-operation agreements and the crisis management framework to keep pace with the development of financial markets.

There are a number of new ideas and opportunities for progress arising in connection with the organisation of future exercises and the formulation of scenarios. Making simulations more realistic is the aim of those ideas, for example, which suggest that the exercise should be unexpected, decision-makers should not be aware of the date of the exercise in order to make them experience the outbreak of the crisis as a real stress situation, and also e.g. that the person to be notified in the event of a crisis should not be available. Testing of market solutions would also be facilitated by involving real market participants in the exercises.

THE PARTICIPATION AND ROLE OF THE MAGYAR NEMZETI BANK IN CRISIS SIMULATION EXERCISES

Under the direction of the MNB, the Hungarian authorities organised the first simulation exercise with the involvement of the central bank and the supervisory authority in 2005. It can be considered as progress in co-operation that in the exercise held in the first quarter of 2007 the Ministry of Finance was also an active participant. In the exercises, in addition to testing the sharing of information and co-operation between authorities in the event of a crisis, special emphasis was laid on external communication and, in the second simulation, on testing crisis solution possibilities with the involvement of the MoF. Senior executives of the organisations described the exercises as successful and useful, as they contributed significantly to the improvement of the efficiency of co-operation.

One of the important results of the exercise was that, also taking account of the experiences gained from the simulation, in 2006 the MNB and the Hungarian Financial Supervisory Authority (HFSA) signed an agreement on the principles and framework of co-operation in crisis situations, in order to increase the efficiency of their co-operation. Following the simulation held with the participation of the MoF in 2007, in accordance with the practice in the EU, the agreement is completed with the undertaking of a role by the Ministry of Finance in crisis solutions.

In addition to national-level exercises, the MNB's representative participates in EU-level simulation exercises as well. In the exercise held in 2003, the MNB's representative, as one from a future member country, participated only as an observer, while in the second exercise held in 2006 the MNB's representative was an active participant, together with the representatives of the HFSA and the MoF.

In terms of the simulation exercises formulated with the MNB's co-ordination, the Hungarian authorities play a leading role among newly joined countries. At regional and EU-level conferences and special expert meetings the MNB shares its experience relating to the challenges and lessons of crisis simulation exercises as well as the future tasks stemming from the exercises. Within the framework of co-operation with central banks of the region, during expert visits it also provides information about the methodology of formulating and organising the exercises.

In accordance with international practice and in order to increase the efficiency of domestic-level crisis management work, the MNB intends to organise regular simulation exercises in the future as well, focusing on various areas. In addition, in the future the MNB intends to test co-operation between domestic and foreign authorities in a crisis situation, and also urges regional-level simulation exercises.

Moreover, in order to develop the crisis management framework, the MNB – together with the supervisory authority – plans to conclude bilateral co-operation agreements to be applied in crises situations with the authorities of countries responsible for parent banks which have systemically relevant subsidiaries in Hungary.

CONCLUSIONS

Recently, developments in the international money market, the impact of the US sub-prime mortgage market crisis on the European money market and the mitigation of its negative impact on the markets have been factors which have required very quick reactions from central banks. All of these events call the attention to the necessity of the continuous development and fine-tuning of the central bank crisis management framework and instruments.

A prominent element of this crisis management framework is the performance of crisis simulation exercises, which is practically the only instrument to test crisis solution before

an actual crisis. Crisis situations cannot be prevented by the exercises, and it is obvious that all crisis and decision situations and crisis solutions cannot be tested in the course of the simulations. However, the deficiencies and problems which emerge during the exercises, the identification of potential conflicts of interest between authorities and the solutions thereof contribute to the improvement of the co-operation between authorities and to quick solutions, which result in the lowest possible costs for the society both at the national level and when managing cross-border crises.

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Máté Barnabás Tóth: Monetary policy rules and a normative approach to the central bank's objective function

This study attempts to explain in an understandable manner that the central bank's effort to keep inflation low is not an end in itself, but ultimately serves the interests of social welfare. We attempt to substantiate this argument on the basis of economic theory, based on the logic of New Keynesian models, by describing loss functions that contain welfare relevant variables and interest rules that minimise them. By using this framework, we point out that – taking into account the limits of measurability, learning and potentially non-rational expectations – decision-making rules that give considerable weight to a departure from the inflation target and take into account real economy considerations generally perform well in terms of welfare and may be considered robust in New Keynesian-type models with forward looking agents. Finally, we argue that through the strategy of inflation targeting the normative implications of the above framework can be put into practice.

INTRODUCTION

It is a generally accepted view in economics and in the practice of monetary policy that the best way for a central bank to contribute to the long-term welfare of society is to create a stable, predictable environment for market agents by maintaining price stability and anchoring inflation expectations. However, this does not mean that, in addition to their price stability objective, central banks do not or should not take into account real economy considerations to some extent.

In establishing monetary policy objectives, it is of primary importance to evaluate such objectives from a welfare perspective. On the one hand, any monetary policy can be maintained legitimately in keeping with the norms of democracy if, by considering the structure of the economy as a given, it leads to the maximum welfare of society for the longest possible period of time. In order to provide a normative definition for the optimal monetary policy as described above, it is indispensable to ensure that the decisions (regarding interest rates) made by the central bank can be evaluated in respect of their impact on welfare. In order to do so – within the framework of economic models – we need to define an objective or loss function that is suitable for evaluating the outcome of variables that are relevant for welfare and for ranking, in keeping with the above, monetary policies that weigh diverse considerations in different ways.

For a long time, economics was not able to provide a solid welfare criterion which was in line with the decision-making practices of central banks and which could serve as a basis for classifying and prioritising various types of monetary policies. The primary reason for this was that for a long time there was no realistic analytical framework with a microeconomic basis to model the impact of monetary policy on the real economy and the explicit welfare costs of inflation. Consequently, comparison between different monetary policies happened in an *ad-hoc* manner and/or on the basis of loss functions with arbitrarily chosen parameters. Naturally, an *ad-hoc* format is also capable of describing a central bank's system of goals, but a loss function which can be analytically deducted from a realistic model and which contains the so-called deep parameters of the model constitutes an objective basis for comparison, which helps formulate normative implications for monetary policy.

WHAT DOES ECONOMIC THEORY SAY: A NORMATIVE APPROACH

In the past decade, the so-called New Keynesian or neo-Wicksellian analytical framework has became widespread in both academic research and the practices of central banks (see Clarida et al., 1999; Woodford, 2003; Gali and Gertler, 2007). Compared to previously widespread models, the most novel feature of the New Keynesian framework is that it deducts conclusions from first principles,[1] with a microeconomic basis and has an explicitly modelled connection between monetary policy and the real economy. Due to the microeconomic basis, the aforementioned framework has proven suitable for evaluating the impact of monetary policy on welfare and for approaching monetary policy from a normative perspective (see Rotemberg and Woodford, 1997). An additional feature of New Keynesian

[1] Such is, for example, the maximisation of utility by households and of profit by companies.

models is that their basic versions can be described in a transparent three equation system by using the first order conditions arising from the optimisation problems of households and firms and by adding a monetary policy rule.

In the following we would like to provide a simplified description of the main features of the New Keynesian model that can be reduced to three equations starting from the most simple specification to the more complex and at the same time more realistic ones. It is important to note that we do not believe that the results generated by the New Keynesian models can be directly and unconditionally translated into central bank practice: their most important merit is that they provide a logically consistent, normative framework for thinking about monetary policy.

New Keynesian models differ from similar, general equilibrium models (e.g. real business cycle models) in that they presuppose market imperfections that impact nominal variables. In this framework, corporations have market power (which means that they are price-setters) and compete in an oligopolistic way while there is friction in their pricing decisions.[2] This friction (or rigidity) may arise, for example, if obtaining information for a pricing decision or the very process of pricing is costly for corporations. The simplest New Keynesian model approaches this friction with the so-called Calvo pricing (see Calvo, 1983).[3] Due to these frictions, pricing is not instant and is not synchronised between firms. Therefore, in any given time period non-zero inflation leads to unintended changes in relative prices (in other words, causes a real effect) because there will be firms that are able to establish an optimal price, while others are unable to change their prices to their optimal level. Due to this friction, the actual output will fluctuate around the so-called natural level (which would occur in the absence of nominal rigidities).

In the absence of nominal rigidities, the steady state price set by firms would equal the sum of their nominal marginal cost and a desired price mark-up; however, due to the 'stickiness' of prices the actual and desired price mark-up will differ as a result of various shocks. Firms that are unable to change the price of their product at a given moment in time will have to adapt to the change in profit margin, which occurs as a result of a change in their relative prices, by way of their output. Therefore, companies that are in the process of making their pricing decisions will determine their current prices as a function of the prices and marginal costs which they expect in the coming periods, in other words, the expected profit margin. The former is reflected in the real marginal cost indicator which is the inverse of the above-mentioned profit margin, that is, the ratio of the nominal marginal cost and the price.

The so-called New Keynesian Phillips curve, which is an approximation of the steady state supply side of the model, is a result of the above-described pricing behaviour of profit-maximising companies. The New Keynesian Phillips curve is forward-looking in which inflation at any given time depends on the output gap and the inflation expected in the next period.

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t \qquad (1)$$

Where π_t is the inflation at time t, $\tilde{y}_t$ is the output gap which, in this framework, is the difference between the actual (y_t) and the 'natural' level (y_t^n) of output. E_t is an operator that indicates (rational) expectations which are based on information that is available at time t, while β and κ are coefficients which are derived from the structural or 'deep' parameters of the model. The output gap – in the case of certain assumptions concerning preferences, technology and labour market structure (see Clarida et al., 1999) – fluctuates in proportion to the deviation of real marginal cost from its steady state value. However, as a result of various nominal (or real) frictions, the proportionality between the real marginal cost and the output gap ceases to exist and a trade-off emerges between the stabilisation of inflation and the output gap (we will discuss the role of trade-offs below in more detail).

Another important, demand-side consequence of assuming not instantly adjusting (or 'sticky') prices is that monetary policy is capable of having a short-term impact on the forward-looking real interest rate by changing the nominal interest rate, which thus affects the distribution of household consumption over time periods. If time preference remains the same,[4] an increase in the real interest rate compared to its

[2] There may be several reasons for this: prices fixed in a long-term contract, costs related to re-pricing a product (menu cost), etc.

[3] In the Calvo type pricing, firms can change their prices at any given time only as a function of an exogenous process and only with a certain degree of probability, regardless of whether they changed their prices in the previous periods. As a result of this, the time periods during which the prices of various products remain fixed overlap, that is, the changes in prices will not be synchronised. The Calvo type time-dependent pricing is of an ad-hoc nature; however, if used in standard models, it yields results that are similar to those produced by the more realistic but mathematically more complex state-dependent pricing (see e.g. Klenow and Kryvtsov, 2005). At the same time, however, Lombardo and Vestin (2007) point out that although that the two most popular time and state-dependent pricing types (Calvo- and Rotemberg pricing) result in identical aggregate behaviour of firms (Phillips curve), they may have different welfare implications if the distortion that appears as a result of the oligopolistic competition cannot be perfectly offset by the government.

[4] The utility function of households in a given time period contains consumption and leisure. The time preference measures the amount of future utility a household is willing to sacrifice for the sake of current utility.

natural level motivates households to reallocate their consumption from the present to the future and the other way round when real interest rates decrease. In keeping with the above, the demand side of the standard New Keynesian model – presupposing a closed economy and not taking into account investments – can be described in the form of the IS curve below which is derived from the behaviour of a utility maximising household:

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \frac{1}{\sigma}(i_t - E_t\{\pi_{t+1}\} - r_t^n) \qquad (2)$$

where i_t is the nominal interest rate which can be affected by the central bank, $i_t - E_t\{\pi_{t+1}\}$ is the forward-looking real interest rate, and r_t^n the natural level of the real interest rate (which prevails in an equilibrium without nominal rigidities).

The two equations described above also clearly show the basic transmission channel of monetary policy: by changing the interest rate the central bank diverts the real interest rate from its natural level and, by way of its impact on aggregate demand, opens the output gap which affects inflation through the New Keynesian Phillips curve. Since both inflation and the output gap are forward-looking variables, it is clear that they are affected not only by the current interest rate but by its future path as well.

As we have indicated before, in the New Keynesian framework the welfare loss of households resulting from a deviation from flexible price equilibrium[5] allocation can be approached with a loss function[6] which is directly suitable for examining the impact of monetary policy on welfare (see Rotemberg and Woodford, 1997; Woodford, 2003).

$$W \equiv E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{U_t - U_t^n}{U_C C} \right) = \frac{1}{\lambda} E_0 \sum_{t=0}^{\infty} \beta^t (\kappa \tilde{y}_t^2 + \varepsilon \pi_t^2) \qquad (3)$$

where U_t^n is the (hypothetical) utility of households in the given period if prices were perfectly flexible and U_t designates utility under the actual imperfections. U_c is the marginal utility of consumption, C is the level of consumption in a stable equilibrium, and the product of the two yields a utility measure. The quadratic loss function above results from a second order approximation to this welfare loss which, in addition to its microeconomic foundations, is also intuitive because it is similar in form to objective functions that are widely used in the literature,[7] but which contain parameters and variables in an *ad-hoc* way.

MONETARY POLICY IN THE NEW KEYNESIAN MODEL

The New Keynesian models are closed with a monetary policy block that determines the nominal interest rate. If we describe monetary policy as a feedback rule that reacts to endogenous variables, the inflation parameter must be greater than one if we want stable equilibrium, that is, the forward interest must also increase if inflation increases. For monetary policy[8] to be optimal, the central bank must determine the interest rate in a way that minimises social loss on the basis of the welfare criterion defined above.

$$i_t = r_t^n + \phi_\pi \pi_t + \phi_y \tilde{y}_t \qquad (4)$$

In the simplest New Keynesian model, monetary policy has an easy task: it follows a rule of action that always closes the output gap and therefore also brings the rate of inflation to zero[9] by simultaneously minimising social loss; this is also true the other way around. It is important to underline that in the framework of the New Keynesian model monetary policy reduces social loss not when it unconditionally 'smoothes' fluctuations in output, but rather when it attempts to approximate it to its natural level which, in the case of technology shocks, may be volatile. Therefore, the approach of the New Keynesian model is fundamentally different from the approach that defines the output gap as a difference between actual and long-term trend-output.

Monetary policy also has an easy task when only demand shocks (those that are related to the 'IS equation') can divert the economy from a state of stable equilibrium. The demand shocks that are assumed to be exogenous in the above framework change the output gap and inflation in the same direction, therefore the optimal reaction of monetary policy – which minimises welfare loss – is trivial.

Because target variables are forward looking, that is, they also depend on the values that they will take on in the future, at any given time they will be determined not only by current

[5] In the standard New Keynesian model the Pareto-optimal or efficient (lacking any kind of distortions) and the natural output are the same. Although the latter contains distortions (similar to dead weight losses) that arise from the presence of monopolistic competition; however, based on an implicit assumption, fiscal policy is capable of providing a counterweight in the form of lump sum (non-distorting) taxes.

[6] With a second order Taylor series approximation around the flexible price equilibrium allocation.

[7] The so-called loss functions are widespread in the literature and contain the sum of the deviation of inflation from its target value and the square of the output gap in respect of a particular period. The popularity of the square loss function can be explained by the fact that it is a good representation of the symmetrical nature of monetary policy: decision makers do not want high inflation, deflation, output below or in excess of its potential. On the other hand, a quadratic target function yields a mathematically easily manageable system coupled with equations that describe the demand and supply in the economy in a linear (or log-linear) form (see, for example, Benigno and Woodford, 2006).

[8] It is important to note that normative conclusions depend on the assumption that expectations are rational and monetary policy is fully credible.

[9] Blanchard and Gali (2005) calls this phenomenon 'divine coincidence'.

monetary policy but also by the expectations related to it. The so-called 'discretionary' monetary policy does not recognise that expectations can be influenced and re-optimises in every period. At the same time, non-discretionary monetary policy recognises that – if there is a short-term trade-off between inflation and the output gap (see below) – welfare loss can be reduced by using the expectations channel. Monetary policy can influence expectations if it is credibly committed to an optimal interest rule in the long term (indefinitely). In order to be able to benefit from such a commitment, the central bank must be fully credible, that is, it must stick to its decisions made in the past even if they did not have the optimal result in respect of a given time period ('history dependence', see Woodford, 2003). Naturally, in real life central banks are unable to commit themselves for an indefinite period of time; however, the above serves as an important lesson in the practice of monetary policy. Establishing credibility and managing and/or anchoring expectations result in welfare gain, and expectations for the future are important for effectively achieving the stabilisation goals of monetary policy.

It is important to explain the difference between optimal and simple interest rules. The optimal rules minimises the loss function derived from the utility of the representative agent; its coefficients result from the 'deep' parameters of the model, and it assumes a knowledge of the natural level of output and real interest rates. Because the latter are variables that are not directly observable, therefore the optimal rules that contain them are not necessarily suitable for direct use in monetary policy practice. On the other hand, the so-called simple rules are based on observable variables and are not derived from the optimisation of a concrete model (an example is the classic Taylor-rule[10]). In an ideal case, simple rules may have the advantage of 'performing well' in several models with different specifications, in other words, they result in a social welfare loss that is close to one that can be achieved with a monetary policy that is considered optimal in the given models.

In the above cases monetary policy could minimise the social loss function without confronting a trade-off. Therefore, this feature of the standard New Keynesian model implies a loss-minimising monetary policy which immediately returns inflation to zero in the case of exogenous shocks. Maintaining zero inflation eliminates welfare loss arising from the presence of nominal price rigidities; in the New Keynesian framework this is the most that monetary policy can do. Although central banks that follow inflation targeting are often accused of leaving all factors, other than the inflation process, out of consideration, the simplified approach above is not characteristic of them either because the short-term trade-off between output gap and inflation stabilisation is an empirically well-established fact.

TRADE-OFF BETWEEN TARGETS

The trade-off between inflation and output gap can be illustrated by making a small change to the standard models described above. The simplest way to introduce the trade-off is to supplement the New Keynesian curve above with an *ad-hoc* 'cost shock.' As a result of the cost shock, the output gap and inflation start moving in opposite directions, therefore their simultaneous stabilisation is no longer possible. In such cases, the task of monetary policy is to distribute the effect of the shock in an optimal manner – in an attempt to minimise social loss – between output gap and inflation.

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa y_t + u_t \qquad (5)$$

Although the introduction of an ad-hoc cost shock (u_t) makes the implications of the New Keynesian model regarding monetary policy more realistic, it is not in line with the principle of building from microeconomic foundations. However, the trade-off can also be introduced from a 'deeper' foundation: the possibility of stabilising inflation and output gap simultaneously depends primarily on the frictions implied in the model. One example is when there is a time-varying difference between 'effective' (completely frictionless) and natural (absent of nominal frictions) level of output. A trade-off results also when price rigidities are coupled with a rigid labour market causing the real wage of the representative household deviating from its 'natural' level. This is another factor that, by distorting the real marginal costs of companies and the choice of households between labour or leisure, results in a non-optimal allocation and therefore leads to social loss.

Erceg et al. (2000) introduces nominal wage rigidities into the standard New Keynesian model analogously to Calvo pricing: the nominal wage of households remains fixed to a certain degree of probability in every time period, regardless whether the wage changed in the previous period or not. As a result of the frictions affecting prices and nominal wages, wage inflation (changes in nominal wages, π_w) is also included in the social loss function; however, the simultaneous stabilisation of inflation, wages and the output

[10] The classic Taylor rule (Taylor, 1993) is an estimated feedback rule which ties the level of the central bank's prime rate to one constant (or the deferred prime rate) to the deviation from the target value of inflation and a variable that measures tension in the real economy.

gap will no longer be feasible and there will be a trade-off between these goals.[11]

$$W \equiv E_0 \sum_{t=0}^{\infty} \beta^t (\phi_y \tilde{y}_t^2 + \phi_p \pi_t^2 + \phi_w \pi_{w,t}^2) \qquad (6)$$

In this case, an optimal monetary policy reacts to price and wage inflation as well as the output gap by giving more weight to the 'stickier' nominal variable. In the previous framework Erceg et al. (2000) examined the performance of several simple interest rules in addition to that of the optimal one. The results show that a welfare loss generated by the optimal rule can also be achieved by a rule that reacts to price and wage inflation, or price inflation and the output gap.

Besides labour market rigidities, the trade-off between inflation and output gap may also emerge when the New Keynesian model is extended to an open economy, and we assume that there is friction concerning the pass-through of exchange rate movements into prices. Gali and Monacelli (2005), by placing both foreign and domestic goods in the representative consumer basket and assuming that the pass-through of exchange rate changes into consumer prices is immediate and complete, concluded that social loss depends on domestic consumer price inflation and on the output gap. In this approach foreign monetary policy is assumed to be optimal (which means that it reached the flexible price equilibrium allocation) and the law of one price holds in the case of imported consumer goods (which means that the domestic and foreign prices of these products, if calculated in the same currency, will be the same at all times) Based on the above, this open economy model approach is analogous to the standard New Keynesian model, that is, there is no trade-off between the output gap and the stabilisation of domestic inflation, therefore the optimal monetary policy can be approximated with an interest rate rule that reacts to the inflation of domestic consumer goods in addition to the natural level of the real interest rate. Having a monetary policy that reacts to the entire price index or fixes the nominal exchange rate may result in greater welfare loss because, due to the partial or full stabilisation of the exchange rate, the relative price adjustments of foreign and domestic consumer goods will occur, partially or fully, through the nominally rigid domestic prices.

Monacelli (2005) proved in a similar open economy framework that by relaxing the implausible assumption of complete and immediate pass-through (see Campa and Goldberg 2005) of exchange rate movements into prices there will be a trade-off between the stabilisation goals of monetary policy. Due to the incomplete pass-through in the short term, the law of one price does not hold in the case of foreign consumer goods, and exchange rate changes directly affect the output gap and inflation. In this case monetary policy could reach the flexible price equilibrium allocation if it could simultaneously stabilise domestic inflation and the deviation from the law of one price, which is infeasible in this case. With respect to social welfare loss, a monetary policy with commitment that reacts to the whole consumer price index appears to be the least costly on the basis of a loss function, used by Monacelli (2005), which contains the output gap and total consumer price inflation. However, it is important to note that the partial stabilisation of exchange rate changes is implicit in this monetary policy.

THE LIMITS OF IMPLEMENTING OPTIMAL MONETARY POLICIES

In this sub-section we describe the problems – which are related to the basic assumptions of the theoretical framework described above – that modify some of the normative implications stemming from the simpler New Keynesian models. One such problem may arise from model-uncertainty and non-rational expectations of market participants. Orphanides and Williams (2007) assume that the central bank and economic agents, instead of rational expectations, have imperfect information about economic structures, especially concerning natural rates (output, unemployment, real interest rate). Agents form their expectations on the basis of a learning process, in the course of which they use a simple forecast model which is continuously re-estimated as new data come in. These circumstances considerably change loss minimising monetary policy compared to models that consider known economic structure and rely on rational expectations. On the basis of the objective function used by Orphanides and Williams (2007) – which is similar to those described above, but is not deduced from the utility of the representative household – a loss-minimising monetary policy reacts stronger to inflation and to a lesser extent and more gradually (by interest rate smoothing) to real economy variables, which are estimated with uncertainty.

In connection with the above, it is important to note that the real time estimates of the output gap may be rather inaccurate due to various methodological problems and frequent data revisions and may not even have the appropriate sign (see Orphanides et al., 2000). It has been demonstrated within a

[11] We have mentioned above that monetary policy is an economic policy tool that is suitable primarily for eliminating distortions that result from nominal rigidities. If in the above-mentioned case only wage rigidities prevailed, monetary policy would be able to eliminate them similarly to the standard New Keynesian model. However, the simultaneous prevalence of price and wage rigidities directly affects the accommodation of real wages and therefore results in a real economy distortion that monetary policy is unable to counterbalance.

model framework by Clarida and others (2000) that a monetary policy, which gives considerable weight to real time output gap estimates, may lead to strongly suboptimal outcomes. The problem of taking real economy considerations into account explicitly is apparent when a central bank's loss function or policy rule contains deviations from the estimated long-term output trend (that is, from an atheoretic measure generated by a simple time series method) as a variable that measures real economy tensions. Although at first sight a monetary policy that attempts to 'smooth' real economy fluctuations appears to be justifiable from a welfare perspective, output should fluctuate as an 'effective' response to technological shocks that cannot be observed in real time. If in this case monetary policy attempts to return output to its long-term trend, it may generate inflation or deflation, contrary to its original intention. On the basis of the above, an explicit reaction to the output gap estimate that is available for decision makers in real time poses a risk which is also reflected in the practice of central banks: typically, they take into account real economy considerations within the tolerance band surrounding the inflation target, in the time-horizon of monetary policy reaction, or by targeting a certain core inflation indicator (see Palmquist, 2007). Targeting core inflation means that monetary policy hardly, or not at all, takes into account changes in price index components that are frequently affected by cost/supply shocks (this is the monetary policy that is carried on, for example, by the US Fed). The tolerance band around the inflation target also allows for such impact.

The New Keynesian models described above also assume an absolute credibility of monetary policy; however, this is not always the case in real life. If market agents do not find the central bank's commitment to fighting inflation credible, taking into account and emphasising real economy considerations may be perceived as an inflation bias. In order to avoid this, clear communication, transparency and accountability by the central bank are of key importance.

WHAT DOES GOOD MONETARY POLICY LOOK LIKE ON THE BASIS OF THE LOGIC OF NEW KEYNESIAN MODELS?

On the basis of the logic of the New Keynesian model framework described above, we can formulate the following normative implications in respect of monetary policy:

- Monetary policy must take into account that theoretically, all it can do is to eliminate the impact on welfare of distortions that result from nominal rigidities; in other words, it cannot attempt to reach an output that is permanently higher than the natural level.
- It has a decision-making rule that focuses on stabilising those price and/or wage inflation indices that exhibit nominal rigidities. The weight(s) given to stabilising individual price and/or wage indexes is in proportion to the extent of their stickiness. It is especially important for the central bank's interest rate to change in the same direction as the inflation but to a greater extent, that is, for example, in the case of a demand shock that increases inflation, the real interest rate must increase as well.
- A deviation from the natural level of output is included in the loss function of the representative market player, and monetary policy also attempts to minimise it. If the economy suffers a shock that changes inflation and the output gap in opposite directions, an optimal monetary policy would distribute its effect between the two variables. Furthermore, when taking into account real economy considerations, it is important to ensure that the price stability goals of the central bank's monetary policy is credible.
- It is aware that expectations of future changes in monetary policy, when market players are forward looking, are just as important in respect of welfare-relevant variables as current interest rate changes. A loss-minimising monetary policy benefits from the welfare gains stemming from the management of expectations and creates a high degree of credibility in order to do so. Credibility depends primarily on whether previously declared goals and commitments have been met.
- If there is considerable uncertainty about the models that describe the economy or if assumptions about being perfectly informed and about expectations being rational are not realised, a loss-minimising monetary policy will react to a considerably greater degree to inflation and to a lesser extent to variables which reflect the slack in the real economy but cannot be directly observed. Furthermore, under the conditions described above a lower welfare loss may result if monetary policy changes the interest rate only gradually (smoothing over the interest rate) in response to new information.

CONCLUSIONS: IS INFLATION TARGETING A GOOD MONETARY POLICY?

We argue that inflation targeting provides a strategic framework within which the implications formulated above can be put into practice. Central banks that conduct the 'best practice' of inflation targeting (hereinafter IT central

[12] Such is the British, Canadian, Norwegian, Swedish and New Zealand central bank.

banks)[12] typically do not have a well-defined real economy target in addition to their explicit numerical inflation target. This, however, does not mean that they do not take into account real economy considerations. This may not be evident, but by attempting to reach their price stability goals for a horizon of 1-2 years, IT central banks implicitly declare that they are unwilling to take any magnitude of real economy cost in order to stabilise inflation in the short term when shocks that move inflation and the output gap in opposite directions occur. However, making decisions 1-2 years ahead requires the central bank to prepare forecasts and formulate its monetary policy accordingly. This practice ('inflation forecast targeting' – see Svensson 1997) also allows real economy considerations to be taken into account even though the central bank only reacts if the inflation forecast deviates from the target. This is because the inflation forecast by definition includes the impact of all variables that may have a significant impact on inflation in the future. They typically include the current values of variables that may be considered relevant in respect of welfare on the basis of the models that are described above (e.g. wage and output gap estimates). As Svensson (2007) points out, most modern central banks follow 'flexible' inflation targeting (which means that they also take into account real economy considerations). 'Strict' IT (which is only construction with inflation), on the other hand, can be considered more of a theoretical construction with the possible exception of periods when monetary policy has credibility problems.

IT central banks also fit into the described theoretical framework because they typically use a short-term interest rate as an instrument, and, furthermore, their behaviour ex post can be well approximated with an estimated Taylor rule that gives considerable (greater than unity) weight to deviation form the inflation target.[13] This, however, does not mean that in practice monetary policy follows a pre-defined interest rate rule that is effective at any point in time. There is a commitment that is in line with the theoretical implications; however, it is not a commitment to an interest rule but to a medium-term target criterion that constitutes the inflation target (see Svensson and Woodford, 2003). This practice – if it appears to be credible for economic agents – creates inflation expectations that correspond to price stability and – as we have mentioned above – provides adequate flexibility in the short run in adapting to supply or cost shocks.

In order to use short-term flexibility effectively and/or to create credibility that is necessary for anchoring medium-term expectations, IT central banks focus on transparency and the accountability of decision makers. Furthermore, commitment, transparency and the accountability of decision-makers also ensure that monetary policy does not systematically attempt to reach an output that is higher than the natural level.

Consequently, the current practice of inflation targeting places considerable weight on reaching price stability while also taking into account real economy considerations, mostly by avoiding potential risks arising from explicit reactions to variables that are hard to observe or measure in real time. Furthermore, inflation targeting takes advantage of managing expectations in the form of a commitment to a medium-term target criterion. Based on the above, we can claim that the strategy of inflation targeting satisfies the most important normative implications that can be derived from the theoretical framework introduced above.

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Balázs Zsámboki: Impacts of financial regulation on the cyclicality of banks' capital requirements and on financial stability[1]

One of the main functions of the central bank is to strengthen the stability of the financial system, an important aspect of which is to take an active part in the legislation process to improve the regulatory environment and to assess the potential impacts of new regulatory measures. In the summer of 2007 substantial changes took place in the governance of financial institutions with the introduction of regulations based on the new Basel capital standards (Basel II). The objective of this study is to investigate the likely consequences of such new bank regulations and their potential impact on financial stability. To this end, the study analyses the foreseeable developments in the cyclicality of capital requirements of banks based on the corporate credit portfolio of internationally active large banks, and points out that bank regulations are not always capable of fulfilling their intended function of enhancing financial stability in times of economic distress. Notably, the prospective increase in the cyclicality of capital requirements could well lead to a deepening of economic problems and to instability in the banking system, if the banking system appears undercapitalised relative to the risks assumed. All of this highlights the need for the development of a forward-looking risk assessment system and a supportive regulatory regime providing proper incentives.

INTRODUCTION

With a view to the rapid transition of financial markets and institutions and the emergence of new risks, it is necessary to improve financial regulations continuously on an international level. As far as banking regulations are concerned, the international capital standards published by the Basel Committee on Banking Supervision are set as benchmarks and currently provide a basis for several EU directives as well. The purpose of the Basel capital standards is to set forth regulatory principles at the international level, with the aim of creating a level playing field, enhancing the stability of banks and protecting the interests of customers. The new Basel rules adopted in 2004 (Basel II) fundamentally rearrange the principles and practical application of bank regulations, and are expected to have a significant impact on the banks' behaviour, and thereby on the real economy. According to plans, the new Basel rules will be implemented in more than 100 countries and made part of their national laws, which also means that their impact will be felt in many countries in the near future. The transposition of EU directives which are based on Basel II into Hungarian law took place in the summer of 2007.[2]

Nowadays, the key element of bank regulations lies in the definition of capital requirements consistent with the risks assumed, as capital is the primary source to absorb losses, and thereby to protect depositors and other clients. To this end, it is of particular importance to have risks assessed accurately, and to define the capital requirement to cover potential losses. However, one major characteristic of risks is that they are not constant over time: when economic cycles are on the rise, expectations become more optimistic while the income of economic agents is also on the upswing, thereby improving their credit repayment capability, the value of collaterals is increasing and the number of bankruptcies is declining. In these cases, the level of measured risks is decreasing, and hence, the capital requirements prescribed for banks under the new Basel rules are also more lenient.

However, risks tend to build up during times characterised by strong economic activity, and they materialise in banks' books as losses in times of economic depression. What this means is that if a bank fails to build up its reserves in 'good times', it may become capital-constrained at times when the economy turns sour and when losses begin to accumulate; in other words, it will not be able to comply with the statutory provisions relating to capital requirements. One possible reaction banks might take to the above-specified phenomena is to cut back on lending operations and refuse loans to customers whom they deem risky in order to reduce the capital requirement. However, this could lead to the deprival

[1] This analysis is based on Zsámboki, Balázs (2007): Basel II and financial stability. An investigation of sensitivity and cyclicality of capital requirements based on QIS 5, published under MNB Occasional Papers.

[2] The transposition of Directive 2006/48/EC adopted on the basis of Basel II into Hungarian law was implemented by Act LI of 2007 on the Amendment of Act CXII of 1996 on Credit Institutions and Financial Enterprises and Other Regulations Concerning Specialised Credit Institutions, and by Government Decree 196/2007 (VII. 30.) on Credit Risk Management and Capital Requirement for Credit Risk.

of resources from economic agents who needed them the most. Typically, small and medium-sized companies are considered as such, as their access to alternative financial resources, apart from banks, is limited.

The correlation between lending cycles and economic cycles, i.e. procyclical banking behaviour is clearly apparent in most countries, however, the role of capital regulations for banks is not yet clear in this process. The objective of this study is to analyse the ties between real economic cycles and the cyclicality of capital requirements for banks, and thereby to provide a better understanding of the foreseeable consequences of the new bank regulations and their potential impact on financial stability. In this analysis, it is important to point out that the fluctuation in capital requirements fails to convey a complete picture on the impact of changes in risk factors that may occur over time, as banks are required to cover their losses not only with capital, but also by making provisions or value adjustments (hereinafter referred to collectively as 'provisions'). While capital covers unexpected losses, provisions are set aside to cover expected losses.[3] It is important to point out that banks are required to cover any shortage of provisions with capital, consequently, in this analysis we will address both capital and provisioning requirements in terms of their movements over time.

This article is intended to point out that, even though the ultimate goal of these regulations is to support banks' prudent operation, and through it to promote economic growth, these rules relating to individual institutions possibly fail to fulfil their role in supporting economic development and stability in times of economic distress. If the banking system on aggregate is undercapitalised relative to the risk assumed, the rules themselves could contribute to pushing the economy toward a deepening crisis, and therefore to destabilising the banking system.

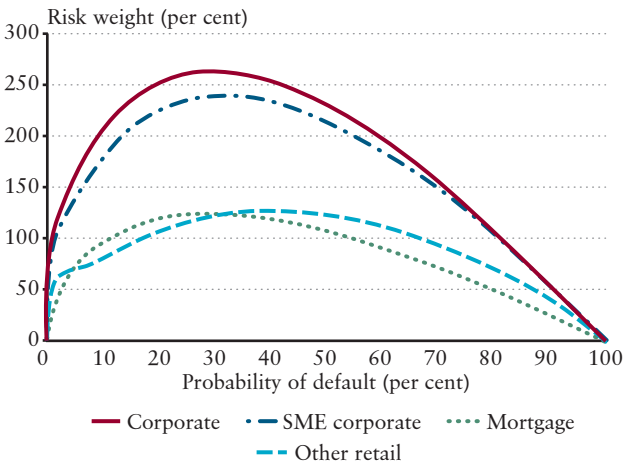
MAIN CHARACTERISTICS OF BASEL II

The original regulatory framework adopted in Basel in 1988 (Basel I) contained uniform rules for all corporate exposures in terms of risks. Irrespective of differences in default and recovery rates, a risk weight of 100% was assigned to all corporate exposures, and a capital requirement of 8% of the amount of such risk-weighted exposure was defined.[4] One of the major innovations of the new Basel capital standards (Basel II) is that risk weighting and the calculation of capital requirements have become more sensitive to changes in risks, with respect to the relative riskiness of exposures and the changes in riskiness of a specific exposure over time. The previous regime is replaced by a revised standardised method and by two internal rating based (IRB) methods, for banks to choose the most suitable one for their needs, consistent with the risk management practices they employ. Of the two IRB approaches, the more advanced one allows banks to determine – subject to supervisory recognition – the risk weight for each exposure using their own estimates of risk parameters, and consequently their capital requirements. These risk parameters include the probability of default (PD), loss given default (LGD), exposure at default (EAD) and maturity (M) estimated for each exposure.

Banks use a variety of statistical methods and internal risk models to estimate the aforementioned parameters, which then have to be substituted into the risk weight functions prescribed by the regulators to arrive at the capital requirement for the exposures in question. In this context, it is important to point out that while the risk weight functions define a cross-sectional relation, meaning that they measure the relative riskiness of various exposures, these very same

Chart 1

Risk weight functions



Note: In the above illustration for corporate and other retail loans an LGD of 45% and for mortgage loans an LGD of 20% is assumed, based on the average LGD data of QIS 5. Using higher LGDs would increase the steepness of the functions, while lower values would flatten out the functions. As regards corporate SME loans, where the regulations prescribe different risk weights according to the size of the firm, annual revenues of EUR 25 million are assumed for SMEs.

[3] Expected losses are generally incurred in connection with the banks' usual business activities, and may be estimated with statistical methods. Banks usually recover their expected losses through pricing of loans. On the other hand, unexpected losses are treated as being generated by extraordinary events (e.g. external economic shocks), which have to be covered by capital.

[4] Risk weights are designed to express the degree of riskiness of bank loans and other exposures in relative terms. Different weight risks are assigned to different exposures. In the Basel I regulatory framework the risk weight assigned to exposures to the central government and the central bank is 0%, to exposures to banks it is 20%, to exposures covered with mortgage it is 50%, and finally to other corporate and household exposures it is 100%. Banks are required to sum up their exposures under various risk weights, and to set aside capital covering 8 per cent of the value of this risk-weighted aggregate exposure to cover potential losses.

functions are to be applied to determine the capital requirement in connection with changes in riskiness of a specific exposure over time. Notably as time goes by, parameter estimations tend to change accordingly, just as the regulatory capital requirement for the individual exposures. The risk weights of different portfolio components are illustrated in Chart 1 as a function of PD. The chart clearly indicates that the risk weight of corporate exposures could be much lower or higher than the 100% specified uniformly under Basel I, depending on the probability of default.

The probable effects of the new Basel rules are addressed in several impact studies, the most comprehensive of which is the so-called Fifth Quantitative Impact Study (QIS 5) conducted during the second half of 2005 by the Basel Committee on Banking Supervision, with the findings published in 2006.[5] The impact study indicates the prospects concerning capital requirements for specific portfolios in a given time, but fails to offer any information relating to the dynamics of capital requirements. Consequently, the findings of the study largely depend on the macroeconomic and financial market conditions prevailing at the particular time, which was decidedly favourable during the period under review. From the perspective of financial stability, however, it is important to investigate how booms and depressions in the economy influence developments in the capital requirements of banks over time.

The only database that is available to the general public, and that would be required for the purposes of the analysis, is concerned with corporate exposures. This study relies on the database of Moody's, a credit rating agency, including data from the period between 1983 and 2006 to model changes in the capital requirements for corporate credit portfolios in the various phases of economic cycles. This database contains information on corporate exposures covering approximately 5,000 companies worldwide. The 1983-2006 period covered by the analysis contains two recession periods (1990-91 and 2001-2002). The database offers information on the default rates within the various categories, the spread of such defaults and the minimum and maximum rates during the period under review.[6] In the analysis numerous assumptions are made, which have to be taken into consideration for the evaluation of the results as well.

ANALYTICAL FRAMEWORK

For the analysis of the impacts of the new Basel capital regulations, first we have to create a model bank, whose corporate portfolio reflects the composition of the portfolios of major international banks. On the one hand, this is necessary because Basel II is also calibrated upon these types of institutions, and on the other hand because the rated companies in Moody's database are typically clients of large banks. As for portfolio composition, we relied on the findings of QIS 5. Then, based on this portfolio, the effects of changes in risk parameters are investigated, calculating the developments of expected and unexpected losses over time as well as the impacts of changes in quality composition of the portfolio.[7]

Estimation of probability of default (PD)

QIS 5 lists the various exposures under three categories with different PD bands. For the sake of simplicity, we will refer to these categories as good, average and poor portfolios.

From the perspective of this study, it is imperative to determine the average PD for these categories, and consequently to review developments in these average PDs over time. To this end, the following assumptions were employed:

1. For good and average categories, we consider the middle of the PD bands as defined in QIS 5 as the average PD. Therefore, in the 'good' category the PD is the middle of the 0-0.2% band, that is 0.1%, while in the 'average' category it is the middle of the 0.2-0.8% band, that is 0.5%.

Table 1

Percentages of corporate exposures of large international banks according to PD bands in accordance with QIS 5 (%)

	Good	Average	Poor
PD band	<0.2%	0.2–0.8%	0.8–99.99%
Share of corporate exposures	38.5	31.8	27.8

Source: BCBS (2006).

[5] The impact study covers approximately 400 banks from around the globe. For more details, see BCBS (2006).
[6] For a detailed description of the database, see Hamilton et al. (2007).
[7] In this paper only the effects of changing PD and LGD are analysed, while both EAD and M are assumed to be constant.

2. In the 'poor' category, that covers the 0.8-99.99% PD band, the middle of the band would be unrealistic for any estimation of the average PD. Therefore, in this category we will make calculations with two alternative assumptions, namely 3% and 7% PDs. These PDs are close to the average default rate of exposures classified as speculative by the credit rating agencies, therefore, they can be interpreted empirically as well.

Naturally, breaking up the portfolio into three categories makes the analysis considerably simpler, as the new Basel rules require banks to set up at least 7 categories. This type of breakdown, however, is not possible with the publicly available databases, but the impact mechanisms of Basel II under such simplified conditions is still more understandable than if we were to use only one average corporate PD estimate.

In the next step, we examine which category a portfolio with a presumed 0.1%, 0.5%, or 3% and 7% average PD can be mapped with Moody's database. This analysis makes a critical assumption, namely that a bank portfolio with a specific average PD behaves during an economic cycle the same way as a portfolio with similar average PD according to the Moody's database. However, it is important to emphasise that the new Basel rules require banks to make their own PD estimates under the internal rating categories based on the long-term average default rate observed in the given category. Therefore, in this analysis we assumed that our model bank uses the five-year average default rate to estimate the PDs for the exposures listed under the category in question (in other words, the PD estimated for 1987 is the same as the average default rate of the previous five-year period). This assumption smoothes out short-term fluctuations of PDs, and as such it can be viewed as a step toward a through-the-cycle rating method.

Estimation of loss given default (LGD)

In connection with LGDs, initially a fixed 45% is assumed, then we will make calculations for LGDs as a function of PDs. There are several studies to prove that there is positive correlation between PDs and LGDs, which naturally has an impact on the capital requirements of banks as well, meaning that this relation has to be taken into consideration for these calculations.[8] Therefore, as an alternative scenario a simple relation between PDs and LGDs is assumed, which is still consistent with the results of empirical studies. In our analysis, in the environment of long-term average PDs the LGD is assumed to be 45%, however, the more significant fluctuations seen in the PDs are assumed to have an impact on the LGDs as well. The assumed relationship between PDs and LGDs is shown in the table below.

Accordingly, if the 5-year average PD is at least 25% greater (smaller) than the long-term 24-year average from between 1983 and 2006, according to our estimate the LGD changes from 45% to 50% (or 40%). If the 5-year average PD is at least 50% greater than the long-term average, we will apply an LGD value of 55%, or 35% if it remains that much behind.

Naturally, these assumptions are arbitrary, merely attempting to provide a more accurate understanding of the impact mechanisms and systemic consequences of Basel II. All of the banks using the more advanced IRB approaches will have their own estimates of PDs and LGDs, and the correlations calculated on their own portfolios could even be different, however, they are unlikely to deviate substantially on average from the assumptions made in this study, in line with those commonly supported by academic literature.

CYCLICALITY OF UNEXPECTED LOSSES (CAPITAL REQUIREMENTS)

The Moody's database is an adequate tool to define average default rates for each rating categories and to monitor changes in the default rates within the various categories during the economic cycles. According to the database, the average long-term PD of the Baa2 rating category is 0.107%, that is practically the same as the 0.1% average PD assigned to the portfolio of our model bank with a 'good' rating, therefore, in our analysis we presume that this portfolio will behave during the cycle as the portfolio rated Baa2 by Moody's. Similarly, the average long-term PD for Moody's Ba1 rating category is 0.636%, that corresponds with the

Table 2

Assumptions relating to LGDs

	PD5 < PD24 · 0,5	PD24 · 0,5 ≤ PD5 < PD24 · 0,75	PD24 · 0,75 ≤ PD5 ≤ PD24 · 1,25	PD24 · 1,25 < PD5 ≤ PD24 · 1,5	PD24 · 1,5 < PD5
LGD	35%	40%	45%	50%	55%

Note: 'PD5' means the 5-year average PD, while 'PD24' means the long-term (24-year) average PD.

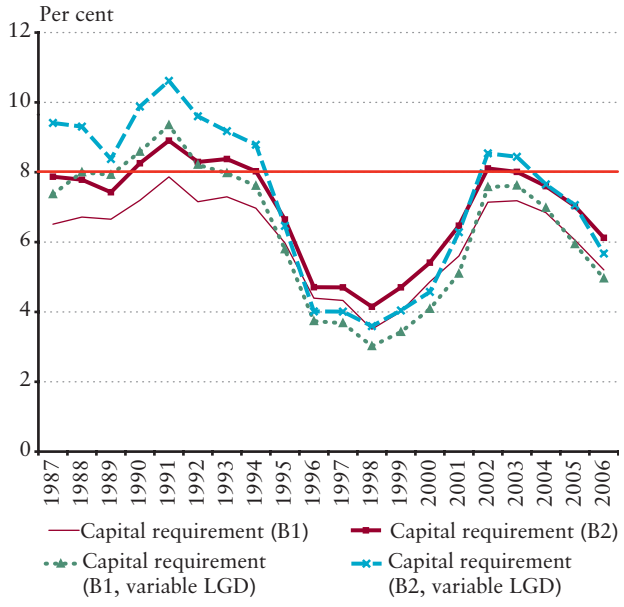
[8] For more details concerning the findings of the studies and a list of references, see Zsámboki (2007).

0.5% PD assigned to the portfolio of our model bank with 'average' rating. As for the portfolios rated 'poor' we apply two alternative assumptions: one is to make calculations for the B1 rating category, whose average PD is 3.132%, and for the B2 rating category with an average PD of 7.004%. The share of each rating category within the entire corporate portfolio is determined in accordance with QIS 5.

Chart 2 contains a summation of our calculations and shows the supposed trends in the capital requirements of banks covering expected losses during the period under review, if we were to calculate them according to the Basel II rules, and if we were to apply the positive correlation between PDs and LGDs. Apparently, there is considerable fluctuation in corporate capital requirements in spite of applying a 5-year average PD, that has a smoothing effect on the cycles in question. Moreover, relative to the fixed 45% LGD hypothesis, variations in LGD, depending on the PDs, have an additional cycle-strengthening impact on capital requirements. The chart below indicates the supposed course of capital requirements under B1 and B2 ratings for the 'poor' category.

Chart 2

Changes in corporate capital requirements



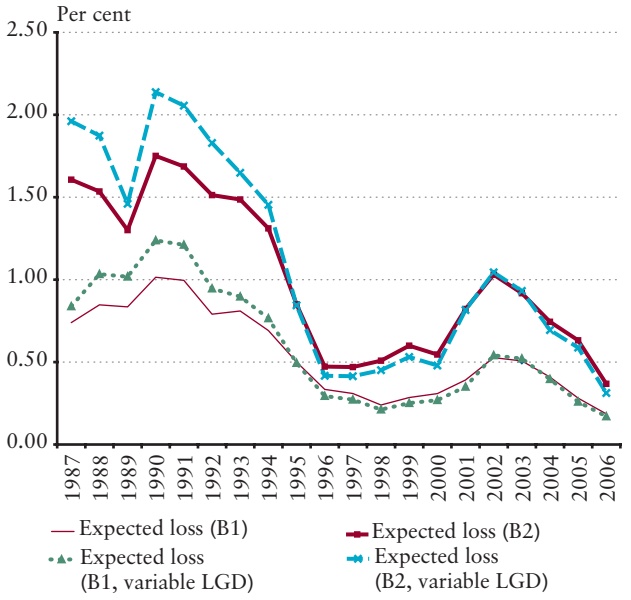
The results indicate that capital requirements remain, on the average, below the 8% prescribed in Basel I, and that they could be somewhat higher in times of recession, or drop to close to half in times of economic boom. It is also apparent that our alternative assumptions on the portfolios with 'poor' rating have only moderate effect on the level of capital requirements, and they do not influence the shape of the curve materially. Consequently, if we were to apply the changes in the average PDs, and the positive correlation between PDs and LGDs, capital requirements may vary considerably, even assuming a constant portfolio composition.

CYCLICALITY OF EXPECTED LOSSES

Leaving our PD and LGD assumptions unchanged, Moody's database can be used for the estimation of expected losses as well. Chart 3 demonstrates changes in expected losses during the period under review. Contrary to the results contained in the previous chapter, our alternative assumptions on the portfolios with 'poor' rating have a substantial impact on the size of expected losses; the difference between the need for making provisions could be twofold. Furthermore, it is also apparent that the amount of expected losses was significantly higher during the early 1990s, when the deterioration in portfolio quality mostly affected the portfolios with 'poor' rating, while deterioration in portfolio quality during the early part of 2000 surfaced in the 'average' and 'good' categories, which did not have a major impact on expected losses, but did have a considerable impact on capital requirements, as risk weight functions are more sensitive to any decline in the quality of exposures with higher ratings.

Chart 3

Changes in expected losses



The combined effect of expected and unexpected losses, i.e. provisioning and capital requirements is demonstrated through a simple example. If our model bank has a corporate exposure of EUR 100 million in 1998, which is considered as a year with a low default ratio, and the composition of portfolio in terms of rating and the correlation between risk parameters is consistent with our previous assumptions, our bank should have to set aside EUR 212,000 in provisions for

expected losses if the portfolio was rated B1, with EUR 3 million in capital requirements according to Basel II. Under the same conditions, in 2002, which was considered a recession year, the requirement for provisioning would have been EUR 541,000, with EUR 7.5 million in capital requirements. What all this indicates is that significant changes are expected to take place over a span of a few years in terms of capital requirements and provisioning, even if the portfolio composition remained unchanged.

IMPACT OF CHANGES IN PORTFOLIO COMPOSITION ON CAPITAL REQUIREMENTS

Up to this point, we have applied the same portfolio composition throughout the analysis. However, in times of recession ratings tend to drop, while they are more likely to improve when the economy is booming. This process is seen in the transition matrices calculated on the basis of Moody's database. Changes in the portfolio composition can be estimated based on these transition matrices. Although credit rating agencies prefer to classify their clients in a manner that bridges several economic cycles, it is apparent that changes in their rating tend to follow changes in the economy, i.e. they are procyclical. For the purposes of analysis a year of recession (2002) and a year when the economy was growing (2004) was selected to demonstrate the effects of migration in ratings. The original portfolio composition, calculated on the basis of QIS 5, and hypothetical changes in portfolio composition estimated based in the transition matrixes are shown in Table 3.

Relying on this new portfolio composition we can estimate changes in the capital requirements during the two years under review. The results of these calculations are shown in Chart 4.

Although, according to our calculations, the effects of migration in ratings is not overly significant as regards changes in capital requirements, monitoring these developments might prove important for some undercapitalised banks, as any unfavourable changes in portfolio composition increases their capital requirements, and consequently, it will take less time to deplete their capital reserve, which in turn will force them to face the imposition of regulatory minimum requirements.

Chart 4

Estimated effects of migration in ratings on changes in capital requirements

CONCLUSIONS

On the basis of Moody's corporate database we examined the hypothetical changes in the capital requirements of banks for the 1987-2006 period, with regard to movements of risk parameters (PD and LGD) within an economic cycle, under varying assumptions as to their correlation. According to our findings, the regulatory minimum requirements calculated by the advanced Basel II method could range within a broad spectrum during the cycle, and it could double within a few years, or may be cut in half, even if we use for the estimation of PDs a 5-year average. Furthermore, we wish to point out that the correlation between risk parameters has the potential to significantly enhance fluctuation in capital requirements. Consequently, it is of particular importance for banks to build up capital reserves above the regulatory minimum requirements when the economy is booming, in order to

Table 3

Estimated effects of migration in ratings on portfolio composition

Quality band	Share (QIS 5)	Estimated share (2002)	Estimated share (2004)
Good	38.5	34	43
Average	31.8	31	30
Poor	27.8	33	25
Defaulted	1.9	2	2
SUM	100	100	100

cover any future losses and any increase in capital requirements.

Another important issue, naturally, is how binding regulatory capital requirements are on banks, and how much institutions tend to rely on their own internal capital calculation models in the process of making business decisions (such as pricing, lending intensity, etc.). These models are typically set to estimate PDs for shorter periods, and they do not attempt to classify their clients in a manner that bridges economic cycles, hence movements in their internal capital requirement could be greater. Consequently, even if regulatory capital requirements are not effectively restrictive upon banks, changes in risk parameters in terms of time could still have an impact on their actions. Keeping a close eye on these factors should be essential for the authorities responsible for promoting financial stability, just as provisioning procedures. In the absence of proper provisioning practices the indicators on capital adequacy cannot be considered reliable, as in this case capital would serve to cover expected losses to some extent as well.

Both insufficient provisions and undercapitalisation could have an impact on the actions of banks and, under unfavourable economic circumstances, some banks in tight capital positions might be forced to cut back their lending activities. The ensuing short supply of loans then may result in further decline in economic growth, which in turn may enhance fluctuations in the real economy, and could compromise the stability of the financial system on the whole, particularly in times of recession. Through the pricing of bank funds, the market's disciplinary power may play an important role in forcing banks to take a more cautious approach and to follow prudent behaviour even in the case of appropriate capitalisation in times of economic boom. Under Pillar 2 of Basel II, i.e. the supervisory review procedure, supervisory authorities also have a responsibility of paying proper attention to the adequate capitalisation of banks, in response to the expected growth in fluctuations in capital requirements.

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November 2007

Print: D-Plus

H–1037 Budapest, Csillaghegyi út 19–21.