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.

The articles and studies appearing in this bulletin are published following the approval by the editorial board, the members of which are Gábor P. Kiss, Róbert Szegedi, Daniella Tóth and Lóránt Varga.

The views expressed are those of the authors and do not necessarily reflect the official view of the Magyar Nemzeti Bank.

Authors of the articles in this publication: Csaba Balogh, Dániel Holló, Gábor Kézdi, István Kónya, Péter Karádi

This publication was approved by Ágnes Csermely, Péter Tabák, András Kármán, Ákos Valentinyi.
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Summary

DEAR READER,

The Magyar Nemzeti Bank (MNB) is committed to making available to the general public central bank analyses dealing with various topical economic and financial trends of general interest. With three articles and the review of a workshop, this publication is the third issue of the fourth volume of the MNB Bulletin. Focusing on the topical issues of the Hungarian economy and central banking, the subjects discussed in the three articles of this issue of the Bulletin range from the role of two-week MNB bills in domestic financial markets, developments in the credit risk of retail mortgage loans and the wage-setting practices of Hungarian firms. Finally, the fourth article provides a review of the workshop which was organised by the MNB jointly with the London-based Centre of Economic Policy Research and held in Budapest on 3–4 September.

In his article Csaba Balogh demonstrates that – based on one of the major correlations in the central bank’s balance sheet – credit institutions are free to decide on the volume of two-week MNB bills they purchase at the individual level; however, they are unable to affect the volume of bills in the overall banking sector. Considering that the tripling in the volume of MNB bills held by credit institutions over the past year was primarily due to the foreign currency financing of the government, the large volume of MNB bills is the consequence of subdued demand in the government securities market rather than the reason for it, and hence the inevitable result of the foreign currency borrowing of the government. Since adjusting the interest rate does not prompt a central bank intervention in the foreign currency market under the current exchange rate regime and there is no other direct link between the base rate and the liquidity of the banking sector, there is no direct link between the substantial volume of bills and the relatively high key policy rate. At the same time, serving as banks’ liquidity reserves, the mounting volumes of two-week bills support a rebound in lending. Nevertheless, for the recovery of lending activity, the risk appetite of banks will have to improve as well.

Dániel Holló’s findings suggest that, in terms of the domestic retail mortgage portfolio, the denomination structure and type of loans (home equity or housing), the initial loan-to-value (LTV) ratio and the debtor’s level of education can be considered as the main customer-specific and product-specific drivers of default risk, while the unemployment rate, domestic and foreign interest rates as well as the exchange rate constitute the major macro-risk factors impacting defaults. The loss on the retail mortgage loan portfolio would increase considerably in a macro-risk scenario characterised by a 10 per cent decline in GDP and an exchange rate of EUR/HUF 340. Based on the direct effects alone, along the stress path the total loan loss of the banking sector would increase from the baseline level of HUF 118 billion to HUF 372 billion, which is approximately 6 per cent of the banking sector’s end-2008 retail mortgage loan portfolio.

Examining the findings of a survey of wage setting in Hungarian enterprises, Gábor Kézdi and István Kónya conclude that – despite a flexible institutional framework – the wage setting practices of Hungarian firms are relatively rigid. In terms of wage setting outcomes, Hungary shares much more similarities with Western European countries than with countries in the Central and Eastern European region. The wage setting practices of Hungarian firms are generally not restricted by external constraints, although the minimum wage represents an important exception. Despite this fact, wages appear rigid, particularly as it relates to base wages. Wages are adjusted in a time-dependent manner, maximum once a year on average. Wages are insensitive to temporary shocks; firms are accommodating these shocks by cutting other costs, and to a lesser degree, by changing prices, margins and output. Flexible wage components are not used to absorb external shocks; rather they seem to be used for internal motivation.

Péter Karádi’s review of the workshop entitled ‘DSGE Models: A Closer Look at the Workhorse of Macroeconomics’ points out that the unexpected magnitude of the financial and economic crises stirred a debate within and outside the economic profession about the adaptability of current business cycle models. The main conclusion of the workshop was that even though current versions of the business cycle models are useful in “normal” times, the ongoing crisis requires rethinking of the standard ingredients and policy conclusions of these models. It was revealed at the workshop that the reconsideration process had begun already, the main elements of which may include the incorporation of the financial sector and incomplete credit markets into models and a potential revision of the standard assumption of rational expectations. The workshop also provided an opportunity for researchers and central bankers to discuss their latest results on topics such as price stickiness, optimal policy questions, issues related to open market economies and the estimation of models.

The Editorial Board
Csaba Balogh: The role of MNB bills in domestic financial markets. What is the connection between the large volume of MNB bills, bank lending and demand in the government securities markets?

The two-week MNB bill is a central component of Hungary’s monetary policy instruments; it is a key instrument of the central bank, the interest rate of which is identical to the central bank base rate. By mid-2009, the outstanding amount of MNB bills reached HUF 3,000 billion, which – in addition to representing one third of the central bank’s liabilities – accounts for a significant part of the domestic banking sector’s liquid assets. By using the two-week bill to absorb the excess liquidity of the banking sector, the central bank ensures that developments in banks’ interest rates will be driven by the MNB bill as an opportunity cost. The volume of these liquid assets builds up gradually, regardless of banks’ willingness to lend. Indeed, the growth observed in the holdings of MNB bills helped to relieve the liquidity tensions of credit institutions and contributed to gradually reducing the role of this factor in the decline in lending activity in 2009. Nonetheless, lending remained restrained despite the ample liquidity, which primarily reflects banks’ deteriorating risk appetite. One of the major correlations in the central bank’s balance sheet is the fact that, while credit institutions are free to decide on the volume of two-week MNB bills they purchase at the individual level, they are unable to affect the volume of bills in the overall banking sector. The accelerated growth rate in the volume of two-week bills observed in the previous year resulted from the use of foreign currency loans to finance the general government, which implies that the large volume of two-week bills is a consequence of poor demand in the government securities market, rather than the reason for this. In a regional comparison, however, the relatively high central bank base rate does not affect the volume of the key instrument, as the central bank interest rate has no direct impact on the liquidity of the banking sector.

INTRODUCTION

The key policy rate of the Magyar Nemzeti Bank (the central bank base rate) is the interest rate remunerated on the two-week MNB bills purchased by credit institutions. Consequently, the two-week bill is a key instrument in the monetary policy of Hungary. Using the two-week bills, credit institutions deposit liquidity with the MNB (which, in fact, translates into funds deposited into central bank accounts, i.e. central bank money). The key instrument therefore constitutes the central bank’s liabilities to credit institutions, which means that the banking sector has excess liquidity. While excess liquidity has consistently characterised Hungary since 1995, this phenomenon is not specific to Hungary. It has been observed in other Central European economies following the political transition and is a frequent phenomenon in other emerging countries as well. It was typically generated by various forms of external capital inflows, while the selected exchange rate system had a fundamental impact as well.

Since the introduction of this instrument in 2007 the amount of two-week bills has tripled, rising to more HUF 3,000 billion by August 2009. This accounts for more than one third of the total liabilities of the central bank and at the same time represents a large portion – around one-tenth – of the banking sector’s total assets. The positive inflow observed in the past year resulted primarily from the foreign currency financing of the government deficit, and conversion of the related foreign currency funds into forints at the MNB. In respect of these rapid flows, questions came to the forefront about the possible consequences of this process. In this regard, several analyses have been published on how the MNB bills may crowd out government securities from the market, and how the large volume of bills may lead to a decline in banks’ lending activity through their favourable interest rates.

On the other hand, several foreign central banks have started the process of quantitative easing, also resulting in expanding balance sheets at these central banks. Nonetheless, it is important to stress that the growth in the volume of MNB
bills observed in the previous period did not result from classical quantitative easing, i.e. active market intervention by the MNB, but instead primarily stemmed from factors beyond the central bank’s influence.

In this paper, we first present the role of the MNB bill in the central bank’s monetary policy, followed by an overview of factors determining developments in the volume of the bills. Then we provide a detailed analysis of three issues related to the volume of bills. First, whether the central bank base rate affects the volume of these bills; second, whether the large amount of bills influences demand for government securities; and third, their effect on bank lending.

**THE ROLE OF MNB BILLS IN MONETARY POLICY**

In 2001 the MNB decided to abandon its exchange rate target (crawling peg exchange rate regime) and adopt an inflation targeting monetary system. In small, open economies this means that monetary policy makers (in our case the Monetary Council) set the key policy rate relying on inflation and real economy forecasts as well as money market and financial stability analyses. In the next step, through monetary policy instruments, the central bank ensures that financial market yields and expectations about those yields adjust to the key policy rate. Through changes in the forint exchange rate on the one hand, and Hungarian interest rate levels on the other hand, shifts in market yields modify the behaviour of market participants and change economic prospects; thus, by updating central bank forecasts and analyses, the Monetary Council has the opportunity at its next session to base its decision on new information.

The monetary policy instruments of the central bank are defined as the sum of the forint denominated money market and capital market operations performed by the MNB. The most important element of forint market instruments is the main policy instrument, i.e. the two-week MNB bill, the interest rate of which controls forint market yields. The credit institution counterparts of the MNB (hereinafter simply banks) can decide how many bills they wish to buy at the weekly auctions, i.e. how much of their holdings with the MNB they wish to hold in two-week bills. All bids submitted by the banks are accepted by the MNB without restriction. Moreover, in order to provide banks with sufficient central bank money to fulfil their payment obligations, the central bank traditionally supports banks’ liquidity management through two additional instruments: the reserve requirement, which is subject to a monthly averaging mechanism, and the interest rate corridor. In order to fulfil their payment obligations resulting from larger interbank and client transactions, individual banks’ demand for central bank money may increase significantly on certain days. Banks can satisfy their liquidity needs primarily on the interbank market, but to prevent individual banks’ temporary liquidity surplus or liquidity shortage from generating drastic fluctuations in interbank yields, in line with the general practice of central banks, the MNB has adopted the two instruments described above.

The provisions of the reserve requirement ensure that banks maintain a minimum account balance with the MNB at all times. Indeed, banks may fulfil their reserve requirement by depositing the required funds calculated as a monthly average into their “current account” (settlement account) at the central bank. This allows them to adjust their day-to-day account balances flexibly during the specific month, dampening the effect of potential liquidity shocks. In addition, up to the amount of their reserve requirement, the central bank pays the banks the central bank base rate; therefore, they do not suffer an interest loss. On the other hand, as the portion of the account balance in excess of the reserve amount does not bear interest, on a monthly average the account balances banks held with the MNB are practically always limited to the currently required reserves.

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1 The MNB has used deposit-type policy instruments since 1995. Initially, this was a reverse repo operation, which was replaced by the one-month deposit in 1997, and the two-week deposit in 1999. In 2007, the two-week deposit was replaced by the two-week MNB bill. For more details, please see Balogh–Varga (2006) and MNB (2002, 2006).

2 With a view to assisting banks in their liquidity management, from the autumn of 2008 the MNB introduced several additional instruments, including the overnight FX swap facility.

3 By contrast, before Hungary’s accession to the EU in 2004 the interest rate paid by the MNB was lower than the market yields, and therefore the minimum reserve system featured an implicit tax burden at the time.
The other instrument is the interest rate corridor defined by interest rates on overnight central bank loan and deposit instruments, which are set close to the key policy rate. The width of the interest rate corridor currently maintained by the MNB around the key policy rate is ±0.5 percentage points. Accordingly, if the base rate is 8%, banks can obtain overnight loans at an interest rate of 8.5% and receive interest of 7.5% on their overnight deposits. The interest rate corridor moderates the volatility of interbank interest rates by setting a lower and an upper limit, over which banks will not be willing to carry out interbank transactions. If the conditions are worse than that, it will be more advantageous for banks to use the central bank deposit or loan facility. Under normal market circumstances, banks’ recourse to overnight instruments is restricted to a minimum as they typically manage their liquidity through transactions conducted in the interbank market.\

On the whole, under normal market circumstances, central bank instruments facilitate the implementation of monetary policy by keeping interbank interest rates close to the interest rate on the two-week MNB bill, while the fluctuation in the latter is mitigated by the minimum reserve requirement and the interest rate corridor. Interbank interest rates, on their part, determine the opportunity cost of banks’ funds, on the basis of which banks price their deposit and loan products. Therefore, it is the key policy rate and expectations about the key policy rate that eventually determine the relevant deposit and loan interest rates for actors of the economy.

Although, based on the above, the MNB considers the interest rate on the two-week bill to be of key importance, the total volume of outstanding MNB bills does not play a prominent role in monetary policy. On the one hand, the volume has no direct effect on economic developments, and on the other hand, it is typically influenced by factors over which the MNB has no control. Using the simplified balance sheet of the MNB is the easiest way to demonstrate the contribution of the factors influencing the volume of bills.

The MNB bill is one of the most significant items on the liability side of the central bank’s balance sheet. Other than currency in circulation (the only interest-free liability of the central bank) and government deposits, no other item matches the two-week bill in terms of magnitude. By contrast, foreign currency reserves constitute the most dominant item on the asset side, as the central bank buys forint-denominated securities and provides forint-denominated loans in exceptional cases only. To put it simply: the MNB holds its liabilities arising from currency in circulation, deposits of banks and the government in foreign currency reserves.

Only in exceptional cases does the MNB influence the foreign currency reserves on the asset side. Essentially, this item is

<table>
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<tr>
<th>Table 1 Monthly average statistical balance sheet of the MNB, July 2008–July 2009 (HUF billions)</th>
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<tbody>
<tr>
<td><strong>Assets</strong></td>
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<tr>
<td><strong>July 2008</strong></td>
</tr>
<tr>
<td>External assets (FX reserves)</td>
</tr>
<tr>
<td>Loans of credit institutions</td>
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<tr>
<td>Hungarian Government Securities</td>
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<tr>
<td>Remaining assets</td>
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<td><strong>Total assets</strong></td>
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</table>

In this context the past year was an exceptional period; the lack of overall market confidence forced banks to rely much less on interbank markets. Despite a loss of 50 basis points, wary banks resorted to the use of the overnight deposit facility of the MNB far more intensely than in previous periods.
increased by the foreign currency revenues (e.g. EU assistance or foreign currency borrowings) and decreased by the foreign currency expenses of the government. There are two exceptions: in the first case, the central bank intervenes in the foreign exchange market; in other words, it buys or sells foreign currency with a view to influencing the market exchange rate of the forint. The central bank resorts to this instrument in extraordinary cases only (such as the speculative pressure that accompanied the strengthening of the forint in early 2003). The second case, when the central bank becomes indebted in foreign currency, is very rare also (e.g. central bank borrowing from an international organisation).

On the liability side, the MNB has practically no influence on changes in the amount of currency in circulation: economic actors are free to decide how much cash they wish to hold. Similarly, it has no direct control over the size of government deposits, or whether the government finances these deposits from forint or foreign currency funds.

Liabilities vis-à-vis banks constitute the last large item in the MNB’s balance sheet, including banks’ holdings of two-week bills, which are defined on the basis of the residual principle. Namely, if any other balance sheet item is subject to changes affecting the banks’ central bank accounts, without the central bank’s active intervention they will adapt to the change by adjusting their two-week bill portfolio. Banks could also adapt through their account balances or through the overnight instruments constituting the interest rate corridor, but the associated terms and conditions would be more unfavourable (the MNB does not pay any interest on excess reserves; moreover, the interest banks receive on overnight deposits is 0.5% lower than the interest rate on the two week bill). As such, in the case of MNB bills the MNB is not a classical security issuer in the sense that refinancing risk is a meaningless concept for the central bank. The volume of two-week bills is increased by the liquidity growth in the banking system, and decreased by a decline in liquidity. Although liquidity managers at individual banks might decide to absorb their liquidity surplus in interbank transactions, the partner bank may face excess liquidity as well. Consequently, at the level of the banking sector, excess liquidity will invariably flow into two-week bills eventually. In other words, while banks may make adjustments to their two-week bill portfolio at the individual level, they are unable to change the overall volume of these bills through their interbank transactions: they merely redistribute liquidity across the banking sector. This sharply sets apart the correlations that apply to the individual balance sheets of banks and the balance sheet of the central bank.

The specific examples below highlight factors which may lead to an increase in the volume of the MNB bills as a result of changing the structure of the central bank’s balance sheet:

- an item on the **asset side** of the central bank’s balance sheet increases:
  - foreign currency reserves increase as the central bank buys foreign currency in the market
  - central bank loans extended to banks increase
  - the central bank’s portfolio of government securities increases (the central bank buys government securities in the market)

- or an item on the **liability side** of the central bank’s balance sheet decreases:
  - a decrease in the account balance of the government’s account leads to an increase in the account balance of the banking system, generating a positive flow into two-week bills.
  - the account balance of banks decreases. For example, the minimum reserve ratio is lowered and as a result, the account balance banks are required to maintain with the central bank decreases. At the level of the banking sector, banks are forced to deposit the released funds into two-week bills, as all other options would imply substantial losses in interest.
  - the volume of currency in circulation decreases. Cash demand is essentially based on household habits, and as such, it fluctuates seasonally. Before Christmas, for example, the cash demand of economic participants surges, then as the holidays are over, banks record a cash inflow once again. As a first step, banks can obtain cash from their central bank account, and subsequently the MNB credits the same account with the cash returned. Since banks’ account balances are determined by the

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1. On the other hand, if the MNB decided to restrict the quantity of two-week bills, ceteris paribus, the banking sector would have to use another instrument to absorb the growing liquidity, meaning that market yields would no longer be defined by the two-week bill. In this case, overnight deposits would be an alternative option for banks, thus the interest rate on O/N deposits would become the de-facto policy rate. In other words, restricting the quantity of two-week bills would be the equivalent of an immediate interest rate cut.

2. Most government payments are as such. For instance, the government typically transfers the amount of public salaries (or pensions) to retail accounts with commercial banks. In the payment system, this process implies a transfer from the Treasury account to the banks’ accounts with the central bank, and simultaneously, the banks credit the accounts of their customers’ with the amount deposited to their central bank account.
reserves, changes in the cash stock will eventually be reflected by the two-week bill portfolio. Therefore a sustained decline in cash demand will lead to an increase in the volume of MNB bills.

On the whole therefore, if the central bank acts passively (both in the foreign exchange and the forint market), the central bank balance sheet will constitute a closed unit; in other words, changes in items on the asset or liability side will be eventually reflected by two-week bill flows.¹

Until the autumn of 2008 the central bank assumed a passive stance: it practically refrained from purchasing government securities and did not offer any substantial loans to banks. Flows in the two-week bill holdings during that period almost exclusively reflected developments in the account balance of the government’s account.

From the autumn of 2008, however, in an attempt to relieve mounting liquidity tensions in the banking sector, the MNB proceeded to intervene actively, which generated new items on the asset side (government securities purchases, bank lending), moreover, the reserve ratio was lowered as well. The impact of these transactions, nevertheless, was still negligible compared to the effects of government transactions; even in this period, therefore, changes in the volume of two-week bills continued to be driven by the latter. The increase in foreign currency reserves was initially caused by the growing volume of government deposits (disbursement of the IMF and EU credit facility), but government spending eventually generated growth in banks’ account balances, which in turn triggered a record surge in holdings of two-week bills. This process is clearly reflected by the fact that, compared to early 2008, the increase in foreign currency reserves was gradually approached by the growth in the holdings of two week bills.

THE BASE RATE AND THE VOLUME OF TWO-WEEK MNB BILLS

The interest rate on the two-week bill is the depository of the excess liquidity banks face, but do not need to comply with the minimum reserve requirement. Consequently, the base rate will be the key rate for all their transactions with the same maturity, which means that domestic economic actors (households and companies) as well as non-resident investors in the forint markets will have an opportunity to deposit funds with or receive loans from domestic banks at an interest rate close to the base rate. At the same time – along with expectations about the future path of the central bank base rate – longer-term yields are fundamentally influenced by the risk appetite of market participants and their inflation expectations.

In the current monetary policy system, a potential interest rate adjustment by the central bank will not change any item in the central bank’s balance sheet in itself; therefore it will not change the volume of the MNB bills either. This has not always been the case. In the narrow-band, crawling peg exchange rate regime, raising the base rate could increase the volume of the key policy instrument. All other factors being equal (e.g. country risk), a higher interest rate level encourages the forint investments of non-residents, driving up the forint exchange rate relative to other currencies. In the narrow-band exchange rate regime, the exchange rate hit the strong edge of the band fairly soon (indeed, it practically always stayed around the strong edge), at which point the MNB was forced to intervene (through foreign currency purchases) in order to prevent a further appreciation of the exchange rate. This increased foreign currency reserves and generated a forint liquidity surplus, resulting in a flow into the key policy instrument (which was the one-month, and later the two-week deposit at the time), driving up its volume.

The exchange rate regime maintained in the period of 2001-2008 was also fixed, albeit at a wider band (±15%), and thus

¹Transactions between the state and the MNB may represent an exception. In the case of government borrowings denominated in a foreign currency, the increase in the foreign currency reserves overlaps with an increase in the government’s foreign currency deposit account with the central bank. However, it is typical of public finances that the government raises funds only to the extent needed to cover its expenses; in other words, the government’s deposits with the central bank will be subject to a temporary increase only. As the government gradually depletes these funds, the declining balance of the government’s account will generate a parallel increase in the volume of the two-week bills, as shown above.
therefore in addition to KESZ, the central bank manages a foreign currency account for the government for FX transactions, rather than using the interbank FX market, the central bank, executes high volume foreign currency transactions,锦

changes to the base rate and the volume of two-week MNB bills. The MNB has no intervention obligation in the free-floating exchange rate system adopted in early 2008, and thus non-resident capital inflows or outflows can no longer influence the level of foreign currency reserves, which means that they have no impact on the level of excess liquidity or the volume of MNB bills. Consequently, with the credit rating being equal, an interest rate increase by the central bank can freely exert its strengthening effect on the forint exchange rate without influencing the central bank’s balance sheet or increasing the volume of the two-week bills.

THE LARGE VOLUME OF MNB BILLS DOES NOT REDUCE THE DEMAND FOR GOVERNMENT SECURITIES

Based on the above, in terms of the liquidity of the banking sector, the government’s accounts with the central bank deserve special attention. The Hungarian State Treasury makes payments for the forint expenses of public organisations from the Single Treasury Account (KESZ), and credits their revenues to the same account. The Government Debt Management Agency (ÁKK Zrt.) is responsible for liquidity management, in other words, it has to ensure that the account has a sufficient balance to make the required payments. ÁKK raises the funds required for the financing of public expenses from forint or foreign currency sources; therefore in addition to KESZ, the central bank manages a foreign currency account for the government for FX transactions, and provides a conversion opportunity between the two accounts.

Changes in the balance of KESZ significantly affect the liquidity position of banks. If payment of government expenses depletes the KESZ balance, the liquidity of the banking sector increases, which in turn will raise the volume of two-week bills. On the other hand, tax payments increase the KESZ balance, which reduces the liquidity (two-week bill portfolio) of banks, while the level of KESZ increases.

If the central budget was in equilibrium constantly during the year, i.e. revenues equaled expenses, the KESZ balance would also remain constant and Treasury transactions would have no effect on the overall liquidity of the banking system. However, revenues and expenses cannot be in balance in any case on account of different patterns within the year and within the months; in addition, the financial year is typically characterised by a deficit. Thus the ÁKK is responsible for financing the temporary and permanent deficits, and it depends on the method of financing as to how this impacts the banking sector’s liquidity.

If the ÁKK covers the deficit from the issuance of forint-denominated government securities (i.e. the new issuance exceeds the volume of maturing government papers), the liquidity of the banking sector will remain unchanged. Even though the issuance of government securities would reduce the liquidity of the banking sector, this would be offset by the budgetary expenditure. Obviously, the liquidity position of the banking sector may fluctuate depending on intra year patterns, but its yearly average would not change.

On the other hand, if the government finances the deficit from the issuance of foreign currency bonds, foreign currency borrowings or any other foreign currency source (e.g. EU funds), the liquidity of the banking sector will increase. Indeed, in order to ensure that only one state agent, notably the central bank, executes high volume foreign currency transactions, rather than using the interbank FX market, the government converts all of its foreign exchange revenues into forint at the central bank. At this point, however, the MNB becomes an active party in the transaction, which changes the structure of the central bank’s balance sheet. Initially, the foreign currency reserves of the MNB and the KESZ account balance will increase, but eventually the government expenditure will result in the expansion of the banking sector’s liquidity. In summary, if the government finances the
deficit through foreign currency borrowing, the two-week bill portfolio of banks will increase.

Most of the past year saw this very process. As investors’ risk appetite diminished, the path of Hungarian government debt took a downturn, and the liquidity of the domestic secondary market of government paper deteriorated as well, as investors’ demand for government paper declined. In consideration of the dwindling demand for government paper, the ÁKK reduced its forint issuances, and relied increasingly on international borrowings. While the conversion of foreign currency loans into forint at the MNB increased foreign currency reserves, the forint payments made by the Treasury (classic expenses, payment of maturing and repurchased forint-denominated government securities) increased forint liquidity, which eventually resulted in an inflated volume of MNB bills.

Therefore, it was not the large volume of two-week bills that caused a decline in the demand for forint-denominated government paper; instead, the declining demand in the market of government paper – which was caused by other factors – led to an increase in foreign currency financing, which inevitably generated a surge in MNB bills.

**RATHER THAN BEING AN OBSTACLE, THE LARGE VOLUME OF MNB BILLS SUPPORTS, ALBEIT DOES NOT GUARANTEE AN UPSWING IN BANK LENDING**

If lending picks up, banks’ balance sheets will expand as money disbursed in the form of loans will be re-channelled into the banking system as a deposit, which is then used to finance further loans.\(^4\) On the other hand, a rebound in lending may generate a demand for liquidity at the level of individual banks, because the borrowing company or household may make payments to an account with another bank (e.g. is involved in an investment project, or purchases a home or consumer goods that require a bank transfer). The account manager bank must ensure that its central bank accounts have sufficient funds to make this payment: in other words, its demand for liquidity will be this much higher. Under normal market conditions, this bank should stand a good chance of obtaining this liquidity either in the interbank market or directly from the bank that will end up with the extra liquidity as a result of the payment, or it may even get access to liquidity indirectly, through another bank.

In addition, the lending bank may obtain the necessary liquidity from other banks through other means of financing (e.g. deposit redemption). Since the lending involved in these transactions does not concern the MNB in any way, it has no effect on either the central bank’s balance sheet, or the liquidity surplus, or the volume of the MNB bills. Only in case of market turbulences may the MNB play a role. In such cases, the bank with a liquidity demand has several options as to how to obtain the required central bank money. On the one hand, it may quote less MNB bills than its maturing stock, thereby reducing its MNB bill portfolio. However, the bank on the receiving end of the transfer will face excess liquidity and will therefore increase its two-week bill portfolio by the same amount. Consequently, the volume of bills in the overall banking sector will not decline. Ultimately, the specific bank may also borrow money from the central bank (against sufficient security collateral, i.e. government paper, MNB bills, etc.), but this would typically imply worse conditions than those prevailing in the market. Again, in this case lending would not decrease, but rather increase the volume of two-week bills in the banking sector. Indeed, while the lender bank will not reduce its bill portfolio, the excess liquidity generated by the customer’s transfer will wind up at another bank in the banking sector in any case, and that bank will hold those funds in two-week bills.

Therefore, a large portfolio of MNB bills means that the holder has liquidity reserves: on the one hand, it is a short-maturity (two-week) liquid asset; on the other hand, it is accepted at any time by the central bank as collateral for loans (overnight, collateralised loans). Consequently, a large bill portfolio reduces the liquidity risk associated with lending.

Although banks’ restricted liquidity in the second half of 2008 significantly contributed to the downturn in lending, on its own, the improvement in liquidity conditions in the first quarter of 2009 could have increased banks’ lending activity already. Banks’ holdings of two-week bills strongly supported the improvement in liquidity conditions. Nevertheless, the declining risk appetite of banks (they were unwilling to take worsening credit risks) and the deteriorating economic prospects led to a sustained decline in lending. Due to sector-specific problems, the deterioration further intensified for corporate lending, while in the case of households the worsening prospects of the housing market contributed to a sustained downturn in lending.

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\(^4\) Only a small fraction of the deposit growth deriving from lending winds up with the MNB – currently only 2%, i.e. the specific portion of the minimum reserves – and even that portion is deposited to the central bank accounts of banks rather than held in MNB bills. Therefore, the banking sector’s demand for central bank money to support its lending is limited to this small amount.
On the whole, the growing volume of MNB bills gradually improved banks’ liquidity position and supported their lending activity; however, driven by other, more powerful factors, they were forced to restrain their lending supply.

Chart 4
Factors contributing to changes in credit standards and terms of mortgage loans

Source: MNB lending survey, August 2009.

CONCLUSIONS

Based on the correlations between the balance sheet items of the central bank, we demonstrated that it was primarily the foreign currency financing of the government that accounted for the tripling in the volume of MNB bills over the past year. The large volume of the key policy instrument is therefore the consequence of subdued demand in the government securities market rather than the reason for it, and hence the inevitable foreign currency borrowing of the government.

We do not see a direct link between the substantial volume of bills and the relatively high key policy rate, because a change in the overall volume of MNB bills can only be triggered by a change in another central bank balance sheet item. Adjusting the interest rate, however, does not prompt a central bank intervention in the foreign currency market under the current exchange rate regime, and there is no other direct link between the base rate and the liquidity of the banking sector. At the same time, serving as banks’ liquidity reserves, the mounting volumes of two-week bills support a rebound in lending. Nevertheless, for the recovery of lending activity, the risk appetite of banks will have to improve as well.

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KOMÁROMI, ANRÁS (2008): A monetáris aggregátumok szerepe a monetáris politikában (The role of monetary aggregates in the monetary policy), MNB Occasional Papers No. 71.
Continuous monitoring and measurement of credit risk in mortgage portfolios is of particular importance, as demonstrated by the financial crises that began in August 2007. The underpricing of risk and the spread of complex financial instruments have contributed significantly to financial strains and tightening credit conditions, which are now exacerbating the world-wide recession.

As in many countries, mortgage loans play a dominant role in retail lending in Hungary. At the end of 2008, 31 per cent of banks’ interest income was related to these products, and these loans accounted for approximately two thirds of the total household loan portfolio (HUF 5,800 billion, of which HUF 4,300 billion was foreign currency-denominated debt at end-2008).

Although there have been no signs of substantial deterioration in the creditworthiness of Hungarian mortgage borrowers on the scale of the developments in the USA so far, a continuous increase in the default risk of these loans has been seen. The default probability (the probability of falling into payment arrears in the coming year) of retail mortgage loans advanced to 3.8 per cent in 2008, from 2.4 per cent in 2005.¹

Although mortgage-type loans usually bear moderate default and recovery risks for financial institutions compared to other retail products, the build-up of real estate market concentration may make the banking sector sensitive to housing price fluctuations. In addition, due to FX lending, a substantial, permanent exchange rate depreciation may add not only to default risk, but – through the change in the forint value of outstanding debts- also to recovery risk. This, in turn, might jeopardise the financial stance of credit institutions, ultimately affecting the stability of the Hungarian economy. Therefore, it is very important to develop a stress testing framework for analysing the mortgage portfolio’s risk sensitivity to adverse macro shocks.

In this study, using three commercial banks’ retail mortgage loan portfolios (monthly data from January 2003 to June 2008 on 200,000 debtors with housing and home equity loans), the risk characteristics of these loans is analysed. We then describe the methodology developed for investigating the portfolio’s macro shock sensitivity (stress testing framework). Finally, in an illustrative manner, we present the use of these models for stress testing purposes in an extreme macro-risk scenario (10 per cent decline in GDP; exchange rate of EUR/HUF 340, in line with the stress path of the April 2009 Report on Financial Stability).

RISK CHARACTERISTICS OF THE RETAIL MORTGAGE LOAN PORTFOLIO

Mortgage portfolio quality is fundamentally determined by two interdependent factors: the share of loans granted in different years within the outstanding loan stock (vintage effect), and the ‘ageing’ of the portfolio.

Taking into account the ‘ageing’ effect in determining the portfolio’s riskiness is important, as empirical evidence indicates that the closer the loan is to the date of expiry, the

¹ Values computed on the basis of the retail banking database.
lower the default risk is. International empirical evidence suggests that defaults mostly occur within four years after loan origination (see, for example, Gross and Souleles, 2001), but then the ratio of problem loans decreases progressively as a function of loan age.

In addition to the ‘ageing’ effect, the other factor that determines portfolio quality is the ‘vintage effect’. The ‘vintage effect’ captures the impact of the time period (year) of loan origination on portfolio quality. Due to the different macroeconomic and market circumstances, the life cycle of loans may differ depending on the year they were granted. For instance, if banks grant credit with eased conditions in a certain year (i.e. higher starting LTV ratios, longer maturity, etc.) then due to easing liquidity constraints borrowers with a tight financial stance may gain access to the credit market. As a result, financial institutions can grant more credit, but banks can also expect that as a proportion more clients may encounter payment problems compared to years in which lending standards were tighter. This can have a significant influence on the portfolio’s riskiness, especially if a large share of the portfolio is comprised of ‘cohorts’ with an unfavourable risk profile.

Between 2004 and 2007, the lending standards of retail mortgage loans eased considerably (the average initial LTV and maturity of housing loans increased by 30 per cent during this period), resulting in 29 per cent nominal growth in the average loan amount and a 12 per cent increase in the initial loan instalment (Table 1).

### Table 1

<table>
<thead>
<tr>
<th>Changes in lending standards between 2004 and 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Average housing loan amount taken (CHF-based)</td>
</tr>
<tr>
<td>Average starting maturity of housing loans (Year)</td>
</tr>
<tr>
<td>Average yearly APR of CHF-based housing loans</td>
</tr>
<tr>
<td>Starting loan installment of an average CHF-based housing loan</td>
</tr>
</tbody>
</table>

Note: The table shows Swiss franc loans, as this was the key currency in the period under review. Initial loan instalments were quantified using the credit conditions presented in the table (amount of loan, maturity, APR), assuming annuity type constructions.

The easing of lending standards resulted in a ‘dilution’ of the portfolio, as shown by the differences in mortgage vintage curves between 2004 and 2007 depicted in Chart 1. The chart demonstrates the less favourable life cycle (risk profile) of credits which were originated later. For example, while approximately 1 per cent of mortgage loans granted in 2004 became non-performing one year after origination, for loans granted in 2007 this ratio was already close to 7 per cent.

### Chart 1

**Vintage curves of mortgage loans granted between 2004 and 2007**

The cumulative default rate (per cent)

- **Granted 2004**
- **Granted 2005**
- **Granted 2006**
- **Granted 2007**

Note: As the number of loans granted before 2004 is relatively small in the sample, the vintage curve for 2004 contains loans granted in and before 2004. The chart does not show the vintage curve of loans granted in 2008, as observations for 2008 as a whole were not available.

---

1. However, if the banking behaviour is prudent (i.e. pricing of credit risk and reserve accumulation is adequate) this lending policy does not necessarily threaten the capital position of banks. Higher credit risk is validated in the loan price, which on the one hand increases default risk, on the other hand banks can realise significant “loss-compensated” revenues on clients who are willing to and are able to pay the higher cost of credit.

2. We define those borrowers to be in default who are past due more than 90 days on any credit obligation, or those that can be considered highly unlikely to be able to pay their credit obligations (BCBS, 2006). In the database, on the basis of the aforementioned definition, the three banks identified the defaulting debtors with the help of a binary variable (0, 1). We denote the ratio of the number of vintage k loans experiencing a default at age s over the number of vintage k loans with no default for age<s by $P_s$. We compute the cumulative default rate (CDR) for vintage k at age t as the fraction of loans experiencing a default at or before age t:

$$CDR_k(t) = 1 - \prod_{s=1}^{t} (1 - P_s)$$
It is important to note that changes in lending standards and macroeconomic developments are not independent of one another. On the one hand, looser lending standards may result in a ‘dilution’ of the portfolio, which may appear in the growing number of defaults and increasing portfolio sensitivity to macroeconomic shocks. On the other hand, the growth surplus caused by the additional lending may improve the macro fundamentals over the short run, and might reduce the ‘default increase’ due to macroeconomic shocks. However, over the long run, the build-up of a riskier portfolio and a standstill in economic growth may result in significant losses.

STRESS TESTING FRAMEWORK FOR THE RETAIL MORTGAGE LOAN PORTFOLIO

In this section, we outline the methodology developed for investigating the retail mortgage loan portfolio’s sensitivity to macro shocks. The models and assumptions are presented, through which macroeconomic factors can be linked to the risk parameters influencing the developments in banks’ losses: the probability of default (PD), loss given default and exposure.

Probability of default

In order to explore the extent and direction of the relations between the developments in defaults and the factors influencing solvency, regression analysis is performed. The applied method (survival analysis) allows us to simultaneously consider the vintage and portfolio ageing effects, customer-specific and product-specific factors as well as market and macro-risk factors on defaults.

In estimating the PD model, the first step is to define the default event. The definition of defaulted loans is similar to that established in Basel II. Namely, obligors that are past due more than 90 days on any credit obligation, or those that can be considered highly unlikely to be able to pay their credit obligations are considered to be in default (BCBS, 2006). The next step is to obtain the determinants of default from a large group of possible covariates. The scope of explanatory variables, in turn, was selected on the basis of their explanatory power. Accordingly, the denomination structure of loans (FX/HUF), the type of loan (housing/home equity), the initial loan-to-value (LTV) ratio, the borrower’s level of education, the unemployment rate, the 3-month Bubor and Euribor rates as well as the percentage deviation between the CHF/HUF exchange rate level at which the individual loan was granted from the actual CHF/HUF exchange rates proved to be the variables with significant explanatory power. The general form of the model is as follows:

\[ DR = f(LD, LT, LTV, E, U, EXCHR, IR), \]

where DR is the default risk, LD is the loan denomination, LT is the type of loan, LTV is the initial loan-to-value ratio, E denotes the borrower’s educational level, U is the

<table>
<thead>
<tr>
<th>Loan denomination</th>
<th>Marginal effect of the variable on default risk (decrease ↓, increase ↑)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>↓</td>
</tr>
<tr>
<td>Foreign</td>
<td>↑</td>
</tr>
<tr>
<td>Loan type</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>↓</td>
</tr>
<tr>
<td>Home equity</td>
<td>↑</td>
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<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>↑</td>
</tr>
<tr>
<td>Higher</td>
<td>↓</td>
</tr>
<tr>
<td>LTV at the time of loan origination</td>
<td>↑</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>↑</td>
</tr>
<tr>
<td>Percentage deviation between the exchange rate level at which the individual loan was granted from the actual exchange rates</td>
<td>↑</td>
</tr>
<tr>
<td>Interest rates</td>
<td>↑</td>
</tr>
</tbody>
</table>

1 In the case of small, open economies such as Hungary, the aforementioned mechanism is far from perfect; as the economic cycle and thus portfolio quality may be more strongly influenced by the change in external demand than by internal lending amplified domestic demand.

2 For a detailed description of the models presented in this chapter see the English-language study by Dániel Holló (2009) entitled ‘Modelling loan losses on the Hungarian retail mortgage portfolio’ (manuscript).
unemployment rate, EXCHR represents the percentage deviation of the CHF/HUF exchange rate level at which the individual loan was granted from the ‘actual’ CHF/HUF exchange rates, and finally, IR denotes the domestic and foreign interest rates. The estimation was prepared on the basis of data for the period from January 2003 to June 2008. The main findings are summarised in Table 2.

The results suggest that forint-denominated loans are less risky than FX loans. This, on the one hand, can be explained with the smaller fluctuations in the instalments of forint-denominated loans compared to FX loans (there is no change in debt servicing costs due to exchange rate depreciation, the repricing period is longer and most forint-denominated housing loans are interest-rate subsidised). On the other hand, the period when a large portion of forint mortgages were granted (i.e. between 2000 and 2004) was characterised by tight lending standards, hence it was mostly high quality borrowers that had access to these products.

The results also show that housing loans are less risky compared to home equity products. This is indeed surprising, as the two credit types are basically the same (loan granted against real estate as collateral), but it is an empirical fact that the quality of the home equity mortgage portfolio is worse than that of the portfolio of housing loans. One of the possible underlying explanations is that most housing loans are intended for purchasing the ‘first home’, and therefore the willingness to pay these loans is strong. By contrast, home equity mortgages are mainly for consumption purposes, and the collateral of the loan is not necessarily the residential property of the debtor, but maybe some other real estate, which may also affect the debtor’s payment attitude.

The qualification variable attempts to capture the effect that the income position and employment opportunities of those with lower educational levels are usually worse, and they are more exposed to income shocks caused by economic fluctuations (e.g. unemployment), which adds to the default risk of these clients.

The loan-to-value ratio at the time of loan origination has also proven to be a significant risk factor. The higher the loan-to-value ratio at which the loan is granted, the lower the downpayment required by the bank, and the more customers in tight financial and income positions have the opportunity to borrow. This may affect both the debtor’s willingness to pay (if the value of the property declines, it is not worth repaying the loan) and the customer’s ability to pay. The impact of the latter appears through the higher instalments related to the higher amount of the loan (assuming unchanged maturity and interest conditions), and through the relevant income-proportionate repayment burden. Therefore, the default risk of loans extended at high loan-to-value ratios may be higher than that of loans disbursed with more conservative LTV ratios.

Finally, the macro indicators (interest rates, unemployment rate, exchange rate) capture the effects of macro-risk factors affecting default risks. Macro-risk factors have an impact on each customer’s solvency, albeit to different degrees. For example, exchange rate depreciation affects the solvency of all debtors with FX loans, but its magnitude depends on the initial exchange rate at which the client became indebted. The underlying reason is that the weaker the exchange rate was at the time of borrowing, the lower the probability that repayment problems will arise directly as a result of permanent, substantial exchange rate depreciation.

Using the estimated parameters of the macro factors of model (1), the effects of various macro-risk scenarios on the default probabilities can be determined, that is the so-called ‘stress’ default probabilities can be computed.

**Loss given default**

Loss given default is the non-recoverable part of a non-performing loan increased by the amount of costs arising during the debt collection process. Its value is affected by factors such as the outstanding loan amount at the time of default, the length of the collection period, costs arising during collection and the size of the interest rate used for discounting money flows arising in various periods.

Considering that – in respect of the factors determining loss given default – we only have information on the developments in exposures, the way we approached loss given default is as follows:

1. If the loan-to-value (LTV) ratio of a loan is below 100 per cent at a given point in time, the bank would not realise any loss on the given transaction in the event of customer default, that is the recovery is 100 per cent (the size of the outstanding exposure is smaller than the value of the collateral).

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1 Making an exact decision regarding this issue is rather difficult considering the fact, that FX loans constituted 80-90 per cent of new loans in recent years, i.e. FX loans dominated the portfolio both in terms of loans outstanding and the number of contracts. In the absence of a basis for comparison (the marginal share of households’ forint-denominated mortgage loans within the portfolio), it is not possible to make a precise comparison of mortgage loans of different denominations in terms of credit risk.

2 Forint denominated home equity loans were not granted practically.

3 In the database, the average exchange rates at the time of loan origination were EUR/HUF 255 and CHF/HUF 162.
2. In the event that the value of the ratio at a given point in time is above 100 per cent, the size of the bank’s potential loss (i.e. the loss given default) is the portion above 100 per cent of the LTV (the size of the outstanding exposure exceeds the value of the collateral).

The loan-to-value ratio may exceed 100 per cent for several reasons. For example, due to exchange rate depreciation, the forint value of FX exposures changes; in addition, housing prices may also vary. When determining the LTV of non-performing customers we took into account the effect of both factors. In calculating the value of the home we took into account housing price developments between the date of borrowing and the default.

It must be mentioned that there may be a close relationship between the number of defaults and changes in the value of collaterals. For example, as a result of permanent, substantial exchange rate depreciation many FX debtors may become non-performers, that is numerous properties may become subject to foreclosure, which may lead to a fall in housing prices and significant increase in banks’ losses.

**Exposure**

Under exposure we denote the outstanding loans of customers at a given point in time. The size of the exposure is determined by the remaining maturity of the loan, the interest rate condition (fixed, variable) and the currency of the loan (FX/HUF).

**ILLUSTRATIVE EXAMPLE: LOSS CALCULATION IN AN EXTREME MACRO-RISK SCENARIO**

Calculation of the total loan loss requires the determination of the loss distribution. We determined loss distribution both in the case without macro shock (baseline) and in an extreme macro-risk path (the stress scenario in the April 2009 Report on Financial Stability [10 per cent fall in GDP; EUR/HUF 340]). The procedure was as follows:

1. Default probabilities for each borrower were computed by using model (1). In the baseline case, the values of the macro variables in the estimation period were used (exchange rate, unemployment rate, domestic and foreign interest rates), while in the stress scenario their shocked values were employed (assuming unchanged customer and loan characteristics). 10

2. We take the outstanding mortgage portfolio in June 2008 (the end of the sample period), and generate uniformly distributed pseudorandom numbers on the interval [0,1) for each borrower. If the default probability of the borrower exceeded the random number (separately in the baseline and in the macro shock case), then the exposure was considered to be in default.

3. The bank incurs a loss on a non-performing debtor if the customer’s loan-to-value (LTV) ratio exceeds 100 per cent. In the baseline, in determining the LTV we took into account housing price changes between the date of borrowing and the date of the default. LTV calculation along the macro-risk scenario was different from the above to the extent that in the case of FX exposures we also took into account the effects of exchange rate depreciation (the forint value of the existing exposure changes) and a 20 per cent decline in housing prices.

4. Loss on the debtor level is the product of the outstanding exposure and the above-100 per cent part of the LTV. By summing up the individual losses, the portfolio share of total retail mortgage loan loss is computed. This procedure ensures that default depends on its own PD, and also considers to some extent the PD-LGD correlation, as LTV is included both in the PD scorecard and the model for the loss rate.

5. Repeating points 2-4, 10,000 times results in the loss distributions shown in Chart 2. We assumed a one-year risk horizon in the calculations.

Knowing the loss distribution (which shows the distribution of the 10,000 portfolio-proportionate loss realisations), allows us to calculate the total retail mortgage loan loss of the banking sector, which only requires to determine the 99.9th percentile of the distribution, 11 and then multiplying the resulting figure with the end-2008 retail mortgage loan...

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1 As the model of the probability of default was estimated on the basis of a period that was not characterised by significant macroeconomic turbulences, the model parameters of macro variables presumably underestimate the effect of macro shocks on default risks.

10 In the model, the effect of GDP does not appear directly, but through the change in unemployment.

11 The given percentile of the loss distribution gives the extent of loss coverage. For example, at a confidence level of 99.9 per cent, the capital and the reserve will not be sufficient to cover the loss in only 1 case out of 1,000. Of course, the lower we ‘set’ the confidence level, the more cases (‘state of nature’) there will be when the capital and the reserve will not cover the losses. Therefore, the deviation of the selected confidence level from 100 per cent can also be interpreted as the probability of a bank’s insolvency. The 99.9th percentile used in the calculations is widely used in domestic and international bank practices in determining the economic capital needs.
portfolio stock (in an implicit manner we assume that the retail mortgage loan portfolio of the three banks is representative from the aspect of the banking sector).

According to our results, on the basis of the ‘baseline loss distribution’ (the distribution marked in blue in Chart 2) the total loss on retail mortgage loans would amount to HUF 118 billion (approx. 2 per cent of the end-2008 retail mortgage loan portfolio), which would increase to HUF 372 billion (approx. 6 per cent of the end-2008 retail mortgage loan portfolio of the banking sector) in the stress scenario.

**Chart 2**

Simulated loss distributions of the retail mortgage loan portfolio before and after the stress

According to our calculations, the loss on the retail mortgage loan portfolio increases considerably in the macro-stress scenario. Along the stress path, the total loan loss of the banking sector would increase from the baseline level of HUF 118 billion to HUF 372 billion, which is approximately 6 per cent of the banking sector’s end-2008 retail mortgage loan portfolio.

In evaluating the results one must keep some further issues in mind. Namely, in the calculations we neglect to measure how the shock propagation affects other sectors in the economy, and how asset prices are affected, which may generate additional, even substantial losses through the deterioration of other banking portfolios and through the decline in collateral values.

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Gábor Kézdi and István Kónya: Wage setting in Hungary: evidence from a firm survey

We document results from a survey of wage setting in Hungarian enterprises. The survey was developed and coordinated by the Eurosystem Wage Dynamics Network, and it was administered in 17 European countries; this allows us to put the Hungarian findings in context. The main conclusion from the survey is that while Hungarian firms operate in a quite flexible institutional environment, their wage setting practices are relatively rigid. In its wage setting outcomes, Hungary shares more similarities with Western European countries than with countries in the Central and Eastern European region. The survey provides strong evidence that the observed wage setting behaviour can be explained by internal factors related to employee motivation, perceived fairness, and firms’ desire to maintain a desired wage distribution.

INTRODUCTION

This paper describes stylised facts about wage flexibility in Hungary, based on a survey of wage setting among Hungarian firms. The survey is part of the Eurosystem Wage Dynamics Network (WDN): it is a harmonised questionnaire administered in 17 countries in Europe. Here we focus mainly on the Hungarian results, and only on a single issue, the flexibility of wages. We do, however, use the European findings to place Hungarian wage setting in a broader context.

The survey was implemented in a decentralised way in which each National Central Bank was responsible for carrying out the survey within its own country. The Hungarian data were collected through personal interviews. The person interviewed was preferably the Chief Executive Officer (CEO) or the Human Resource Manager of the firm. The reference year in the questionnaire was 2006, unless otherwise specified. The sample was restricted to firms having more than five employees. It included seven sectors: manufacturing; electricity, gas, water; construction; trade; business services; financial intermediation; non-business services. The Hungarian sample was representative of employment, so the sampling probability was proportional to firm size. International comparison of the results is made possible by appropriate weights provided by the WDN. Due to poor international comparability, the energy sector and non-market services are excluded from this analysis.

The questions asked can be divided into the following broad categories: (i) descriptive questions about the firm and its employees, (ii) wage setting and wage changes, (iii) wage rigidity and shocks, (iv) price setting and wages. Here we only focus on (ii) and (iii), which relate directly to wage flexibility. For a general overview of the European results, see Babeczky et al. (2009a), Babeczky et al. (2009b), Bertola et al. (2009), and Druant et al. (2009). Kézdi and Kónya (2009) provides a comprehensive overview of the Hungarian survey.

RESULTS

Institutions

Many countries in Europe apply collective agreement in the wage bargaining process. This can take place at the country, sector, or firm level.

As Chart 1 shows, collective wage agreements are common in the euro area countries, but they are rare in the new member states. The difference is large: the Hungarian coverage is below 20%, while in the euro area countries it is above 80%.

Chart 1

Collective wage agreements

<table>
<thead>
<tr>
<th></th>
<th>EA</th>
<th>CEE</th>
<th>HU</th>
</tr>
</thead>
<tbody>
<tr>
<td>set inside firm</td>
<td>0</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>set outside firm</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

% firms, weighted by employment

1 Austria, Belgium, the Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovenia and Spain.
Equally striking is the fact that while in the old member states collective agreements occur mostly at the country or sector level, in the Central and Eastern European (CEE) region\(^1\) only firm-level agreements are present. We thus conclude that in Hungary the wage setting process takes place mostly at the individual level, similarly to other countries in the region but in stark contrast to the euro area nations.

The structure of wages

Performance related components of the overall wage bill are usually more flexible than the wage bill. The WDN data show that in Hungary they are moderately important, comprising about 10% of the overall wage bill. Interestingly, in this respect, Hungary is more similar to the euro area with an average of 9% than to the CEE countries, where such wage components are more common, with a share of more than 16% of the wage bill.

Chart 2

Wage indexation

Inflation indexation is another important determinant of wage flexibility. Chart 2 shows that a significant minority of Hungarian employees work in firms with some kind of indexation. Out of these cases, the majority use implicit adjustment to inflation. Inflation indexation is less prevalent in Hungary than in other CEE countries, which may be surprising given the country’s history of fairly high and volatile inflation. One explanation could be that by 2006 inflation was low enough to allow firms to move away from (implicit) indexation. The lack of centralised wage setting also implies that there are no external indexation requirements on firms. Finally, the results should be taken as a lower limit. It is possible that while firms do not have an explicit (formal or informal) policy of indexation, they nevertheless take inflation into account when adjusting wages.

The timing of wage changes

An obvious indicator of wage flexibility is the timing and frequency of wage changes. The survey question refers to base wages, since other components are typically more flexible. Chart 3 presents results concerning the frequency of wage changes.

Chart 3

Frequency of wage changes

In most of the countries the majority of wages stay fixed for one year, and the same is true in Hungary, where 80% of firms adjust their wages once a year. This proportion is even higher than in the euro area or the CEE region. In general, new member states do not appear to have more frequent base wage adjustments, even though they have more decentralised wage setting institutions.

Since base wages are generally stable for an extended period, it is important to know if wage changes simply happen in predefined time periods (i.e. they are time-dependent), or respond to changes in the environment only periodically (i.e. they are state-dependent). Chart 4 shows that in Hungary, time-dependent wage setting predominates. Fully 40% of employees work in firms where wages are reset in January, and the wages of another 30% are reset in the same month of the year (other than January). These months are the ones following January, so they still correspond closely to the end of the calendar year. Anecdotal evidence suggests that even among these firms wage changes are backdated to January, but the survey does not directly ask about this kind of behaviour.

There is large heterogeneity in Europe in this respect. While new member states have much lower rates of time-dependence, euro area countries have significantly higher rates of time-dependent wage setting (although still not as

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\(^1\) The Czech Republic, Estonia, Poland, Lithuania and Hungary.
January seems to be a focal point for wage setting, but much less so in the CEE region. From the frequencies presented in Chart 3, it is possible to calculate average wage durations that are useful for the parameterisation of macro models with Calvo-type wage and price rigidities. Details about the construction of average durations can be found in Appendix 3 to Druant et al. (2009). Average wage duration in Hungary is 13.8 months (15 for the euro area and 14.8 for CEE), and average price duration is 10.7 months (9.6 for the euro area and 9.5 for CEE). These numbers are similar to other estimates, and the cross-country differences are not substantial. We have also calculated durations by sector and firm size, which are available from the authors upon request. In a nutshell, we found that in Hungary, sectoral and size heterogeneity is moderate, especially for the duration of wages, very similarly to other countries (see Druant et al., 2009).

**Downward nominal wage rigidity**

There is a large body of evidence that firms are reluctant to cut wages (base wages in particular). Chart 5 confirms this for Hungary and for Europe in general. In Hungary, less than 5% of employees experienced wage freezes; and essentially none experienced wage cuts. Wage cuts are rare in all of the countries, but freezes do happen: in the Czech Republic, about 10% of employees were subject to pay freeze. The difference between Hungary and the Czech Republic may be explained by the different inflation environments. While Hungary still had sizable inflation and fast average nominal wage growth in the five years up to 2006, inflation was very low in the Czech Republic in this period. Higher inflation allows firms to cut real wages by keeping nominal wages fixed (or increasing them less than the rate of inflation), while in a low inflation environment significant real wage cuts must also involve nominal wage decreases.

**Chart 5**

**Time dependence of wage setting**

- Chart 6 lists reasons why firms find it difficult to cut wages. Many factors seem to be important, with the ones related to motivation and morale being the most prevalent. Collective agreements are much less important in Hungary and the CEE region than in euro area countries, worries about hiring difficulties and worker quits are less important in Hungary, and implicit wage insurance (the intolerance of instability) is somewhat more common in Hungary than in other nations.

**Wages of new hires**

Another margin of adjustment of the overall wage bill is the wages of newly hired employees. This becomes especially important when the wages of existing employees are infrequently adjusted, as we showed earlier. There is also a
A growing body of theoretical and empirical evidence underscores the importance of this issue.

Chart 7 shows the most important factors in setting the wages of newly hired workers. In euro area countries with sectoral or nationwide wage setting these also apply to new hires. Perhaps more interestingly, however, firms in the CEE countries without such external constraints feel restricted by internal wage equity considerations. In Hungary, almost 80% of firms report that the wages inside the firm are very relevant when they determine the wages of new entrants. The same is true for CEE countries, but to a somewhat lesser extent than for Hungarian firms.

**Adjustment to external shocks**

The survey also included questions that addressed (i) the flexibility of wages in response to different types of shocks and (ii) the importance of alternative adjustment mechanisms. The hypothetical shocks under consideration were: a decline in demand, a rise in the price of an intermediate input, and an increase in competitors’ wages. Here we focus only on the first; Kézdi and Kónya (2009) has more details on the other shocks.

Chart 8 lists the most common ways firms respond when demand for their products falls. Hungarian firms mostly try to cut costs, while output, price and profit margin adjustments are common in other countries. Base wages are never cut in any of the countries, and cutting flexible wage components is not very important either. Interestingly, adjusting temporary employment is an important margin in the euro area, but not in the new member states - presumably because such work arrangements are less common in the CEE region.

**The minimum wage**

A section of the survey specific to Hungary asked about the effects of an increase in the minimum wage. The questions refer to (i) a hypothetical 20% increase in the minimum wage and (ii) the actual increase in the minimum wage in 2001–2002 (with a total increase of almost 100%). Table 1 lists the answers to the first sets of questions. The findings are consistent across the hypothetical and the actual experiments, which differ only in their magnitudes (more details below). For this reason, we report only results concerning the hypothetical minimum wage increase.

On average, around 14% of employees would earn at or below the hypothetical higher minimum wage (after the 20% increase). Thus, such an increase would represent a significant wage shock to firms. Given the magnitude of the shock, it is surprising to find that very few companies would respond by laying off workers: less than 8% indicated any possible layoffs. Those who said yes would, on average, lay off one-third of the affected workers. This implies that about 2.5% of affected employees and 0.34% of all employees would lose their jobs as a direct result of the 20% increase in the national minimum wage.

This number may seem surprisingly low: as a share of total employment it is essentially zero. While one may suspect that firms underestimate the layoffs in a hypothetical scenario, the responses to the 2001-2002 minimum wage increase are even lower. Note that such a weak response is corroborated by other estimates: Kertesi and Köllő (2003) estimated the aggregate employment response to the 2001 increase (which was nearly 60 per cent in itself) to be around 0.5%. The weaker response to the 2001–2002 minimum wage increases may be explained by the fact that they took place at a different stage of the business cycle, and they may have hit firms less than a similar or even weaker increase would in 2006. Of course, it is also possible that the minimum wage was not effective before 2001–2002. Tonin (2007) provides...
some evidence that tax evasion was an important reason why
the reported minimum wage may not have been an effective
constraint on firms in that period.

The second important finding is that firms would (and did)
pass the minimum wage increase on to employees not directly
affected. About 30% of the firms (weighted by their
employment) gave an affirmative answer to this question, and
they would raise wages for a large set of their employees. In
case of a hypothetical 20% increase in the minimum wage,
these firms would increase the wages of an additional 62% by
around 10%. This implies that, in addition to the direct
effect, the minimum wage increase would lead to a further
2% increase in the economy-wide wage rate. Again, the
numbers are somewhat smaller for the 2001-2002 increase,
but they are still significant.

This finding is consistent with the hypothesis that firms are
concerned about the relationship among their employees and
want to have a wage distribution that is perceived as ‘fair’.
This seems to include the keeping of a ‘pecking order’ of
workers, where relative wages are important, in addition to
absolute levels. An interesting question is the way firms
would respond to maintain profitability in the face of a
significant cost shock. While the survey did not ask this
question for the minimum wage increase, previously we saw
that the way Hungarian companies are trying to adjust is
mainly by cutting non-labour costs.

**ECONOMIC INTERPRETATIONS**

After presenting the findings from the WDN wage setting
survey, in this section we discuss their possible economic
interpretation.

The first conclusion we can draw from the survey is that
Hungarian firms are not constrained by external factors in
their wage setting factors (with the important exception of
the minimum wage). Collective agreements at the national or
sector level are non-existent, and even within firms wages are
typically set individually. On the other hand, wages are set in
a fairly rigid manner. The wages of new hires conform to the
wages of existing employees, and most firms reset their wages
at most once a year. Base wages are never cut, and are rarely
frozen, although the latter finding may be due to the sample
period during which average wage growth was high.

To reconcile these findings, we need to look for wage
theories that emphasise that wages may have other roles than
reflecting workers’ marginal product. Implicit contract
theory (see, for example, Beaudry and DiNardo 1991) argues
that workers receive an insurance against idiosyncratic

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**Table 1**

**The effects of a hypothetical minimum wage increase**

<table>
<thead>
<tr>
<th>Question</th>
<th>mean (weighted by wl)</th>
<th>min</th>
<th>max</th>
<th>obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>What fraction of your employees have earnings under the hypothetical new minimum wage (that is, under HUF 79,000)?</td>
<td>13.7</td>
<td>0</td>
<td>100</td>
<td>1,517</td>
</tr>
<tr>
<td>Due to the increase in the minimum wage, would you lay off some employees whose wages would be directly affected (i.e. whose earnings are under the hypothetical new minimum wage, that is, under HUF 79,000)? Where: 1=yes (or likely), 0=no (or not likely)</td>
<td>0.077</td>
<td>0</td>
<td>1</td>
<td>1,477</td>
</tr>
<tr>
<td>If 1 (yes or likely), what fraction are those who are affected (i.e. earn under HUF 79,000)?</td>
<td>31.8</td>
<td>1</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>Due to the increase in the minimum wage, would you increase wages of some employees whose wages would not be directly affected (i.e. whose earnings are above the hypothetical new minimum wage, that is, under HUF 79,000)? Where: 1=yes (or likely), 0=no (or not likely)</td>
<td>0.295</td>
<td>0</td>
<td>1</td>
<td>1,585</td>
</tr>
<tr>
<td>If 1 (yes or likely), what fraction are those (i.e. earn above HUF 79,000)</td>
<td>62.1</td>
<td>0</td>
<td>100</td>
<td>347</td>
</tr>
<tr>
<td>If 1 (yes or likely), by how much on average?</td>
<td>9.9</td>
<td>0</td>
<td>38</td>
<td>225</td>
</tr>
</tbody>
</table>
shocks, since firms may be better able to hedge against such risks. While infrequent wage setting and the reluctance to cut wages supports this hypothesis, the lack of inflation indexation suggests either money illusion on the workers’ part or other considerations behind the stability of wages.

Another set of theories comes under the heading of ‘efficiency wages’. Efficiency wage theories assume that wages may have an incentive component, so that the right wage motivates workers to work harder and more productively. Firms may use their wage setting policies to alleviate moral hazard problems (Shapiro and Stiglitz 1984), to provide workers with a ‘fair’ wage relative to others (Akerlof and Yellen, 1991), or to reduce costly turnover (Salop, 1979). An important empirical contribution in this area is Bewley (1999). In interviews with over 300 business leaders and human resource officers, Bewley found that employers are reluctant to cut wages because they think it would hurt morale.

The WDN survey is supportive of the Bewley (1999) findings. Firms are reluctant to cut wages even in the case of adverse shocks. This is true even for flexible wage components which should in principle act as ‘shock absorbers’. It seems that bonuses are used less to accommodate outside shocks, and more to motivate individual worker effort. Employers also pay close attention to relative wages within the company, either in the case of new hires or in the case of changes in the minimum wage. Altogether, a robust conclusion seems to be that maintaining employee morale and work incentives is a key consideration in wage setting.

CONCLUSION

In this paper we summarised findings from the 2006 Hungarian wage setting survey of the Eurosystem Wage Dynamics Network. We focused on the aggregate findings and comparisons to two country groups, the euro area and the CEE region. The main results can be listed as follows:

- Hungarian firms do not face external constraints in wage setting, with the important exception of the minimum wage.
- Despite this fact, wages appear rigid, particularly base wages. They are reset on average at most once a year, in a time-dependent fashion.
- Wages are insensitive to temporary shocks. Firms are accommodating these shocks by cutting other costs, and to a lesser degree, by changing prices, margins and output.
- Flexible wage components are not used to absorb external shocks; rather they seem to be used for internal motivation.
- The WDN survey provides support for the time-dependent nature of wage setting. Wages are reset infrequently, mostly once a year. Many wages are adjusted in January, or in other fixed periods.
- By 2006 the minimum wage is a binding constraint for firms. A 20% minimum wage increase would spill over to other workers, and lead to an additional 2% increase in average wages.
- Overall, the Hungarian labour market is similar to other CEE countries and is institutionally flexible. In terms of outcomes, however, it is much more similar to the more rigid euro area countries.

Many other interesting questions can be investigated that we did not have the space to do in this overview - a task that we leave for future research. A particularly interesting question concerns the behaviour of firms under different circumstances. The current labour market conditions are very different from the ones in 2006 and repeating or updating the survey would provide information on how firms adapt to such changed circumstances. We hope that such an update will indeed take place, and we look forward to reporting the findings from that exercise.

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INTRODUCTION

The family of business cycle models the MNB workshop was centred around (tagged ‘DSGE’- models from the abbreviation of Dynamic Stochastic General Equilibrium) has become the common language of macroeconomists interested in recessions, booms and the best fiscal and monetary policy responses to them. Macroeconomists working with these – quite complicated – models generally agree that it is not enough to assume that economic agents (households, firms, banks) follow simple behavioural rules (e.g. 80% of households take foreign currency-denominated debt and 20% of them domestic), because a new policy (e.g. a change from a fixed exchange rate to a floating exchange rate regime) might make them change their behaviour (e.g. households might be less willing to take credit denominated in foreign currency that is subject to exchange rate fluctuations).

4 Rather, if the main purpose of the model is to learn something about the appropriate policy, it is suitable to assume that agents are more clever than to follow simple rules; they recognise their possibilities and the effects of various economic policies on them. These models, therefore,

‘DSGE Models: A Closer Look at the Workhorse of Macroeconomics’ was the title of the international workshop organised for the 8th time by the Magyar Nemzeti Bank (MNB) jointly with the London-based Center for Economic Policy Research on 3-4 September 2009. The recent sub-prime debacle, the resulting financial meltdown and the substantial policy responses gave the topicality of the event; even more so as the unexpected extent of the crisis stirred a heated debate within and outside the economics profession about the applicability and usefulness of the current business cycle models.  

The keynote speakers of the event were professors Lawrence Christiano (Northwestern University) and Mark Gertler (New York University, NYU), who are both world-renowned for their essential and continuing contributions to the development of the current versions of business cycle models. The keynote speakers with the 15 presenters from 10 countries and their discussants provided important attempts to challenge or defend basic assumptions of the models (e.g. sticky developments in prices or rational and forward-looking expectations); argue for adding long missing factors (e.g. an explicit financial sector and imperfect credit markets) to the models, or for dropping others (e.g. money-demand) which seem non-essential. There was general agreement among the participants with Governor of the MNB András Simor, who said that in the current crisis ‘we need [models of business cycles] more than ever,’ but they need to be developed further to be able to analyse and quantify factors that the current crisis showed essential.

‘...whimsicality, a willingness to play with ideas, is not merely entertaining but essential in times like these. Never trust an aircraft designer who refuses to play with model airplanes, and never trust an economic pundit who refuses to play with model economies.’

Paul Krugman

Peter Karadi (ed.)¹: Rethinking Business Cycle Models – Workshop at the MNB

¹ Péter Benczúr, Anna Naszódi, Katrin Rabitsch, Katalin Szilágyi and Balázs Világi contributed to the article.

² See for example a Survey of the Economist journal, a response of Chicago University professor Robert Lucas, and the resulting debate; or the debate Crisis and Macroeconomy of Hungarian economists on the eltecon blog (in Hungarian).

³ It is a general name for any model with some basic methodological traits. While earlier models assumed some basic static behavioural equations (like individuals tend to consume a certain fraction of their current paycheck), these more complicated models assume that economic agents make dynamic and forward looking decisions, (i.e. they take into consideration not only their current income, but also their expected future income when deciding about current consumption. Also they take uncertainty (stochastic world) explicitly into consideration, meaning they buy insurances against events (e.g. fire) that would cause disruption in their consumption. The term general equilibrium means that these models are interested in the behaviour of the whole economy and not only that of the individual agents, and for this reason, they are looking for prices, wages and interest rates, where the whole economy is in an equilibrium, where the demand and supply equal in each markets and nobody want to change their decisions.

⁴ It is the famous ‘Lucas-critique’ named after the Nobel-prize winning Chicago economist Robert Lucas, who famously recognised this problem with earlier non-micro-based business cycle models.
explicitly model the agents’ behaviour consistently with the model economy.

As one of the keynote speakers, Mark Gertler emphasised it, these models were developed to explain and support policy in ‘normal’ times, and they were relatively successful at this. By providing a common language for macroeconomists of different schools, this framework allowed researchers to debate about and agree on the necessary ingredients that these models need in order to be able to explain essential real-world characteristics. For policy applications, the models have proved useful not only in giving some basic intuition about the appropriate policy (such as that the nominal interest rate increase should exceed the increase in inflation if policy wants to stabilise inflation (Taylor-principle), or that an appropriate fiscal policy should try to smooth tax rates over time), but they also provided tools for quantitative evaluations of the appropriate policy stance. The models, therefore, allowed policy makers to make more informed decisions. The current crisis, however, has shown that important ingredients are missing from these models: for example, standard DSGE models1 have left out financial markets from their estimated models, even though in their 1999 article current Fed Chairman Ben Bernanke with Mark Gertler (NYU) and Simon Gilchrist (Boston University) developed the tools necessary to insert financial sector into these models and showed that the resulting ‘financial accelerator’ mechanism would influence the reaction of these model economies to economic shocks – i.e. financial markets matter (see below). It is clear that the current crisis cannot be understood without financial markets – either as a source or as a propagator of shocks – and proper model-based policy advice could not be made without a model that takes financial markets seriously. The number of, and the general interest in, papers in the workshop that deal with financial markets prove that macroeconomists are taking this challenge seriously and are working hard to develop the proper models.

MODELLING THE FINANCIAL SECTOR

In a perfect world with no information problems, banks and financial markets could be ignored for business cycle analysis: they can instead be considered as the extension of the central bank that uses its instruments to influence financial markets to obtain a level of market interest rates or the money supply it considers appropriate. Credit in this world would flow freely to every firm that can invest it profitably. That is probably the reason why the first generation of DSGE models has not considered it necessary to explicitly model financial markets.

An important exception from this was the model of Bernanke, Gertler and Gilchrist, 1999 (BGG) that abandoned the unrealistic perfect information assumption and assumed that firms know more about their own profitability than the banks they want to borrow from. Banks need to pay monitoring costs if they want to observe the firms’ profitability. As it was shown earlier by Townsend, 1979, this setup justifies the standard debt contracts between banks and firms: the borrowing firm promises to pay interest to the bank, and, in case it becomes insolvent, the bank – in a standard default procedure by paying the monitoring cost – observes all its assets and collects everything it can. For this contract to be acceptable for the bank, the interest rate it receives in good times should cover its opportunity costs (government interest) plus the expected value of its losses in the case of default. This way the model can capture and explain the interest rate premium (the excess interest rate the borrower pays over the risk free interest) generally observed in real world debt contracts. But the model can say more than this: it shows that in (general) equilibrium this premium will be dependent on the proportion of the firms’ own funds (net worth) to the amount it intends to borrow. The lower its own funds are, the higher the premium will be, as it reduces the expected amount the bank can recover in the case of default. The authors show that this leads to an economy level ‘financial accelerator’ mechanism that influences the propagation of standard business cycle shocks: a negative shock leads to lower investment and lower price of capital, which, in turn, causes losses for firms and reduces their net worth. But this increases their borrowing costs that make them to invest even less. This ‘credit channel’ thus amplifies the effects of the original shocks. The authors show that this amplification effect is quantitatively important for standard values of the model parameters.

Both of the keynote speakers presented variants of the ‘financial accelerator’ model and argued that it offers a fruitful starting point for incorporating financial markets into the business cycle models. Lawrence Christiano presented a recent paper that he is working on with Roberto Motto (European Central Bank, ECB) and Massimo Rostagno (ECB). The main aim of the paper is to insert financial markets and banks into the standard business cycle model with a rich set of shocks and potential propagation mechanisms and use financial market data (including stock markets, monetary aggregates and interest rate premium) to identify which shocks and mechanisms help most in explaining the data. A new shock the keynote speaker introduced to his model is a ‘risk shock’ that influences the riskiness of credit, leading to worsened credit conditions:

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higher premium and lower credit levels. The reason is that a higher risk level increases the potential difference between firms, which – because of the specific assumptions of the model – makes the potential losses of the banks higher. Even news about future risk shocks can strongly influence stock markets and the real economy, according to the model. The authors show that this shock helps explain the behaviour of financial market variables (such as the stock market and the interest rate premium), and has significant effects on real variables (e.g. output and investment). These results underline, according to the authors, that financial markets matter not only as propagators of shocks – as the standard BGG model suggested – but also as independent sources of shocks. A further important message of his speech was that explicitly modelling the money supply process (i.e. the liability side of the banking sector) either as a source of shocks or as a propagation mechanism does not seem to matter. This supports the conventional view that dropping money from the analysis – and assuming that monetary policy sets interest rates directly – is sufficient for general questions of business cycle research (see, for example, Woodford, 2003), and the current crisis does not seem to invalidate this result.

It was also the asset side of the central bank’s balance sheet (e.g. buying mortgage backed securities) and not its liability side (e.g. increased bank reserves) that Mark Gertler in his keynote speech found important for understanding the current crisis and the unconventional monetary policy response. In his presentation, he admitted that the recent ‘credit-easing’ policy of the US Federal Reserve indeed led to substantial increases in the narrow definitions of money (M0: cash and bank reserves increased by close to $1 trillion). But he emphasised that, contrary to ‘normal’ times, this entailed a much smaller increase in broader money aggregates (M1: cash and bank deposits outside the banking system increased by less than $300 billion), which might be considered potentially inflationary. The main reason for this is that US banks now hold unusually high amounts of reserves at the Federal Reserve (an increase of $800 billion). Through this, they practically finance the central bank in its credit operations. It should also be noted that the Fed now pays positive interest on these reserves, and by changing the reserve rate it can keep these reserves at the central bank and thus can avoid unintended increases in the money supply during the normalisation of the financial markets. Besides bank reserves, the Fed is further financed by short-term debt issued by the Treasury under the Supplementary Financing Program. From these sources the Fed is providing credit to various sectors of the economy. The Fed’s policy, therefore, can be considered more as substituting the private sector in financial intermediation (‘credit easing’) than increasing the money supply in the economy (‘quantitative easing’), as was also explained by Fed Chairman Ben Bernanke in an earlier speech.

In this vein, Mark Gertler continued his speech by presenting the results of a paper he is working on with Peter Karadi (MNB) which explicitly models the banking sector and shows how this credit easing policy can be inserted into a financial accelerator model. In this model, the banks are the ‘interesting’ agents that face credit constraints (not the firms as in the BGG model). The reason for this in the paper is moral hazard: the chief executive of the bank can divert a certain fraction of the capital. The model household knows about this, and restricts the amount of credit a certain bank can obtain relative to its net worth, ensuring that no stealing happens in equilibrium. This modelling technique leads to a financial accelerator mechanism that is equivalent to the one of BGG: there will be an interest rate premium in the economy that is caused by the credit constraint of the banks which becomes tighter if their net worth drops relative to their assets (i.e. their leverage ratio increases).

To model the current unconventional monetary policy of the Fed, the model assumes that the central bank can offer credit to firms without the same credit constraints that banks face. On the other hand, the model assumes that the government is not as good at allocating funds as banks, consequently, it loses a certain fraction of the direct credit it provides as an efficiency loss.

The paper captures some important features of the current crisis by assuming that it was triggered by a ‘capital quality shock’: the value of the housing stock was not as high as market participants expected. A drop such as this in a standard model without a financial sector would result in a short-lived recession with higher investment quickly increasing the capital to its previous levels. With an explicitly modelled financial sector, however, the drop in the value of capital translates into a drop in the banks’ net worth (amplified by their leverage), which reduces their ability to obtain funds and thus to provide the credit that would be necessary for a speedy recovery. Their gradual deleveraging makes the recession more prolonged. Through providing direct credit to the economy, the central bank can substantially reduce the severity and length of the recession caused by the shock. The paper shows that for relatively low efficiency costs (less than 40 basis points yearly) optimal policy fully substitutes for private intermediation during the

\footnote{The lognormal distribution of firm level shocks.}
crisis, while for higher efficiency costs it is optimal not to provide direct credit at all. This result justifies the Fed’s behaviour (also required by law), namely, that it only provides credit to very high grade debtors with sufficient collateral (where the efficiency or default costs can be expected to be very low).

In his workshop presentation of his paper written jointly with S. Boragan Arouba (University of Maryland), Frank Schorfheide (University of Pennsylvania) challenged the conventional wisdom that the role of money can be ignored in these DSGE models. He argued that a possible reason why standard methods found such a small role for money is the simplistic way they quantified the reason for money demand. The presented paper explicitly models the role of money (applying results of search-based monetary theory introduced by Kiyotaki-Wright, 1989): it assumes that there is a sector in the economy where the one-shot and anonymous nature of trade makes money necessary – as credit is inadmissible and the chances of a successful barter are very low. The estimated model implies that this sector matters quantitatively and mainly because a positive interest rate is a distortionary tax on money holdings, welfare considerations should be a factor supporting a lower inflation target.

LEARNING IN BUSINESS CYCLE MODELS

Since the 1970s, it has been assumed in most academic macroeconomic models that key economic agents’ expectations are based on a sophisticated knowledge of the working of the economy and all available relevant information. This approach of describing expectations is the rational expectations (RE) hypothesis. This assumption is justified by the belief that if agents formed their expectations naively, there would be unexploited profit opportunities; however, in a market economy such phenomena do not survive in the long run.

The RE hypothesis has important implications accepted by even the non-academic community: For example, the importance of central banks’ credibility and expectations management in the conduct of monetary policy can be derived from RE. On the other hand, in a world where economic agents form their expectations simply by extrapolating some past experience without any forward-looking considerations the above issues would be much less important.

Despite its appealing properties, the RE assumption has problematic features as well. It implies that economic agents’ forecasts are always unbiased and have only unsystematic errors. However, empirical evidence contradicts these strong requirements.

Recently, there is a growing macroeconomic literature which wants to refine our knowledge on expectations formations. It wants to get rid of the most extreme characteristics of the RE hypothesis, without returning to the assumption of naive and purely backward-looking expectations. While, according to the RE hypothesis, economic agents always use the best possible forecasting models and know precisely the appropriate parameter values of these models, the new literature of learning assumes that agents’ forecasting models have limited abilities and the exact values of the parameters are discovered only gradually. In the workshop three papers were presented on learning and expectations.

Sergey Slobodan (CERGE-EI, Prague) and Raf Wouters (National Bank of Belgium) estimated and compared different versions of a DSGE model with and without RE using US data. They replaced RE with different forecasting algorithms in their DSGE model and analysed how deviation from the RE hypothesis influenced the empirical properties of the model. They find that replacing RE with learning improves significantly the empirical fit of the model, and, especially, inflation dynamics are explained much better. They also demonstrated that learning leads to substantial time variation in the parameters of the forecasting algorithms: the beliefs about the dynamics of the inflation process turn out to be very important for the overall performance of the model.

Arturo Ormeno (Universitat Pompeu Fabra) presented a paper on how the information content of survey expectations of inflation can be used in estimating DSGE models. He estimated a DSGE model using US data and found that the ability of the model to explain the cross correlation of inflation and survey inflation expectations data was very weak. Then, he specified a forecasting model based on learning and estimated it using survey expectations. He demonstrated that survey expectations can be approximated by simple models with few regressors where private agents heavily discard past information. Furthermore, he combined the DSGE model with the above forecasting model and re-estimated it. He found that the empirical fit of the model complemented with learning improved significantly. To summarise, both papers suggest that it is a promising research agenda to replace RE by learning algorithms in DSGE models.

Cosmin Ilut (Duke University) tried to resolve the uncovered interest rate parity (UIP) puzzle. According to the UIP
hypothesis, periods when the domestic interest rate is higher than the foreign interest rate should be followed by periods of domestic currency depreciation. An implication of UIP is that a regression of realised exchange rate changes on interest rate differentials should produce a coefficient of 1. However, empirical studies strongly reject this conjecture. This anomaly is called the UIP puzzle. Although it is possible to explain the UIP puzzle by models with RE, they do not provide plausible solutions.

Instead, in the presented paper agents’ knowledge is more limited than the requirements of the RE hypothesis. They do not know exactly the statistical process governing interest rate differentials. Moreover, it is assumed that they form their conjecture on the properties of the above process in a pessimistic way: they try to prepare for the worst-case scenario. As a consequence, agents, who want to invest in the higher interest rate bond by borrowing in the lower interest rate bond underestimate the future interest rate differential: they believe that it is more likely that observed increases in the investment differential have been generated by temporary shocks, while decreases are reflecting more persistent shocks.

Hence, on average, next period investors are surprised to observe a higher interest rate differential than expected. This updating effect creates the possibility that next period the agent finds it optimal to invest even more in the investment currency because this higher estimate raises the present value of the future payoffs of investing in the higher interest rate bond. Increased demand will drive up the value of the investment currency, contributing to a possible appreciation of the investment currency. Thus, an investment currency could see a subsequent appreciation instead of a depreciation, as predicted by UIP.

In financial economics there are several phenomena labelled as puzzles, since the RE paradigm cannot explain them efficiently. This paper also reveals that to refine modelling expectations is a fruitful research programme with a huge potential for explaining these financial anomalies.

**PRICE STICKINESS**

Abandoning the classic assumption of fully flexible prices allowed DSGE models to better explain observed characteristics of the business cycle – especially the estimated responses to monetary policy shocks – and made these models able to explain the role of monetary policy in stabilising business cycles. The elegant results on developments in the inflation rate, however, are based on a potentially restrictive assumption for the price setting behaviour of individual firms: they are allowed to reset their prices only at randomly arriving times (when the ‘Calvo-fairy’ touches their shoulder, named after Guillermo Calvo a professor of Columbia University who developed the model). An important question of the profession ever since is whether this assumption is really restrictive in terms of the general questions of these models. The general agreement is that during ‘normal’ times in a relatively low inflation environment, these models capture the important characteristics of price stickiness. This question was also asked by Bernardo Guimaraes and Anton Nakov at the workshop.

Anton Nakov (Banco de Espana, BE) and his co-author James Costain (BE) examined the effect of monetary policy shocks on output in a model that abandons the Calvo assumption and replaces it with a less restrictive assumption of menu costs: the firms are allowed to change their prices any time they feel it necessary after paying a small fixed cost (reprinting the menu). This so-called ‘state-dependent pricing’ assumption relative to the standard ‘time-dependent pricing’ assumption has been given a prominent role in recent debates, when Robert Lucas (Chicago) and Mikhail Golosov (MIT) in their 2007 paper showed that standard menu cost models – calibrated to hit basic characteristics of the observed consumer price data – would imply negligible output effects on monetary policy shocks. In his presentation, Anton Nakov challenged this result – in lockstep with other papers by Gertler and Leahy, 2007 and Midrigan, 2008. He presented a model with maintaining the intuitive property that firms are more likely to change their prices if it is more profitable, but allowed the data to shape the exact behaviour of this probability. This modelling technique allowed him to take into consideration extra characteristics of the observed price change distribution that Golosov and Lucas failed to match (such as the amount of small price changes). Extending the model this way would be of great importance: as the authors show, this more realistic menu cost model would imply similar output responses to monetary policy shocks as a standard Calvo model.

In a paper written with Kevin Sheedy (LSE), Bernardo Guimaraes (London School of Economics) addresses the issue of observable frequent sales in consumer prices. Standard DSGE models assume relatively infrequent price changes (in every 9 months on average); but if we look at time series of prices, sales make these price changes more frequent (in every 4 months). Price changes because of sales, however, are substantially different from infrequent and permanent ‘regular’ price changes: during sales, prices drop by a relatively large amount and a week or two later they return exactly to their previous value. This fact prompted many authors to drop sales from their analysis. In his presentation, Bernardo Guimaraes gave an elegant theoretical reason to support this claim.
Their model recognises that there can be two substantially different types of consumers: some that are loyal to certain brands and some that are bargain hunters: they will look for the cheapest product, irrespective of its brand. The authors built a model that rationalises stores holding occasional sales: they are setting higher prices for their loyal customers at some points in time and lower prices occasionally for the bargain hunters. The important finding of the paper is that even if we assume that firms can set sales prices fully flexibly, it would not influence the standard DSGE results on the limited inflation effects of monetary policy shocks. The reason is that for a firm offering sales, it is more important how other firms also offering sales set their prices than for it to respond optimally to the monetary shock: a response to a monetary shock would result in the firm losing too many bargain hunter customers.

**ESTIMATION OF BUSINESS CYCLE MODELS**

Standard medium-scale DSGE models, such as that of Smets and Wouters (2007), contain a high number of parameters and shocks that need to be estimated. The Bayesian estimation technique, which is now standard in the literature, obtains parameter estimates by combining the authors’ prior knowledge on the parameters with the information content of the data. If the estimates are close to the priors, it suggests that the data does not contain enough extra information on the parameters, or the parameters are weakly identified. Smets and Wouters (2007) showed that their model’s forecasting ability is competitive with non-theoretical, data-based approaches, which is an important achievement, but if key parameters are weakly identified, then caution is necessary in the policy application of these models.

The presentation by Nikolay Iskrev (Banco de Portugal) dealt with the strength of identification in DSGE models. Parameters are unidentifiable or weakly identified if the economic features they represent have no empirical relevance at all, or only very little. This may occur for two reasons. First, those features are not important at all, or only moderately important on their own. Second, they are redundant. If a parameter is redundant, then there is another parameter, or another set of parameters that can take over its role. When some parameters are not identifiable or only weakly identifiable, then different values of these parameters would make our sample be observed with almost equal probability.9

The paper by Iskrev develops a new framework for analysing parameter identification that can tell us not only if a parameter is unidentifiable based on the information matrix, but also the reason for the lack of identification. The main advantage of the methodology is that it does not involve timely simulation, as opposed to the method proposed by Canova and Sala (2009). This feature makes the method suitable for analysing large and complicated models. After introducing this methodology, Iskrev (2009) applies it to the Smets and Wouters (2007) model.

The results indicate that the parameters in the Smets and Wouters (2007) model are quite poorly identified. This finding is in line with that of the previous literature, e.g. Canova and Sala (2009). Thus, it may be concluded that this and other similar models are indeed nearly overparameterised, as it has also been argued by Chari, Kehoe, and McGrattan (2009). One could overcome the problem of weak identification either by modifying the model, or by collecting richer data. The proposed method of Iskrev is useful at identifying how the model should be changed and what kinds of data are needed for a better identification. And even if one does not include new data in the analysis explicitly, Bayesian estimation can provide a coherent way of incorporating some additional information making the estimates and the policy conclusions more reliable.

**OPTIMAL MONETARY POLICY**

A theoretically appealing feature of dynamic stochastic general equilibrium (DSGE) models is the existence of a well-defined welfare measure. Consequently, the models can be solved for optimal (welfare-maximising) policies. The paper presented by Katalin Szilágyi (MNB), written jointly by Zoltán M. Jakab, Henrik Kucsara and Balázs Világi, explores optimal monetary policy in a DSGE model for Hungary. While the solution to the optimal policy problem is a useful benchmark for monetary policy evaluation, it is not operational from a central bank’s perspective. To make the results easier to interpret, the paper approximates the welfare-maximising policy rule with a set of simple rules that react only to observable variables.

The main conclusions are as follows.

*Compared to the optimal policy, the empirical rule implies too much variability of nominal variables.* This is a natural consequence of the modest estimated feedback coefficient to

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9 Or in other words, the likelihood function is not sensitive to the changes of these parameters. Therefore, one way to analyse which of the parameters of a model are identifiable is to look at the likelihood function, or a transformation of the likelihood function, like the Fisher information matrix.
inflation. Optimal rules that respond to a few standard and observable variables (simple rules) can approximate the fully optimal policy well – that responds to everything – if they respond strongly to domestic inflation.

Once monetary policy reacts to changes in domestic inflation, it should not target the nominal exchange rate separately. This result depends heavily on the paper’s assumptions about the production process and the role of imports in the economy.

Including wage inflation in the policy rule implies significant improvement in welfare. This suggests that the welfare loss associated with sticky wage setting is more severe than those related to nominal rigidities in product markets.

The results of the paper build on some crucial assumptions (a high share of imports in the export sector’s marginal cost, perfect exchange rate pass-through for import prices, broadly similar production process for the domestic and the export sector, no imported consumption). Further research is needed to examine these assumptions and check the robustness of its conclusions to relaxing them.

An essential component of the welfare measures and hence optimal monetary policies is the level of the ‘output gap’, which is the distance of the current income level from a theoretically defined potential level that would prevail if prices and wages were flexible and there were no shocks causing inefficiencies in the economy (such as shocks to the price-markups firms add to their prices over their costs). Potential output, however, is not observable, consequently, Ulf Söderström (Sveriges Riksbank), in a paper written with Luca Sala and Antonella Trigari (both at Bocconi University, Italy), present a DSGE model-based method that helps obtain estimates. Their main result is that their estimated potential output level is close to the ones that are usually obtained by standard time-series smoothing techniques (e.g. the HP filter). This result is important, because, theoretically, potential output could develop more erratically than actual output, and then smoothing would produce a wrong result.

A potential caveat of the paper, however, as suggested by Lawrence Christiano during the discussion of the paper, is that assuming temporary shocks, as it is standard in these models, may be an important reason why the authors obtain potential output series that is smoother than output; if they assumed permanent shocks instead, then potential output might turn into a much more volatile series. A further important conclusion of the authors is that their estimates do not seem to imply high estimation uncertainty, consequently, for a given model, they can be fairly sure about where the potential output lies. A fact that makes this result weaker, though, is that different model specifications (such as reinterpreting a shock from a leisure-preference shock – that is efficient – to a wage markup shock – that is inefficient – which both influence the labour market outcome similarly) may lead to substantially different potential output estimates. The authors argue that if central bankers do not have strong preconceptions about structural shocks, these uncertainties about the potential output estimates should make them increase the weight they put on inflation stabilisation relative to the one they put on closing the unobserved output gap.

Carlos Thomas (Bank of Spain), in a paper written jointly with Javier Andrés (University of Valencia) and Óscar Arce (Economic Bureau of Prime Minister), calculated optimal monetary policy in a model with two distinct financial frictions. In their model, i) borrowing requires real estate as collateral, so its price development influences the agents’ borrowing ability and ii) banks are assumed to have some monopoly power, so their lending rate is higher than the deposit rate in equilibrium. The two types of frictions generate interesting interactions in the model: an expected rise in house prices, for example, leads to lower lending rates through its effect on banking competition. In the model, households and entrepreneurs differ by their level of patience: the less patient entrepreneurs are willing to pay to households for their savings. The authors find that these financial frictions introduce both new terms to the central bank’s welfare function and new trade-offs. This implies that the central bank should try to counteract the effects of the financial frictions even if this makes it deviate from its standard inflation and output-gap stabilisation objective. A practical problem with the results, however, is that the new terms the central bank should respond to are unobservable, and there are not yet observable variables that could provide good enough proxies for them. Quantitatively, furthermore, the effects of the financial frictions were found to be small for the model calibration, consequently, for small shocks these frictions might not yet provide enough reason for deviations from standard rules.

* Besides inflation and the output gap terms it should try to make sure that the heterogeneity between entrepreneurs and households in terms of consumption and real estate holdings are kept as small as possible over the business cycle.
ECONOMIC FLUCTUATIONS IN EMERGING MARKETS: ARE THEY DIFFERENT?

Modelling the behaviour of emerging economies has always been controversial: these countries often follow erratic policies, face such distortions and market failures that make the standard frameworks (e.g. a real business cycle, RBC, or a New-Keynesian DSGE model) inapplicable. In particular, the seminal small open economy RBC model of Mendoza (1991) has turned out to suffer from many empirical shortcomings. The most well-known empirical regularities are the excessive volatility of consumption relative to GDP, the strong countercyclical persistence and persistence of the net exports to GDP ratio.\(^{11}\)

Recent advances, however, have shown that a small set of modifications can go a long way in explaining these empirical regularities. There are two main approaches: Aguiar and Gopinath (2007) proposed an explanation based on the properties of the productivity process, while Neumeyer and Perry (2005) put the emphasis on financial frictions. These two papers have prompted an active research line in understanding the key differences between emerging and industrial economy ‘business cycles’. To see the main issues, let us briefly look at the details of the two competing explanations.

Aguiar and Gopinath (2007) have shown that adding shocks to the trend component of productivity leads to more volatile consumption and more countercyclical net exports. The intuition is simple: a trend shock leads to an increase in the lifetime income of consumers. As they want to smooth the extra consumption it allows, they will borrow against their future income. This results in countercyclical net exports. Since part of the increase in current consumption is financed from future earnings, the change in consumption is higher than the change in current output, hence the excess consumption volatility. If the trend component of productivity is more volatile in emerging than in industrial economies, that can explain the differences in business cycle facts.

A competing explanation is due to Neumeyer and Perry (2005), where the explanation is based on financial frictions. In their model, the real interest rate is decomposed into an international rate and a country risk component. Country risk is endogenous (i.e. it is influenced by productivity developments), but it also amplifies the impact of productivity shocks through a working capital constraint.\(^{12}\) This can also explain the same regularities.

The main question thus became whether one can replace the explanation that ‘the permanent component of productivity is more volatile in emerging than in industrial countries’ with a more structural interpretation. A leading candidate is that emerging markets are special in their limited access to international financial markets (country risk), in their financial underdevelopment (credit constraints). The interaction of productivity and financial market developments would lead to the observed empirical regularities, and this would also make the aggregate productivity series look as if it had a more volatile trend component. It would thus lead to a ‘weak RBC’ interpretation: ‘Shocks impinging upon emerging countries are numerous and of different natures, but may be interpreted as an aggregate shock to total factor productivity. In addition, the neoclassical model is a good framework for understanding the transmission of such shocks.’\(^{13}\)

The two most direct ways to proceed are either to run horse races between productivity-based and financial friction-based explanations, or to estimate encompassing models and examine the relative importance of the two factors. The winning explanation is ambiguous so far: Aguiar and Gopinath (2006) add a restricted version of endogenous interest rate spreads (driven only by the transitory component of productivity) to their benchmark model and find that this kind of financial friction cannot replace the trend shock explanation. Cicco, Pancrazi and Uribe (2007) allow for exogenous interest rate shocks and an estimated elasticity of the country premium to indebtedness. They find that such a model completely eliminates the need for having more volatile trend productivity shocks in emerging economies. Chang and Fernández (2009) – the paper included in the workshop’s programme, presented by Andrés Fernández from Rutgers University (US) – carry out a very careful Bayesian estimation and model comparison exercise, in which they consider endogenous interest rate spreads, a fixed elasticity of the risk premium to indebtedness and working capital requirements. Though they do not do an explicit horse race between the two explanations, their encompassing model assigns a dominant role for financial frictions in shaping fluctuations, and trend shocks turn out to be less important.

In his discussion, Péter Benczúr of the MNB pointed out that most of the existing literature limits its attention to

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\(^{11}\) Benczúr and Rátfai (2005) confirm the same pattern for Central and Eastern European countries.

\(^{12}\) This constraint means that firms must finance part of their wage bill in advance.

comparing the US and Canada with Argentina and Mexico. As countries are highly heterogeneous in their business cycle properties, one should be careful in drawing conclusions based on such a limited comparison. He also emphasised the need for having meaningful and structural financial frictions, and a complex interaction between the financial and the real side of the economy. Nevertheless, he strongly believes that a sufficiently enriched version of the basic open economy real business cycle model can explain many though far from all aspects of emerging market economic fluctuations.

INTERNATIONAL FINANCIAL MARKETS AND COUNTRY PORTFOLIOS IN OPEN MACRO MODELS

A number of papers in this year’s workshop addressed open economy aspects in business cycle models. They laid out methods with which our analysis of the determinants of structure and composition of country portfolios can be improved, applied existing methods to shed light on puzzles like the equity home bias or looked at the role of international financial markets assumptions for macroeconomic policy.

Behind the background of increasing international financial linkages, with gross asset and liability positions having grown rapidly in the last two decades, there are a number of questions that are becoming increasingly crucial to address in models of the open economy. These include, among others, the determinants of the size and composition of gross portfolio flows; whether standard theories can account for the observed structure of portfolio holdings; or if the large size of gross positions makes it likely that the portfolio composition itself will affect macroeconomic outcomes. Work in this area of research has, therefore, focused both on improving the methods of solving for country portfolios and on applying these methods to the recurrent topics and puzzles in this literature such as, for example, the empirical findings of a strong equity home bias or a low degree of international risk sharing. Until recently, existing open economy macroeconomic models have, to a large extent, ignored portfolio composition, and have limited themselves to analysing financial linkages between countries in terms of net foreign assets, with no distinction made between assets and liabilities.

The ways international financial markets have been modelled and what set of available asset to allow in open economy macro models were largely constrained by technical difficulties. Portfolio theory tells us that the composition of a portfolio depends on the risk properties of the available assets. The typical approximation methods for DSGE models take the non-stochastic steady state as an approximation point, that is, they analyse the dynamic properties of the model economy around a long-run equilibrium that is reached if no disturbances hit the economy. At such point, by definition, there is nothing that distinguishes one asset from another and there is nothing that pins down what asset a country’s agents would like to hold: the portfolio is indeterminate. Recently, there have been major advances in this literature: a number of authors, most notably Devereux and Sutherland (2007, 2008), have suggested techniques to derive the optimal portfolio composition in dynamic macro models. They show that using standard first-order solution techniques it is possible to determine the ‘near-stochastic’ optimal portfolio allocation around which the non-linear dynamic model can be approximated. Furthermore, they show that using simple second-order approximation techniques, it is possible to characterise the dynamics of this portfolio.

In a paper written jointly with Luca Dedola (ECB), Giovanni Lombardo (ECB) extends the results of the Devereux and Sutherland (DS) method along several dimensions. While the DS method requires for its solution that the portfolio allocation only enter in the equilibrium conditions multiplicatively with excess returns, the authors show that in certain cases of economic interest one needs to apply a more general solution technique. This is the case, for example, if one were interested in solving a Ramsey optimal policy problem with multiple agents and assets under incomplete markets. In

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14 Benczúr and Rátfai (2009) document this heterogeneity.
15 Home equity bias refers to the strong empirical finding that countries tend to hold a large fraction of their overall equity portfolio in terms of domestic equity.
16 That is, the stock of total external assets or the stock of total external liabilities. In contrast, the net foreign asset position is defined as the difference of gross assets over gross liabilities.
17 The degree of international risk sharing determines how sensitive a country’s consumption behaviour is in response to country specific shocks. Under full risk sharing all countries benefit equally from a shock that occurs in any country, in the sense that the utility of an extra (marginal) unit of consumption is equalised across countries. If the degree of international risk sharing is imperfect, the world allocation is inefficient in that the marginal utility of consumption in one country will be generally larger or smaller than in other countries.
18 Cottle and van Wincoop (2007) present an essentially identical solution method (by proposing iterative techniques) that allows a general class of open economy model with multiple assets to be solved using standard algorithms, while Devereux and Saito (2006), Evans and Hnatkovska (2006) and Rudd et al. (2001) describe alternative solution approaches.
19 That is, a Ramsey policy problem is a setup in which a benevolent planner (the policy-maker) that is fully aware how the economy behaves and that takes this into account, optimally chooses a policy instrument such as to maximise lifetime utility of agents.
particular, they show that when the portfolio terms appear only in such a way that they enter multiplicatively with excess returns – or in general terms that are zero at the non-stochastic steady state (the ‘Zero Jacobian case’) – then the DS method can be applied and the zero-order (steady state portfolio) and first-order portfolio (portfolio dynamics) can be solved separately, and in one step after another. In case this is violated and the portfolio terms also show up multiplying terms that are non-zero at steady state (the ‘Singular Jacobian case’), the zero-order (constant) and first-order (dynamic) portfolio need to be solved for simultaneously, in an iterative algorithm. The paper further clarifies the relations between the Devereux-Sutherland methodology and the approach proposed by Judd and Guu (2001), showing that both approaches share the same formal foundations. In a number of examples the authors show how their extensions of the DS method are of interest not only per se, but can be used in a number of applications in economics such as solving problems of finding the optimal monetary policy (Ramsey problems), models involving some collateral constraint problems or in economies with heterogeneous agents.

A contribution that evaluates the ability to generate equity home bias in a sticky price model with capital accumulation was presented by Ebrahim Rahbari (London Business School, LBS). In the model, world agents face real exchange rate risk and human capital risk (risk from labour income). The author considers agents to be able to hold either (domestic or foreign) equities or (domestic or foreign) nominal bonds. Crucial for the understanding of how countries would like to hold their portfolios is to understand what types of risk can be hedged with what assets held. He shows that, in response to a productivity increase, labour income falls – when economies are faced with price rigidities – while dividends increase as a result of the now higher profits (profits increase both because of the higher productivity and the lower wage bill that needs to be paid out). As a result, domestic equity provides a high payoff at times when labour income is low, and is a good hedge against labour income risk. A similar (negative) co-movement of labour income and dividends can result from investment efficiency shocks that temporarily increase the benefits of ongoing increased investment. This decreases dividends and raises labour effort, making home equity also a good hedge in response to this type of shock. But what about hedging against real exchange rate risk? It turns out that the assumption of nominal bonds as available assets means that they are not very effective hedges for real exchange rate risk (nor for human capital risk), and, as a result, the position in equities will reflect both the desire to hedge human capital risk and also real exchange rate risk. Rahbari shows that even though a sticky price model with capital accumulation can generate a home equity bias, the portfolios are not stable, but depend strongly on specifications of preference parameters (which determine the extent of real exchange rate risk). The empirical analysis of the paper, namely, a vector autoregressive model estimated using sign restrictions, seems to support the idea that home equity bias is driven by the desire to hedge human capital risk and not real exchange rate risk for a set of industrial countries.

Robert Kollmann (European Centre for Advanced Research in Economics and Statistics, ECARES, Université Libre de Bruxelles), in joint work with Nicolas Coeurdacier (LBS) and Philippe Martin (Sciences Po, Paris), also analyses the issue of equity home bias using a two-country flexible price business cycle model in which agents can choose among domestic and foreign equities and domestic and foreign bonds to hedge the risks they face. Similarly to the previous contribution, the risk in this model world originates from the presence of productivity shocks and from shocks to the marginal efficiency to investment (which affect the benefits from investing an extra unit). The available assets considered are again (domestic and foreign) equities and bonds, but a crucial difference is that the latter are real bonds. In the case of real bonds, the relative return on real bonds is perfectly correlated with the real exchange rate. Therefore, bond holdings are used to hedge against movements in the terms of trade or the real exchange rate, while equity home bias, on the other hand, results from agents’ incentive to hedge risk that is unrelated to movements in the terms of trade. This is, in particular, labour income risk: a home investment boom induced by temporarily higher investment efficiency leads to a decline in home dividends at a time when output and, as a result, employment increase. Local dividends and local wage income are negatively related, at a constant terms of trade. The author shows that this co-movement also finds empirical support for a set of industrial countries. The equity positions generated from the model setup are not only realistic but also stable, in the sense that they do not hinge on preference specifications: as terms of trade movements are perfectly correlated with the difference between payoffs on Home versus Foreign bonds, they are hedged through the bonds portfolio. Equity home bias is generated only because they are a good hedge against labour income risk. The paper then goes beyond the analysis of equity home bias and looks at the model’s implications for portfolio dynamics,

20 A vector autoregressive (VAR) model is an econometric model in which the times series of (several) economic variables are jointly explained by past observations of these variables. As the way these economic variables may affect each other is typically not unique, there needs to be some additional structure imposed on the VAR, that is, it needs to be identified. An identification by ‘sign restrictions’ imposes this structure by forcing the impulse responses (to a shock) of the VAR model to behave qualitatively (a variable should increase or decrease) as we believe they should according to what we believe to be economically meaningful.
Showing incomplete markets) allocation.

markets world, improving over the flexible price (but closer to the ones that would occur in the efficient complete manoeuvre international relative price responses that are sharing a policy-maker is shown to find it optimal to increasingly important). Also, in a world of incomplete risk elasticities wealth effects under incomplete markets become goods are complements (as with very low substitution substitutes and also larger under financial autarky when goods are

as in Cole and Obstfeld (1991). In all other cases, terms of trade considerations lead the policy-maker to deviate from price stability. Because independent policy-makers generally fail to take into account the effect of the terms of trade on the other country’s welfare, there are welfare gains from coordination to be achieved. These turn out to be larger under complete risk sharing when goods are substitutes and also larger under financial autarky when goods are complements (as with very low substitution elasticities wealth effects under incomplete markets become increasingly important). Also, in a world of incomplete risk sharing a policy-maker is shown to find it optimal to manoeuvre international relative price responses that are closer to the ones that would occur in the efficient complete markets world, improving over the flexible price (but incomplete markets) allocation.

Katrin Rabitsch (MNB and CEU) presented a paper showing that the degree of international risk sharing across countries can be important in shaping optimal monetary policy in an open economy, and that the closed economy prescriptions of price stability as the optimal policy do not necessarily translate into the open economy. The reason for this finding is that policy-makers may not only be interested in stabilising domestic prices but also in affecting international relative prices (the terms of trade or the real exchange rate) strategically in their advantage. How to strategically affect the terms of trade depends on the amount of risk sharing obtained, which, in turn, depends on the assumptions on international financial markets together with trade elasticity – the elasticity of intratemporal substitution. In particular, the author studies financial market assumptions of complete financial markets, financial autarky, and an incomplete markets-bond economy, looking over a wide range of the elasticity, and contrasts differences between policy coordination across countries and the case in which countries’ policy-makers act in an uncoordinated fashion. She emphasises that (producer) price stability is a very special case, which only obtains when financial markets are complete and policy-makers act co-ordinately or when risk sharing across countries is automatically obtained through terms of trade movements, as in Cole and Obstfeld (1991). In all other cases, terms of trade considerations lead the policy-maker to deviate from price stability. Because independent policy-makers generally fail to take into account the effect of the terms of trade on the other country’s welfare, there are welfare gains from coordination to be achieved. These turn out to be larger under complete risk sharing when goods are substitutes and also larger under financial autarky when goods are complements (as with very low substitution elasticities wealth effects under incomplete markets become increasingly important). Also, in a world of incomplete risk sharing a policy-maker is shown to find it optimal to manoeuvre international relative price responses that are closer to the ones that would occur in the efficient complete markets world, improving over the flexible price (but incomplete markets) allocation.

The workshop provided an excellent opportunity for researchers of business cycle models and central bankers to meet and discuss the potential of the current DSGE models, understand their caveats and agree on the necessary avenues for future research. The main conclusion of the workshop was that even though current versions of the business cycle models are useful in ‘normal’ times, the current crisis requires serious rethinking of the standard ingredients and policy conclusions of these models.

Financial markets, for example, should be inserted into the standard versions of these models: the already developed ‘financial accelerator mechanism’ provides a potentially successful method for this. The debate has already started about how central banks should optimally set their monetary policy if financial markets are present both as sources and propagators of business cycle shocks.

There is also an ongoing debate about whether the standard assumption of rational expectations, which assumes – for consistency’s sake – that agents know everything about the structure of the model-economy, is too strong, and agents should rather be assumed to continuously learn about the behaviour of the economy (as economists do when facing serious recessions such as the current one).

The workshop also provided a great opportunity for researchers to present their results on topics such as the assumption of price stickiness, optimal policy questions, special issues related to open and emerging market economies, current developments in modelling international portfolio choices and problems with the estimation of these models that can greatly contribute to the structure and empirical validity of the standard DSGE models of the future.

CONCLUSION

The workshop provided an excellent opportunity for researchers of business cycle models and central bankers to meet and discuss the potential of the current DSGE models, understand their caveats and agree on the necessary avenues for future research. The main conclusion of the workshop was that even though current versions of the business cycle models are useful in ‘normal’ times, the current crisis requires serious rethinking of the standard ingredients and policy conclusions of these models.

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Appendix

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