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Liquidity management operations at the National Bank of Hungary

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1.1.1 Monetary policy strategies and objectives

The final goal is to maintain price stability

Monetary policy is responsible for achieving various objectives. The macroeconomic objectives pursued by central banks may vary on a wide scale, from promoting economic growth to delivering price stability. The rise of monetarist theories and negative experiences with high inflation have been responsible in the past decade for the growing acceptance of the view that *delivering price stability*[2] and thus ensuring predictable economic environment *should be the final goal* of monetary policy.

1.1.2 Implementing policy objectives

The path to achieving the final goal is paved with a number of issues to address. First, the instruments available for the central bank obviously do not exercise a direct influence on the final objectives. Therefore, the authorities need to make a choice of the key economic target variables and decide on the chain of target variables through which monetary policy may influence the attainment of its final goals. Second, an optimum set of instruments needs to be decided which helps the central bank influence its final goal the most efficiently via the transmission mechanism.

Central banks may achieve price stability via a choice of intermediate targets

Various implementation *strategies* may lead to the achievement of the ultimate policy goal. When designing the monetary policy strategy, the choice needs to be made on how the ultimate goals will be attained. The process of developing this strategy includes choosing *intermediate targets*, implementing the forecasting mechanisms and deciding on those *indicators* which may provide useful in-

[1] This Section of the Paper relies extensively on the handbook by Borio (1997).

[2] Price stability, as a final objective, does not imply that generally central banks target a zero inflation rate over the longer term. Among those central banks which have explicit inflation targets, the European Central Bank, for example, regards as acceptable inflation rates between 0–2 per cent, while the Bank of England has a 2.5 per cent inflation target. Consequently, the ultimate objective of central banks is low and stable inflation.

formation relevant for the influences of monetary policy, its final goals and the operating environment of monetary policy, i.e. the money and capital markets. Deciding on the central bank's communication strategy vis-à-vis market participants is also an element of the overall strategy framework.

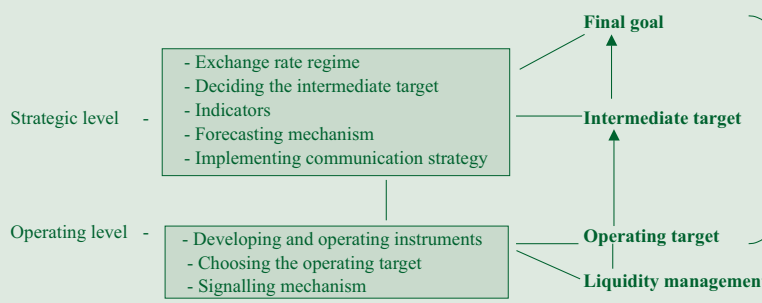
Generally, the *intermediate targets* are economic variables which are closely related to the ultimate goal of monetary policy and are easier to control using central bank instruments than the final goal itself. The choice of an intermediate target may cover the *exchange rate*, the *nominal income level*, the nominal *quantity of money*, the *credit aggregates*, although monetary policy may opt for *inflation targeting* as well.

The *indicators* are economic variables which carry relevant information in respect of the ultimate goal. Some of these are financial variables, such as the slope of the yield curve, money and credit aggregates, bond yields, the exchange rate and other sets of policy instruments. Other indicators are non-financial variables, for example, price and cost variables, indicators of aggregate demand and supply, including the current account and surveys of market expectations.

As a rule, central banks do not directly control the economic variables playing a role at the strategic level of implementation (indicators, intermediate targets); and policy decisions on the strategy generally are taken for horizons longer than one month (see Chart 1).

Chart 1

Levels of monetary policy implementation



Deciding on and operating the set of instruments as well as managing liquidity by the central bank belong to the tactical level of monetary policy

By contrast, *operating procedures* have much to do with the implementation of monetary policy. This level involves the design and operation of *monetary policy instruments* and the choice of *operating targets*, which, being more closely related to the developed set of instruments, substitute for the missing link between the intermediate target and the available instruments. Any short-term, but not neces-

sarily overnight, money market interest rate may be chosen as the *operating target,* although the central bank may adopt a rate taking stance, which means controlling the interest rate level through the quantity of central bank money.

> Since the 1980s, central banks have increasingly adopted interest rate targeting instead of a quantity-oriented approach. The explanation for this is that, in a quantity-targeting framework, the variability of short-term rates tends to be higher, which may endanger the achievement of the intermediate goal. Another feature has been the reduction in the maturity of the operating target. In many countries, the authorities directly aim at the overnight rate, or, at least, they allow overnight rates to fluctuate within a narrow band around the interest rate targeted at a longer maturity. There are several reasons for shortening the maturity focus. First, central banks are less and less willing to interfere with the operations of the market (market-oriented monetary policy), and they would like to extract as much information as possible from current interest rate levels about market participants' interest rate expectations. Second, at longer maturities central banks are less able to resist speculation attached to official interest rate changes.

Adoption of an operating target facilitates the achievement of the intermediate and, later, the ultimate goal via the *transmission mechanism*. *Operating instruments* can be, for example, official interest rates, open market operations (e.g. repo tenders), reserve requirements or direct instruments often used in the past, such as credit, deposit or interest rate ceilings. Basically, the *operating procedures* deal with the implementation of policy *on a daily basis*, although the planning horizon may extend to one month or even longer.

1.2 Demand for and supply of reserves

1.2.1 Components of demand for reserves

Usually a short-term money market interest rate is chosen as the operating target

Central banks in most countries influence their operating objective using market-oriented instruments, which is usually any short-term market rate.[3] They determine the conditions that equilibrate supply and demand in the market for bank reserves. The market for bank reserves is a very special one. The central bank is in a monopolist position in terms of supplying reserves, so it can directly affect equilibrium. There are two sources of commercial banks' demand for reserves. On the one hand, they need liquid assets, which can be immediately converted into cash so as to meet their clients' demand for cash and to transact their daily businesses (working balances). On the other hand, provided that the central bank operates a compulsory reserve system, banks have to comply with the reserve requirements imposed by the central bank (required reserves). Com-

[3] The maturity of the operating rate may vary on a very wide scale. Some banks target the overnight rate, others target longer maturities, i.e. those between 3 to 6 months.

mercial banks may not only obtain finance from the central bank, but from other banks as well. In the *interbank market*, i.e. the organised market for central bank funds, banks lend their surplus liquidity or raise additional finance among themselves at the interbank market rate. However, the market as a whole may only access additional liquidity at the central bank.

1.2.1.1 Working balances

Working balances are required to meet banks' settlement needs

In the absence of reserve requirements, the demand for central bank money is equal to the demand for *working balances*, i.e. those required to meet settlement needs. Although, apart from some exceptions, central banks do not as a rule require banks to meet their settlement needs using their accounts with the central bank, banks do so for a number of reasons. These include the following:

- they have direct access to the ultimate source of liquidity,
- they can reduce credit risks (by entering into payment transactions with risk-free participants),
- the central bank is a neutral participant from competitive considerations.

As working balances bear no interest, to have a positive working balance at the end of the day means to incur some cost equivalent to the interbank overnight rate (*opportunity cost*). Nevertheless, banks tend to hold positive working balances for precautionary reasons, as in this way they aim to reduce the risk of having urgently to obtain additional liquidity at above-market interest rates owing to the inability to meet their settlement obligations. In addition to the institutional and operational characteristics of payment and settlement systems, the demand for working balances is largely determined by the terms and conditions of central bank assistance. Generally, banks would tend to keep their working balances to a minimum. Whenever the settlement system enables banks to lend surpluses or borrow funds after the net positions arising as a balance of their daily transactions become known, the level of precautionary holdings may be reduced to the minimum, even to zero. If the central bank is willing to lend on better conditions than those of the market, then banks may even target negative balances.

Demand for working balances is unstable and it reacts only moderately to fluctuations in O/N rates

Owing to the reasons discussed above, the demand for working balances is insensitive to changes in the overnight rate within the usual band around the expected interest rate trajectory. Reductions in overnight rates do not themselves induce an increase in the demand to hold working balances. However, at the aggregate level, the demand for working balances may be very unstable, especially if banks fail to efficiently manage their positions or there are technical or behavioural impediments to the smooth redistribution of reserves in the system. If the demand for reserves is both interest inelastic and

unstable, managing the supply of liquidity by the central bank on a daily basis is required to avoid undesired fluctuations in the interbank overnight rate.

1.2.1.2 Reserve requirements

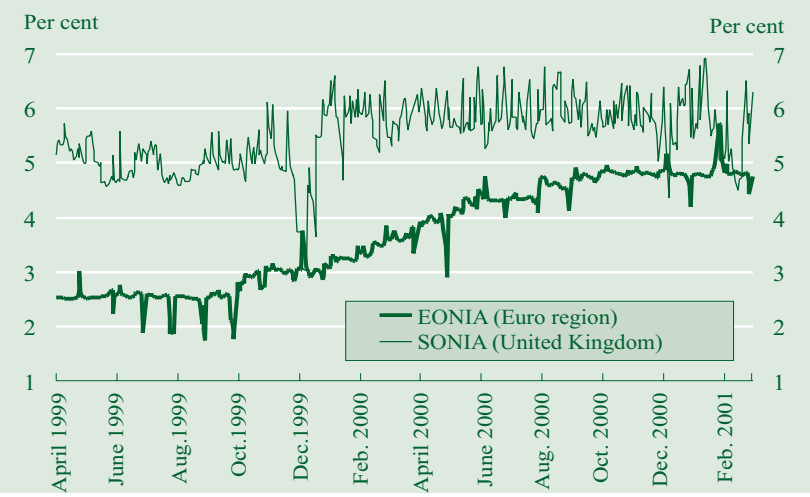
The monetary authorities use *reserve requirements* for a number of reasons. Historically, these were used by central banks as a prudential instrument – to ensure that banks had sufficient liquidity in case of withdrawal of deposits. With the development of financial markets and the reduction in compulsory reserves, this prudential role of the instrument has lessened, and the monetary policy functions of reserve requirements have come to the fore.[4]

The reserve rate has increasingly become a tool for central bank liquidity management

From a monetary policy perspective, required reserves may serve two important functions. Owing to the inelasticity of banks' demand for working balances, volatility in interbank rates may be high in case of a twist in liquidity conditions. Reserve requirements, if accompanied by averaging provisions, alter the interest rate sensitivity of banks' demand for reserves, and they thus help manage liquidity shocks while reducing volatility in interbank rates. Chart 2 plots overnight rates in the euro area and the United Kingdom. While in the euro area there is a 2 per cent reserve requirement in force and the averaging period is one month, there is practically a zero reserve holding requirement in the United Kingdom, with no reserve averaging provisions. Whereas euro overnight rates generally are very stable, apart from the last day of the maintenance period, sterling overnight rates show a high degree of volatility.

Chart 2

Overnight rates in the euro area and the United Kingdom



[4] See Gray, Hoggart and Place (2000).

The other, explicitly monetary policy reason is to create stable demand for central bank money. Stable money demand, in turn, provides a more predictable environment for conducting central bank open market operations, or, as the case may be, the requirement to hold reserves can be used to create a structural shortage of liquidity in the market.

If required reserve holdings with the central bank are unremunerated or are remunerated at below market interest rates, then reserve requirements can be regarded as a source of income from issuing money (*seigniorage*) or a tax on banks.[5]

Required reserves and averaging increase the interest rate flexibility of banks' demand for reserves

In a compulsory reserve system, commercial banks are required to hold as reserves at the central bank a percentage of customer deposits and other liabilities. Two preconditions need to be fulfilled in order for compulsory reserves to directly affect marginal demand for reserves. First, it should be possible for banks to use reserve requirement holdings to meet settlement needs. Second, the amount of reserves banks need to hold to comply with the reserve requirement should exceed their working balance target. On those days when banks are required to hold a given level of reserves on their settlement accounts to comply with the reserve requirement, they cannot have recourse to their reserve holdings as working balances, i.e. to meet their liquidity needs. In these cases, the above two conditions cannot be met, and marginal demand for reserves is determined by additional demand for reserves needed for the operations, above the reserve requirement. Banks are obliged to comply with the reserve requirements on average over a period, ensuring that the two conditions, noted above, are met. This opens the way for banks to hold lower balances on their reserve accounts than the reserve requirement over a certain period, provided that they make adjustments at a later stage in the maintenance period.

Within a reserve averaging mechanism, banks' compliance may differ from the requirement temporarily...

If banks are obliged to comply with the reserve requirement over a certain period, i.e. on the average of the *maintenance period*, then balances held on settlement accounts may serve as a buffer in face of unanticipated liquidity shocks, which also helps reduce the volatility of overnight interbank rates. This means that, if there is an additional need for liquidity in the market, then this will not result in a rise in overnight rates, as temporary shortages can be met using the reserve account.

...so banks may react to changes in liquidity conditions without a considerable change in overnight rates

In the averaging mechanism, the demand for reserves is unchanged at any point in time within the maintenance period, if the opportunity cost of holding the given position, i.e. the overnight rate, is expected to change little over the remainder of the maintenance

[5] This function of reserve requirements is probably the most transparent at the Bank of England, where the required reserve ratio is theoretically zero, however, depository institutions are required to hold a 0.15 per cent non-interest-bearing deposit with the authorities (Cash Ratio Deposit), in order to finance certain expenditures of the central bank from the profits generated on those deposits.

period. Under these conditions, the demand for reserves will react very sensitively to even a slight shift in the interest rate level, so on-average compliance acts as a buffer indeed. As the end of the maintenance period draws near, the buffer function reduces. Explanation for this is that, as time passes, cumulative reserve holdings tend to gradually narrow commercial banks' room for manoeuvre to manage their liquidity, given that the number of days remaining and hence time to adjust for the deviation from the requirement lessen. Consequently, the interest rate sensitivity of the demand for reserves diminishes with the reduction in time remaining until the end of the maintenance period, and on the last day demand for reserves must equal the sum of reserves needed to comply with the requirement and the demand for operational reserves.

With reserve averaging, there is less need for active central bank liquidity management

This means that, if the compulsory reserve system is such that banks must comply with the requirement on average over a certain period, then there is less need of active central bank liquidity management. The extent to which this is true depends on the level of required reserves, the length of the averaging (maintenance) period, and also on how banks are willing to exploit the expected swings in the overnight rate in the interbank market.

Central bank liquidity management means controlling the supply of reserves in order to meet the operating target

Given the characteristics of the demand for bank reserves, the central bank's task is to regulate the supply in order to achieve its interest rate or quantitative targets. Basically, there are two aspects of this function. First, supply and demand need to be balanced. In other words, liquidity needs to be adjusted to demand. This is called *liquidity management*. Second, if the central bank wishes to control the operating variables by adjusting the supply of liquidity to demand, then it has to emphasise this for market participants through adequate communication channels. This is called *signalling mechanism*.

Part of the supply of reserves stems from items autonomous or exogenous for the central bank

In countries where, owing to some reason (for example, due to the fixed exchange rate), there is abundant structural liquidity, absorbing surplus liquidity created by *autonomous* factors constitutes an area of *liquidity management*. The autonomous sources of liquidity are those which cannot or can only indirectly be controlled by central bank instruments. They include, for example, the rise in the stock of net foreign exchange reserves and in the other items on the assets side, or the decrease in government sector deposits with the central bank and in the value of currency in circulation (see Table A). If the supply of central bank reserves is higher than banks' demand for reserves, there is an autonomous liquidity surplus.

As the stylised balance sheet of the central bank shows (Table A), the (ex post) change in reserves depends on changes in the other items of the central bank balance sheet, and is determined by the following formula:

Δ **Reserves (7)** = Δ Central bank holdings of government securities **(1)** + Δ Claims on banks **(2)** + Δ Net foreign exchange reserves **(3)** + Δ Other net assets **(4)** – Δ Liabilities to the general government sector **(5)** – Δ Liabilities to banks above reserves **(6)** – Δ Banknotes and coin **(8)**

But the other part of supply is controlled by the central bank

The factors affecting the change in reserves can be categorised into two groups. Those which the central bank cannot or can only indirectly control (items denoted with **A**) and influence liquidity autonomously, discussed above, belong to the first group. The items under the direct control of monetary policy, i.e. central bank claims on banks and commercial banks' deposits with the central bank above reserves, comprise the second group. The central bank can directly influence the supply of liquidity (reserves) through changes in these items. Accordingly, given the demand for reserves, the supply of reserves can change for two reasons – first, through the effect of autonomous items (*autonomous liquidity effect*) and, second, as a result of liquidity management, i.e. through the change in banks' net positions vis-à-vis the central bank, excluding reserves (*central bank-generated change*).

Autonomous liquidity position = Δ Net foreign exchange reserves (**3**) – Δ Liabilities to the government (**5**) – Δ Notes and coin (**8**) + Δ Other net assets (**4**)

Central bank-generated change = Δ Central bank holdings of government securities (**1**) + Δ Claims on banks (**2**) – Δ Liabilities to banks above reserves (**6**)

Table A

Stylised central bank balance sheet

Assets	Liabilities
Claims on general government (government securities)* **(1)**	Liabilities to general government (A) **(5)**
Claims on banks **(2)**	Liabilities to banks above reserves **(6)**
Net foreign exchange reserves (A) **(3)**	**Reserves (7)**
Net other**(A) **(4)**	Notes and coin (A) **(8)**

Note: '(**A**)' denotes autonomous items from the perspective of liquidity management.

* For the sake of simplicity, we assume that the central bank does not provide finance to general government even for the short term, and the purpose of holding government securities is solely related to liquidity management.

** Holding gains/losses from revaluation of assets and equity have been classified as net other items.

The change in net liquidity equals the additional liquidity which the central bank has to ensure in order to create market equilibrium

Suppose the central bank's aim is to maintain market balance, i.e. to equilibrate supply and demand in the market for reserves while keeping the level of interest rates unchanged. Then the change generated by the central bank must be equal to the difference between the autonomous liquidity effect and the demand for reserves at a given interbank interest rate level, (Δ^d bank reserves), i.e. the *change in net liquidity*.

Change generated by the central bank = **Net liquidity position** = Autonomous liquidity position – Δ^d Bank reserves

The net liquidity position is equal to the additional amount of liquidity which the central bank must ensure in order to balance the market. An important element of liquidity management is the forecast of the net liquidity position. If the supply falls short of the forecast, there is a *liquidity deficit*, so the central bank needs to inject additional liquidity into the system. The opposite case is a – liquidity surplus. Then the central bank needs to withdraw liquidity.

Liquidity deficit: assets side instruments, liquidity surplus: liabilities side instruments

In principle, central banks are able to manage both liquidity deficits and surpluses. However, a number of central banks prefer operating as net lenders at short maturities, rather than as net debtors, on the liabilities sides of their balance sheets. In addition to influencing banks' marginal demand for reserves, reserve requirements can be aimed at raising the average level of the demand for reserves, thereby creating a net liquidity deficit. In certain instances, monetary policy operates only with assets side instruments at shorter maturities. Consequently, its major policy instrument is only able to create additional liquidity, and the central bank therefore can merely influence its operating target in liquidity deficits (*asymmetric systems*). In these mechanisms, central banks need to create liquidity deficits over the longer run in order to ensure that the operation remains active. If monetary policy operates in a liquidity deficit, i.e. on the assets side, then it influences commercial banks' marginal cost of funds; in the opposite case, it influences the marginal rate of available investments on the liabilities side, thereby affecting movements in returns. It is generally regarded as more useful from the perspective of the operation of the transmission mechanism, if the central bank influences banks' cost of funds, i.e. if it operates on the assets side, in a liquidity deficit.

When implementing the operating framework, one of the key objectives is to limit the volatility in interbank rates caused by the variability of liquidity conditions. However, it is also important that the central bank should not take over the task of managing individual banks' liquidity, and hence it should not impede the deepening of the interbank market and the increase in its efficiency.

Variations in the overnight rate may lead to volatility of yields serving as the operating target

A more stable overnight rate fosters the transparency of monetary policy. If the variability of overnight rates spills over along the yield curve, then this may set rates serving as the operating target into motion as well.[6] As a result, monetary policy will lose some of its transparency, as the change in the operating interest rate level is also influenced by variations in the liquidity situation existing at any given moment. With financial markets becoming international and the mobility of capital flows increasing, exchange rate movements and money market interest rates are more and more sensitive to expectations attached to monetary policy. Thus, expectations are gaining an increasing role in the transmission mechanism, and the cost of false 'signals' also rises. The central bank amplifies its influence on market expectations by controlling the volatility of short-term money market interest rates. At the same time, it reduces the danger of the market misinterpreting the reason for the change in rates and drawing false conclusions regarding the objectives of monetary policy. The more successful the central bank in accurately surveying the net liquidity position, the smaller the risk of large swings in the overnight rate. The averaging mechanism of reserve requirements helps reduce the volatility of the overnight rate, but certain central bank instruments may effectively and directly curtail volatility of the overnight rate.

1.3 Central bank instruments to control liquidity

Central banks have many instruments to control liquidity

The instruments of central banks to manage liquidity and achieve the operating targets (apart from the reserve requirements system) can be grouped in different ways. They can be distinguished based on their technical form, the frequency of their use, or whether a given instrument is discretionary or accommodating (*standing facility*).

Technical forms of central bank instruments

Taking into account the *technical form* of instruments used in the developed countries,[7] the following instruments can be distinguished:

(a) *outright sale and purchase of government securities* – The central bank transacts in government securities *in the secondary market* in order to influence liquidity. If the central bank sells securi-

[6] Consequently, the shorter the maturity of the money market rate the central bank targets, the most it should do in order to limit interest rate fluctuations arising from the variability in liquidity conditions.

[7] With the development of money and capital markets, central banks have increasingly abandoned direct tools (credit and deposit restrictions, interest rate ceilings).

ties, it withdraws liquidity from the system, if it buys securities, it injects additional liquidity. The preconditions for the use of the instrument are that a sophisticated and liquid market in government securities should exist, and that the central bank should hold enough paper to trade. Here, the central bank initiates the use of the instrument. This, however, is not binding for market participants.

(b) *sale and repurchase agreements or repos*[8] – Repo transactions consist of two opposing deals, the conditions of which are determined by the parties in advance. In the first leg to the transaction, the central bank buys (sells) the security spot, while in the second leg it repurchases (resells) the same security at a price and future time according to the predetermined terms of the contract. The cash flow on the two transactions equals the cash flow on a collateralised loan. From the perspective of the central bank, a temporary purchase (*repo*) means that the central bank supplies liquidity for the period between the two opposing transactions; a temporary sale (*reverse repo*) means that it withdraws liquidity from the system.[9]

The object of a repo deal can be a *domestic security*, generally a government paper, but it may also be a *security denominated in foreign currency*. In case of a temporary purchase of foreign currency, the central bank creates additional liquidity. A sale of foreign currency, in contrast, means a withdrawal of liquidity from the system.

(c) *issue of short-term money market securities* – The central bank sells securities issued on its own in the primary market, instead of government paper, thus it withdraws liquidity from the system for the period remaining until maturity of the security.

(d) *central bank acceptance of deposits* – A common method of withdrawing liquidity from the system is the acceptance of deposits by the central bank. In this case, the counterparty places a deposit with the central bank, but the central bank does not provide a collateral to secure the deposit, unlike in the case of a reverse repo. (In countries, where the reverse repo facility is in use, the security underlying the transaction has a function other than collateral, as commercial banks do not question the solvency of the central bank. Rather, the security serves as a tool for banks to enter into further transactions among themselves.)

(e) *central bank lending (refinancing, rediscounting)* – The central bank may increase the supply of liquidity by direct lending to

[8] Repo is the major policy instrument in most countries.
[9] For a detailed survey of repo transactions, see Szakály and Tóth (1999).

commercial banks, generally against the pledge of some collateral. Loans may be granted at a predetermined interest rate or at an interest rate evolving on a tender, with the central bank having the choice to limit the amount of loan by counterparty (refinancing line).

(f) *reserve requirements* – Banks are required to hold as reserves at the central bank a percentage determined by the reserve ratio of deposits collected and other liabilities. The reserve requirement acts as a tool for liquidity management via two channels. First, the central bank may create a structural liquidity shortage (surplus) by raising (lowering) the reserve ratio. Second, if the banks are required to comply with the reserve requirement over a given period on average, then reserves serve as a buffer in face of fluctuations in the overnight rate. This is certainly the more important influence of reserve requirements.

1.3.1 Standing facilities vs. discretionary instruments

Banks decide the amount of standing facilities to be employed

If a given instrument is *discretionary*, the central bank decides whether to use it or not, or how much additional liquidity to supply or withdraw from the system. *Standing facilities*, in contrast, are at the disposal of market participants, i.e. they can be activated on demand by banks. The individual elements of the instruments cannot be definitely categorised into either group. Either of them may be a marginal source of satisfying liquidity needs or absorbing surplus liquidity. But banks have increasingly preferred to use discretionary operations to make the required adjustments in marginal liquidity. Typical discretionary tools are, for example, the outright sale or purchase of securities and repurchase agreements. The role of discretionary tools is becoming more and more important in liquidity management.[10] *Standing facilities* are used in three areas: (i) they are employed as safety valves to manage end-of-day imbalances, or (ii) to maintain the upper and lower boundaries of the interest rate corridor setting the limit for fluctuations in the overnight rate and, finally, (iii) in some cases to act as a source of subsidised intramarginal liquidity.

The role of discretionary instruments has been increasing

Two systems for liquidity management can be distinguished parallel with the various categories of instrument. In the case of *accommodating liquidity management* dominated by the use of stand-

[10] In countries with no averaging provisions, or the effect of foreign exchange market intervention is difficult to forecast due to the fixed exchange rate mechanism, standing facilities continue to have an important role.

ing facilities, the central bank does not directly influence the amount of reserves, but it stands ready to deal with commercial banks by offering loans and accepting deposits at predetermined interest rates. This approach is quite different from active liquidity management, as movements in the quantity of liquidity are determined by the market. *Active liquidity management*, i.e. that which relies on discretionary tools, is becoming more and more general in countries with developed money and capital markets. Within this operational framework, the central bank decides how much liquidity it is ready to supply or withdraw from the system, and it influences interest rates via the quantity of liquidity. A precondition for the efficient operation of active liquidity management is the accurate forecast of interbank liquidity and the net liquidity position.

1.3.2 Regular vs. irregular operations

In countries, where reserve requirements apply on average over a certain period, generally a distinction is made between regularly and irregularly used instruments. Regular operations are undertaken at a regular frequency, announced in advance. These transactions generally serve the purpose of controlling mass needs for liquidity, their timing and maturity being closely related to the maintenance period. (Those instruments used regularly include standing facilities as well. Standing facilities serving the steering of the overnight rate within the corridor are offered on a standing basis.)

Operations conducted irregularly generally are given a complementary role. Typically, these instruments are used in three different areas, in order to manage infrequent liquidity problems.

Infrequently used instruments may also be operated to fine-tuning liquidity…

The most frequent area of irregular instruments is fine-tuning within the reserve maintenance period. This type of operations is used both to absorb surplus liquidity and to provide additional resources in cases of liquidity shortages. In countries, where reserve requirements are applied with averaging provisions, there may be a need for 'additional' fine-tuning with the end of the maintenance period drawing near, as the buffer function of reserves reduces. These instruments may be necessary to use more frequently in countries with no averaging provisions.

The second characteristic area of conducting irregular operations is *rough tuning*. These operations are designed (i) to provide liquidity for longer periods than those characteristic for regularly operated instruments and (ii) to absorb the impact of occasional, predictable fluctuations in liquidity (e.g. seasonal influences, foreign exchange market intervention)

....or to create liquidity shortages

Finally, irregular instruments are also used artificially to create net liquidity deficits. Generally, this practice is followed in asymmetric systems, where the central bank's major policy instrument is only able to provide liquidity (see above).

1.3.3 Maturity of central bank instruments

The maturity of instruments is determined by their use

The maturity of the instruments can vary widely depending on the purpose for which a given instrument is used. Instruments used to control structural liquidity, to provide medium and long-term refinancing, or artificially to create liquidity shortages are of longer maturity. Sometimes central banks use two instruments with different maturities to control structural liquidity. The maturity of one instrument generally extends over several maintenance periods. That of the other ends even during the maintenance period.

Typically, the maturity of instruments is short

Typically, the instruments serving the day-to-day management of liquidity and the *major policy instruments*[11] are of short maturity. The maturity profile of the major policy instrument is consistent with the horizon of the operating interest rate target, but the relationship is not as close as one might think in the first instant. There is no need to operate instruments at this maturity in order to influence the money market rate with a given maturity. Standing facilities used to maintain the overnight rate corridor provide the exception, as the maturity of the instrument must be equal to that of the operating variable.

1.4 Liquidity control and communication

The role of communication by the central bank is becoming more important

The implementation of monetary policy can be divided into two areas. First, by smoothing out movements in short-term interest rates, the environment needed for the implementation of the operating target via liquidity management operations should be created. Second, liquidity and the interest rates need to be influenced in order to achieve this objective. Communication, or *signalling mechanisms*,[12] complement, and partly substitute, this latter activity. The role of central bank communication strategy has recently been in-

[11] The key policy instrument is the central bank tool used to achieve the operating target.

[12] One extreme example for this is Switzerland, where the key policy instrument exists only nominally. The interest rate announced on the instrument, called major policy instrument but out of use in practice, serves as the policy rate. In this case, even without a change in liquidity, market rates move in the desired direction at the appropriate signal, that is, communication has taken the role of actively influencing the operating target.

creasing. There are technical reasons for this,[13] such as the very low elasticity and stability of the demand for working balances and the dominant role of interest rate expectations in the demand for reserves. The increasing importance of central bank communication can be traced to the broad changes in the environment of monetary policy as well. First, central banks' aim is to less and less interfere with the operations of the market. Second, with a greater central bank independence the requirement to make policy accountable has increased. Third, the role of expectations about monetary policy and hence the cost of false expectations have increased as a result of the rapid development and globalisation of financial markets.

The central bank may choose to communicate via its *key policy instrument* or via direct *press releases*. It is increasingly characteristic for communication strategy to announce the operating target explicitly, i.e. in press releases, speeches or pronouncements (open mouth policy).

The explicitness of interest rate signals depends on the form of central bank operations in the market

The explicitness of signals conveyed through keynote tender operations largely depends on the selling mechanism applied. The clearest signal is the one that is transmitted through fixed-rate (*volume*) tenders. The situation is less clear-cut, if sales are conducted through variable-rate tenders (*interest rate tender*), when marginal interest rates are published ex post.[14] In this case, it is more difficult to judge whether the outcome of the tender reflects the acceptance by the central bank of minor fluctuations around the desired level or difficulties of the central bank in reconciling the interest rate bids with its liquidity management objectives.

Standing facilities may also have a signalling role

A potential drawback in using regular tenders to convey signals is that the central bank cannot provide any messages in periods between two tenders. This problem is particularly relevant for countries with fixed exchange rates, where policy must react fast to changes in market developments. In this case, interest rates announced on standing facilities, which can be changed even between two tenders, may be given a prominent role in communication. Generally, these instruments can be efficient tools to complement the practice of communicating through tenders, especially if the keynote operation is a variable-rate tender.

It should be made clear whether the individual steps of the central bank are aimed at influencing the operating variable or just at liquidity management purposes

The precondition for an efficient communication strategy is that the central bank should distinguish its measures taken for the purposes of liquidity management from those with which it wishes to influence its operating target. This distinction can be made clear in two ways. One possible solution is for the central bank to act as a price setter in one segment of the money market, e.g. in the market

[13] These were portrayed in detail in the chapter on the demand for reserves.

[14] The variable rate tender does not give signals if the central bank does not announce the interest rate level evolving at the tender. Generally, this happens in cases when the central bank uses the policy instrument with the sole purpose of managing liquidity.

of reserves, and to implement its operating target in this market, while operating as a price taker in another segment (for example, the repo market), where it implements its liquidity management objectives, hardly giving information about these operations.[15] Generally, central banks make their steps aimed at controlling liquidity as price takers, giving as little information about these operations as possible.

As a rule, central banks' communication strategy procedures do not rely exclusively on one key policy instrument – most of them use a variety of complementary tools as well. For example, standing facilities, already noted, may be operated, but the central bank may send signals by adjusting the conditions of a regularly operated instrument, i.e. by altering the quantity of additional liquidity ensured with the given instrument, the time of its use, the maturity of the instrument or its price. Some central banks operate their regular instruments by pacing the injection of liquidity into the market. If the use of the instrument is brought forward or postponed, or the quantity of liquidity is changed, then these may transmit fine signals to the market about the stance of monetary policy.

[15] Exactly this happens in the USA, where the FED follows its operating target in the market of federal funds, while manages liquidity in the sophisticated private repo market.

2 | Liquidity management practices of the National Bank of Hungary

2.1 The environment of liquidity management

Factors determining the monetary policy instruments of the Bank

The monetary policy instruments, and particularly the liquidity management operations, of the National Bank of Hungary basically are determined by three factors:

l. the narrow-band exchange rate regime;

2. the Bank's major policy tool is its deposit instrument. In other words, the Bank influences market interest rates using the liabilities side instruments of its balance sheet;

3. the Treasury Account (in the following: KESZ) is held at the Bank.

In the following, we will review the implications of these factors for central bank liquidity management, and how the Bank's policy instruments have been adapted to these conditions.

The Bank's intermediate objective is the nominal exchange rate

The *final goal*[16] of the Bank is to reduce inflation and to deliver price stability. The *intermediate target*, in turn, is the nominal exchange rate or the exchange rate path. The chosen intermediate goal for a small open economy with an around 10% inflation rate is particularly suitable for playing the role of nominal anchor. The exchange rate directly influences the prices of tradable goods, so the pre-announced and credible exchange rate path has a direct impact on broad price levels and expectations, and may well be an efficient tool of cooling down inflation expectations. Hungary introduced the crawling-peg exchange rate regime in 1995. The forint, its exchange rate being fully pegged to the euro since 2000, is devalued daily by the pre-announced devaluation rate. The market rate of the currency may depart from this value within a ±2.25 per cent wide band. The central bank provides assistance for commercial banks at both the ceiling and the floor of the intervention band, by buying currencies at the ceiling and selling currencies at the floor (foreign exchange market intervention).

The Bank's operating target is the 3 to 6 month interest rate level

The *operating target* of the Bank is the maturity bracket which is the most relevant for interest rate transmission, i.e. 3–6 month interbank rates and government securities yields. The Bank's interest rate policy is aimed at maintaining an interest rate level which, in

[16] For a detailed discussion of the NBH's objectives and the exchange rate regime, see the Bank's publication 'Monetary Policy in Hungary'.

harmony with the anti-inflationary objective, facilitates the maintenance of external balance via its effects on savings and investment.

The consequence of a narrow-band fixed exchange rate regime is that the central bank has to intervene quite often and in a passive way in the foreign exchange market. Apart from the few months of the Russian financial crisis, the forint exchange rate fluctuated practically near the ceiling of the intervention band between 1995–2000, the Bank purchasing foreign currency and selling forints to the amount of more than 10 billion.[17] Part of the evolving liquidity was absorbed by the increase in the monetary base and by the government securities market, but a substantial part flew into NBH bills and deposits. Another consequence of the narrow-band exchange rate system is that foreign exchange market interventions are conducted unevenly, most often in waves, which makes it significantly more difficult to forecast liquidity.

Owing to the abundance of structural liquidity, the major policy instrument is liabilities side

The abundance of structural liquidity and the occasional fast boost of foreign exchange market intervention to liquidity make it extremely difficult to create a liquidity deficit. This phenomenon explains the dominance of liabilities side instruments in the Bank's policy instruments since the introduction of the crawling-peg exchange rate regime and that a deposit facility has been chosen as the major policy instrument (reverse repo and deposit). Since March 1999, the Bank's major policy tool has been the two-week deposit facility, the interest rate announced on the instrument serving as the major policy rate. Meanwhile, this instrument has been the tool of managing liquidity within maintenance periods. The functions performed by the policy instrument and, simultaneously, the form of placing deposits have seen several changes since March 1999.

The interest rate corridor acts to limit fluctuations in overnight rates

Within the instruments of monetary policy, the *interest rate corridor* has been given the function of limiting variations in overnight rates around the policy rate level, in addition to reserve requirements. The lower boundary of the interest rate corridor is defined by the *overnight deposit rate*. The Bank offers the overnight deposit as a standing facility for credit institutions, so banks have unlimited recourse to this facility and therefore it prevents interbank interest rates from slipping below the central bank overnight deposit rate. The upper boundary of the interest rate corridor is defined by the *overnight repo rate*. Up to April 2001, banks had only a limited access to funds at the overnight repo rate, up to a maximum set as a percentage of their balance sheet totals (repo limit). Access to borrowing in excess of the limit was granted by the *supplementary repo facility*, at an interest rate above the repo rate.[18] In April 2001, the

[17] On the assets side of the NBH, foreign exchange reserves rose at a slower rate than this in the period, which was the consequence that the Banks used part of currency inflows to interest payments and repayments of debt.

[18] The implementation of the limit system and the related introduction of the supplementary repo was justified by the intention to defend the exchange rate regime. Without this limit in case of an attack against the forint, domestic banks may have access to unlimited amounts of forint funds, in addition to the access to repo, the conversion of which could lead a rapid drop in reserves.

Bank abolished all quantitative restrictions on repo and simultaneously abandoned the supplementary repo facility. The interest rate corridor is symmetrical above and below the rate on the major policy instrument, so the centre for any movements in overnight rates is provided by the policy rate as well.

The quick tender is a tool to manage unanticipated liquidity shocks

In January 1999, the Bank introduced the *quick tender facility*, a tool that can be used flexibly to handle unforeseen liquidity shocks. The quick tender was the only discretionary tool within the Bank's policy instruments until March 2000, when the three-month NBH bill was introduced. There were basically two objectives with the adoption of the quick tender as one of the Bank's policy instruments. One was to offset the effects on Hungary of unanticipated money flows, often unexplainable by international economic developments but linked with non-macroeconomic developments. The other was to assist liquidity management and particularly to facilitate the handling of potential liquidity shocks which may have arisen towards the last days of the maintenance period and which were difficult to anticipate.

Fluctuations in the Treasury account balance increases volatility of interbank liquidity

The third fundamental factor affecting liquidity, i.e. the Treasury Account held with the Bank, has the consequence that the volatility of interbank liquidity increases significantly. The implication of this for central bank liquidity management is that the influences from fluctuations in the account of the central budget have to be cushioned using central bank instruments.

> International practice is divided among countries over the issue of whether the treasury should hold its account exclusively with the central bank or with commercial banks (as well). Interestingly, even the EMU member states have not yet developed a uniform practice. Whereas in Germany, Austria, the Netherlands and Finland the volatility of treasury account balances held with the central banks is so low that their effect is negligible, in Italy and Spain it is quite large, especially at tax payment dates. Taken together, the volatility of treasury account balances is the item among the so-called autonomous factors which tends to affect interbank liquidity the most.

2.2 Demand for and supply of bank reserves

2.2.1 Demand for reserves: reserve requirements

Demand for reserves is determined by reserve requirements

The National Bank of Hungary requires commercial banks to hold reserves with it. Owing to the high reserve ratio, the reserve requirement exceeds the demand for working balances, so the *system of required reserves* plays a dominant role in the behaviour of commercial banks' demand for reserves. Within a reserve requirements system, banks are obliged to hold as reserves with the central bank a percentage of customer deposits and other liabilities (collectively:

the reserve base) as specified by the reserve ratio. In Hungary, required reserves apply to credit institutions. Until July 2000, all liabilities constituting the monetary aggregate M3 and those nearly qualifying as elements of M3 were counted towards the reserve base. Accordingly, required reserves applied to all commercial banking liabilities, except banks' equity, and interbank as well as foreign liabilities. The reserve ratio was 12 per cent. Banks' cash balances were also covered by the reserve requirement.

Changes to required reserves

On 1 July 2000, the Bank began to implement a two-step reform of the *system of required reserves*. The objective of this change has been to improve commercial banks' competitiveness and ultimately to reduce the drain on earnings burdening the entire economy. Another goal has been to harmonise with the reserve system of the European Central Bank, easing the changeover coming at a later stage. As a result of the planned modifications, the measure of drain on earnings in respect of forint liabilities will reduce, while that in respect of foreign currency liabilities will increase by applying reserve requirements to the entire range of short-term foreign currency liabilities. Therefore, the structural disparity of banks' liability profile caused by the different reserve requirements imposed on foreign and domestic liabilities will cease. The criterion for reserve requirements will be the maturity of liabilities rather than their origin. Accordingly, liabilities with maturities of more than two years will be exempt from the reserve requirement. Implementation of the reform has been progressing in several steps.

As a first stage, from 1 July 2000, reserve requirements are applied to 50% of foreign liabilities and only 50% of forint cash balances can be taken into account to comply with reserve requirements. The nominal reserve ratio has been reduced from 12% to 11%. As a result of the changes implemented in the first stage, the burden imposed by reserve requirements has remained virtually unchanged.

In the second stage of the reform, from 1 January 2001, the reserve ratio has been reduced from 11% to 7%. With this step, the Bank has aimed to reduce the effective reserve rate and the reserve requirement. The reduction in the reserve rate would have released a significant amount of liquidity, therefore, the Bank had to ensure the absorption of the evolving liquidity, simultaneously with taking the measure. To this end, the Bank required commercial banks to purchase government securities from the Bank's holdings equivalent to the amount of released liquidity, parallel with the reduction in the reserve rate.

As a third stage, from 1 July 2001, reserve requirements are applied to the full range of foreign liabilities with maturities of less than two years, and commercial banks may not use domestic currency cash balances to fulfil the reserve requirement. Exempt from the reserve requirement are long-term securities issued by credit institutions, and mortgage bonds issued by mortgage institutions, provided that the maturity of those securities is at least two years, as well as foreign liabilities with maturities of more than two years.

One-month maintenance period

The *calculation period* is one calendar month, in which the daily average of liabilities required to be held as reserves constitutes the basis for the reserve maintenance period. Since September 1998, the *maintenance period* is one calendar month, which follows

the calculation period. This means that the total amount of liabilities in the preceding month serves as the base for the reserve requirement. Reserve requirements are complemented with an averaging mechanism, i.e. banks are mandated to comply with the reserve requirement on average over a maintenance period. Commercial banks' daily settlement balances are allowed to move freely, but they are not allowed to dip into the negative. The objective of reserve requirements complemented with the averaging mechanism is to assist liquidity management by the central bank. This system helps reduce the volatility of overnight rates and, over the longer term, it may assist in creating structural liquidity shortages.

The Bank publishes on the Reuters news retrieval system the effective reserve requirement for the domestic banking sector and compliance with the reserve requirement up to the current day.

2.2.2 Supply of reserves: factors affecting interbank liquidity

Table B

Major elements of the NBH balance sheet

Assets	Liabilities
Foreign exchange reserves	Banknotes and coin in circulation
Claims on general government	Vault cash of commercial banks
Claims on banking sector (refinancing loans)	Settlement account balances of commercial banks
	Two-week deposits
	Net overnight instruments
	NBH bills
	Foreign currency deposit of commercial banks
	Foreign debt
	KESZ and ÁPV Rt accounts
	Net other liabilities (equity, profit/loss, items in transit, accruals, etc.)

Factors affecting forint assets of the banking sector

It can be established based on the stylised balance sheet of the NBH (Table B) which are those items that determine the banking sector's forint-denominated claims vis-à-vis the NBH:

(a) *interventions in the foreign exchange market* – All other factors remaining the same, foreign exchange market interventions conducted at the ceiling of the intervention band increase, on the assets side, foreign exchange reserves and, on the liabilities side, commercial banks' settlement account balances. The effect of foreign exchange market interventions conducted at the floor of the band is just the reverse.

(b) *changes in the balances on the KESZ (or ÁPV Rt[19])* – If the balance on the Treasury Account changes due to a transaction with the NBH (for example, if the Bank receives interest on a government bond), then this will not affect interbank liquidity. If, however, the balance on the KESZ changes due to a transaction entered into with a domestic participant other than the Bank, then the measure of interbank liquidity will also change. (All this is independent of the fact whether or not the party to the transaction is a bank.) The reduction in KESZ will increase the settlement account balance, and vice versa, an increase in KESZ will reduce the settlement account balance.

(c) *a change in outstanding refinancing loans* – If a bank repays a refinancing loan to the Bank, then, obviously, its claims on the Bank will also fall, simultaneously with the reduction in its liability to the Bank.

(d) *interest payment by the central bank* – Interest remunerated by the central bank on required reserves and sterilisation instruments expands interbank liquidity.

(e) *changes in cash holdings outside banks* – Cash held outside banks constitutes a central bank liability, similarly to the settlement account. Therefore, all other central bank balance sheet items remaining unchanged, changes in cash holdings will entail an opposite change in the settlement account balance.

Fluctuations in liquidity always feed through to the banking sector…

The attributes of liquidity at the micro and macro levels and their interpretations show a number of differences. For example, with an adequately efficient and competitive financial market, a financial institution holding large portfolios of government paper can be regarded as liquid, as these securities can be converted into claims on the central bank at any time. This statement is not valid at the level of the entire banking system, given that, all other factors remaining unchanged, the sale and purchase of a government security within the banking system does not change the total amount of claims on the central bank. (Claims of the banking system on the central bank will only change if the other party to the transaction is the Bank or the Treasury.) All this is true if reversed – if a series of government securities matures, then it will certainly induce an increase in interbank liquidity. This fact is independent of whether the given bond is held by a commercial bank, an investment fund or the public. In case, for example, a government paper held by an investment fund matures, then the Treasury transfers the equivalent of the bond to the account of the given fund, which will increase the account holding bank's claims on the central bank.

… and changes in the outstanding stock of sterilisation instruments

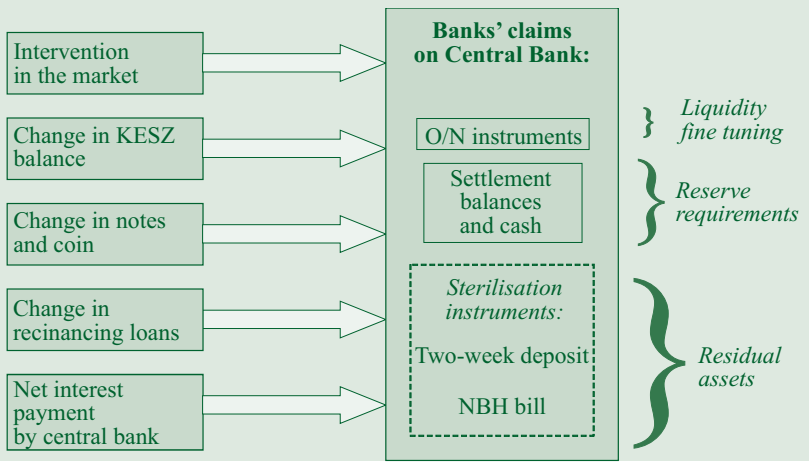
Over the short term, i.e. within one maintenance period, the effect of items influencing the position of banks vis-à-vis the central bank will be reflected in the settlement account. However, because

[19] Under the provisions of the Central Bank Act, the NBH manages the account of the ÁPV Rt as well. The liquidity effect of payments effected from the account are equal to that of KESZ, therefore, for the sake of simplicity, the Paper does not discuss the account of ÁPV Rt.

the balance on the settlement account is determined by the reserve requirement on average over a month, the forecast of developments in the settlement account balance will not be determined by factors affecting liquidity, but by the expected developments in banks' liabilities. In other words, the effect of factors influencing liquidity over one maintenance period will feed through to the fluctuations in the settlement account balance and, within the individual reserve maintenance periods, into the outstanding stock of sterilisation instruments (see Chart 3).

Chart 3

Factors affecting banks' claims on the NBH



2.3 Forecasting liquidity

2.3.1 Over the medium term: the rolling liquidity programme

Rolling liquidity programme: a time horizon of 7–18 months

The rolling liquidity programme, by giving a forecast of the developments in the central bank's balance sheet and income statement items, defines the expected developments in the outstanding sterilisation instruments over a 7–18 month horizon. The theoretical basis for defining the programme is provided by the fact that, at bottom, the factors affecting interbank liquidity influence the outstanding amount of sterilisation instruments.

The logical framework of the rolling liquidity programme is as follows:[20]

[20] The items noted here may, in principle, affect interbank liquidity in both directions (fore example, intervention in the foreign exchange market at the strong edge of the band reduces liquidity and increases at the weak edge). In the list, we have expressed the individual items in a form in which they boost liquidity (for example, the *decrease* in notes and coin in circulation); if their effect is actually the opposite, then, consistently, the negative sign is used.

Factors affecting the size of banks' claims on the NBH:

+ foreign exchange market intervention
+ expansionary effect on liquidity of changes in KESZ
+ decrease in banknotes and coin in circulation
+ net interest payments to banks
+ increase in outstanding refinancing credit

Rearrangements in banks' position vis-à-vis the NBH:

+ decrease in settlement account balance
+ effect of changes in net outstanding overnight deposits, repo and swaps on liquidity

Changes in outstanding sterilisation instruments

Outstanding sterilisation instruments can be forecast on the average of one month

As reserve requirements apply on average over a month, the outstanding amount of sterilisation instruments, too, can be forecast only as the average of one month. Accordingly, the effects of the factors on liquidity need to be forecast on a monthly average basis. This means that, in the case of 'events' affecting sterilisation instruments, not only their size but their timing within the maintenance period as well should be taken into account.

> Let us assume that the NBH is conducting foreign exchange market intervention in the amount of HUF 9 billion, with a value date of 10 September. This will affect the September maintenance period only for 20 days, so the expansionary effect of the intervention on liquidity in September will be 9*20/30=6 (HUF billions). As the average liquidity of the October maintenance period will be affected in full by the intervention conducted in September, the expansionary effect on liquidity in October will be HUF 9 billion. The difference between the two values, HUF 3 billion, will be the *pass-through liquidity effect* of the intervention.

The rolling liquidity programme rounds up the forecasts of several items of the national bank's balance sheet. These forecasts are built on the monetary programme of the NBH;[21] however, they are updated more frequently and are more detailed.

Interventions in the foreign exchange market are the most uncertain item to forecast

The forecast of the size of expected *intervention in the foreign exchange market* relies in part on the projections of the balance of payments and in part on the aggregate balance sheet of the banking sector. By its nature, this is the most uncertain item over the short term; intervention is generally conducted in waves, which are difficult to predict, rather than on an even basis. This is the reason why the rolling liquidity programme is prepared in two versions. One version is based on the assumption of monthly intervention expected on the basis of the monetary programme. The other version, in contrast, does not take into account further interventions. The basis for forecasting the monetary base is the forecast of developments in the banking sector's liabilities.

Transactions between the NBH and the Treasury do not affect interbank liquidity

Probably the most important requirement of the rolling liquidity programme is to quantify *the effect of central government sector on liquidity*. To this end, a forecast of KESZ needs to be made which elimi-

[21] For a detailed description of the monetary programme, see Barabás and Major (2001).

nates transactions from the change in KESZ which the Treasury performs with the NBH and therefore do not affect interbank liquidity. In order to forecast the daily development in KESZ, primary revenue and expenditure, and items related to financing need to be estimated. Although they follow a typical course, developments in the state budget balance[22] cannot be directly estimated with the precision required, therefore, separate estimates of the major items of the central budget, e.g. VAT and PIT revenue, expenditure by the central government units etc., need to be made. The most important background information for the estimate is the developments in earlier years, which are complemented with data reported by the Ministry of Finance and the Treasury. Based on the actual data, the forecast of the general government account is updated daily, using an error correction mechanism.

Developments in currency in circulation are forecast by an error correction model

Forecasts of changes in banknotes and coin in circulation are based on an error correction model developed by the Bank to project changes in the monthly averages of currency in circulation. Velocity growth is defined as the difference between the real growth rates of GDP and cash. According to the model, there exists a long-term equilibrium relationship between velocity growth and inflation, and the velocity of money fluctuates around the trend defined by the equilibrium relationship.

Monthly average cash balance targets are derived from the error correction mechanism. Starting out from these forecasts, developments in the cash balance holdings within a month can be projected based on relatively stable outturns, characteristic of the individual months of the year. In order to be adequately precise, there is the need of using all information available, therefore, the forecasts of daily developments are constantly adjusted taking into account daily data for cash balances.

In addition to forecasting the likely medium-term, i.e. the 7 to 18-month, course of developments in the sterilisation instruments, the rolling liquidity programme is also a useful tool for central bank liquidity planning over the short-term, i.e. over the 1 to 2-month horizon. In case the central bank does not exclusively use standing facilities, it is important to have an adequate picture of the expected stock of sterilisation instruments and the expected demand at auctions when announcing the various quantities or accepting the bids.

2.3.2 Intra maintenance periods: the daily liquidity programme

The structure of the daily liquidity programme is identical to that of the rolling liquidity forecast, with the difference that it provides a forecast of the daily developments in commercial banks' settlement

[22] For the purposes of this Paper, general government comprises only the central government, the social security funds and the extra-budgetary funds (the local government authorities are not in a direct financing relationship with the NBH).

account balances and the outstanding stocks of sterilisation instruments, rather than the average outstanding stock of sterilisation instruments.

The daily liquidity programme helps establish the banking sector's actual and expected compliance with the reserve requirement. The overnight interbank rate, in turn, can be forecast with the help of indicators built on this set of information.

Cushioning liquidity shocks facilitates the monetary transmission mechanism

It is of fundamental importance when using quantitative monetary policy instruments that the central bank should know, even on a daily basis, the banking sector's actual and expected liquidity position. The reserve requirement is currently 7 per cent. Although it provides the banking sector with adequate buffer to handle liquidity shocks, it is useful to announce the quantitative instruments in accordance with the actual liquidity position of the banking sector. Therefore, it is important for the central bank to cushion the effects of liquidity shocks on the sector's reserve accounts (KESZ, cash), which, in turn, facilitates the monetary transmission mechanism via the reduction in interest rate volatility.

A third possible area of using the daily liquidity forecast is fine tuning liquidity and using quick tenders. Interbank rates may depart for protracted periods from the major policy rate. If the central bank believes this to be disturbing the monetary transmission mechanism, then it may alleviate the evolving liquidity strains by using quick tenders on the liabilities side. The daily liquidity programme provides the basis for quantities announced on the quick tender as well.

2.4 Monetary policy instruments of the NBH

2.4.1 Changes to the instruments

Direction of changes to instruments

The monetary policy instruments of the NBH have seen several changes since March 1995, when the crawling-peg exchange rate regime was introduced. The Bank has adopted new tools, while abandoning a number of others it used earlier. In the past five years, the maturity of the major policy instrument has been shortened, so the Bank allows an increasing room for market forces to shape the yield curve. Another important change from the perspective of liquidity management has been the reduction in the averaging period to one month and, later, the broader use of discretionary tools, particularly active liquidity management. In the following, the Paper will present the major stages in the development of central bank liquidity management by highlighting the landmarks of the reform of instruments.

2.4.1.1 Up to March 2000: the period of assistance on a standing basis

The period up to March 2000 basically featured passive, *accommodating liquidity management*. The Bank's policy instruments were operated on a standing basis, except for the quick tender, introduced in January 1999, which played a complementary role. The Bank accepted deposits and provided finance on demand by commercial banks at the given interest rate level. The Bank did not directly influence the quantity of reserves – autonomous factors and the banking sector together determined developments in the quantities of liquidity. The role of the major policy instrument was played by the two-week deposit in the period starting from March 1999. Commercial banks had recourse to the instrument twice a week, on a periodical basis. The two-week deposit served as the major policy instrument, a sterilisation instrument as well as a tool to manage liquidity within maintenance periods.

2.4.1.2 Shift towards active (discretionary) liquidity management

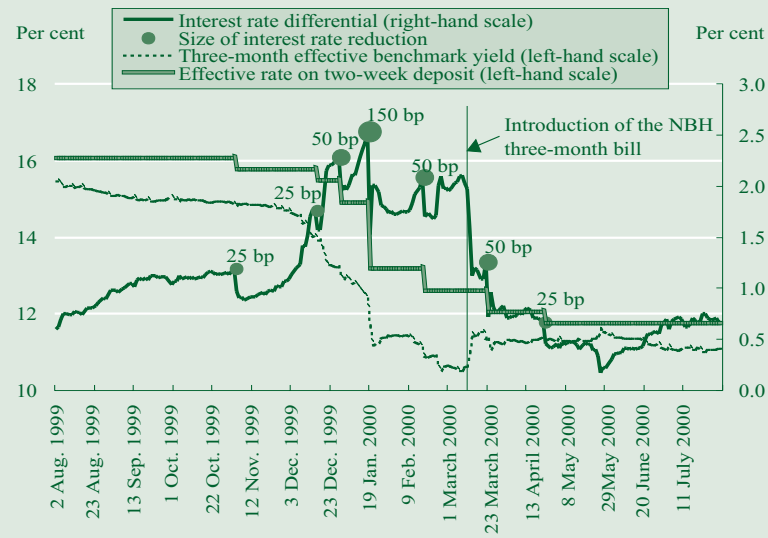
From the 1998 Russian financial crisis up to the third quarter of 1999, the Bank's interest rate policy did not run into any hurdles caused by the exchange rate regime. This was owing to the fact that the demand for foreign investments fell in the second half of 1998 due to concerns over the situation in the international capital markets, and then once again, in the first half of 1999, due to worries linked with the imbalances besetting the Hungarian economy. As a consequence, the inflow of foreign capital remained insignificant at the level of interest rates maintained by the Bank in order to assist the disinflation process. However, from October 1999 international developments encouraged foreign investors to take higher risks and, owing to the reduction in Hungary's current account deficit, the credibility of the exchange rate mechanism increased. These resulted in the demand for forint investments picking up. Intensifying capital inflows triggered more and more massive official interventions, and the amount outstanding of sterilisation instruments rose significantly. The Bank was forced to lower interest rates, in order to curb speculative, short-term capital inflows and reduce the costs of sterilisation. During the period of massive official interventions in the foreign exchange market, the policy rate departed from three-month government securities yields, i.e. it shifted out of focus, with disturbance coming into play in the *transmission mechanism*.

At end-1999, market yields departed from the major policy rate

The recovery of confidence in forint investments had only a muted influence on the domestic interest rate level in the period prior to 1999. The increase in demand for forint investments was reflected in intensifying intervention or the shifts in the exchange rate, prompting the Bank to take an interest rate decision in response. But, in contrast with earlier years, there was no need of central bank intervention to achieve a reduction in the domestic interest rate level in the period between late 1999 and early 2000, and domestic rates drifted away from the major policy rate (see Chart 4).

Chart 4

Gap between three-month benchmark yields and the major policy rate: August 1999–July 2000*



*Effective yield is derived by compounding yields.

Shortage of short-dated paper in the market

Partial explanation for this process was that in the period market participants, other than banks, had access only to short-dated assets bearing much lower returns than that remunerated on the central bank deposit. There were basically two reasons for this. One was that only banks had direct access to the single sterilisation instrument, i.e. the two-week central bank deposit. The other was that purchases of government securities by non-residents caused the amount outstanding of short-dated government paper, accessible to non-bank participants, to fall dramatically. Non-bank participants of the market, therefore, attempted to make short-term investments via the *banking system*. 'Mock' repo is the popular name of the product designed to circumvent paying the costs of compliance with reserve requirements. Due to more stringent control, banks offered less and less of mock repo to their clients. Consequently, non-bank participants were only able to invest their surplus liquidity into bank deposits subject to reserve requirements, the interest rate on which was some 80 basis

points lower, i.e. equal to the costs of reserve requirements, than the central bank policy rate.[23] Foreign investors' demand for government securities picked up. This led to commercial banks running out of their short-dated paper, so they could no longer influence the yields in the government securities market and nor did they offer their clients repo products relying on their long-dated government paper holdings. By doing so, they shut market participants off from yield opportunities offered by central bank instruments. As a result, non-bank participants of the money market were barred even from indirect access to sterilisation instruments, so yield levels in the two partial markets became independent of each other.

Meanwhile, commercial banks converted their foreign exchange assets into sterilisation instruments by selling foreign currencies spot and buying foreign currencies forward.[24] So, by opening on-balance sheet positions, they were able to exploit the differential between the policy rate and government securities yields, while leaving a substantial part of their forint exchange rate risk unhedged. Consequently, despite the fall in government securities yields, the intervention pressure did not abate, and the effect of forint demand arising from commercial banks' derivatives positions accounted for a growing portion of intervention.

The Bank responded to the problem by changing its monetary policy tools. It recognised the need to introduce an instrument which was accessible for non-bank participants as well and was tradable, and it could help narrow the gap between short-dated government securities yields and the interest rate on the two-week deposit, while it had a longer maturity than the major policy instrument, therefore it was capable of increasing the maturity of outstanding sterilisation instruments and, consequently, its stability as well. The Bank has opted for a three-month negotiable bill. The bill is sold once a week at variable-rate tenders, i.e. the Bank, based on the bids received, may choose to depart from the pre-announced amount to be allotted ex post.

Introduction of the three-month NBH bill helped restore market equilibrium

With the introduction of the instrument, tension between the policy function and the sterilisation function of the two-week deposit lessened, and market equilibrium was restored (see Chart 4). More than 50 per cent of outstanding sterilisation instruments were switched into NBH bills in two months following the introduction of the instrument. Simultaneously with this, given that the NBH bill provided room for non-bank domestic investors as well to directly purchase a money market instrument issued by the Bank, participants other than commercial banks took possession of nearly a half of outstanding central bank sterilisation instruments.

[23] Explanation for the more than 80 basis point difference between the two-week deposit rate and the three-month government securities yield is market participants' expectations of a rate cut.

[24] The other party to a forward contract was generally the subsidiary or a commercial bank, e.g. its securities broker. In these cases, banks reduced their overall open positions to zero, although they did not hedge the exchange rate risk, as the broker took a long forint position.

Parallel with the introduction of the three-month instrument, the Bank switched from offering the two-week deposit twice a week into the once-a-week operation of the instrument. The aim with this step was principally to strengthen further banks' independent liquidity management practices.

With the introduction of the three-month bill, the active nature of liquidity management strengthened

The three-month bill is basically a discretionary tool. It helped strengthen the active nature of liquidity management. Although the outstanding amount of sterilisation instruments continued to be determined by the demand for them (taking into account the fact that the two-week deposit was still operated on a standing basis), the Bank had an influence on how much of liquidity to be sterilised flowed into sterilisation instruments. Thus, forecasting developments in liquidity was given a greater role.

2.5 Factors explaining developments in interbank rates – the liquidity indicator

One of the goals of liquidity management is to reduce fluctuations in overnight rates

One of the core objectives with the design of the operating framework and liquidity management is to reduce fluctuations in overnight rates, stemming from the variability of liquidity conditions – if fluctuations in interbank rates spill over along the yield curve, then this may set rates serving as the operating target in motion as well. This may cause two problems. First, monetary policy may lose some of its transparency, as changes in the operating interest rate level are influenced by liquidity conditions of the moment. Second, the danger increases that the market misinterprets the reasons for changes in yields and therefore it draws false conclusions in respect of the objectives of monetary policy.

The interest rate corridor limits movements in overnight rates

The Bank uses several instruments to check volatility in overnight rates. The interest rate corridor bounds fluctuations in overnight rates around the major policy rate level. Another tool for checking interest rate volatility is reserve averaging.

The instruments mentioned earlier are passive from the perspective of reducing interest rate volatility. But there is a need of a discretionary tool, even in the case of passive liquidity management, which is capable of keeping in check fluctuations in interbank interest rate which stem from an unexpected change in liquidity conditions. The preconditions for an efficient reduction in interest rate volatility via active liquidity management or using a discretionary tool are the precise forecast of changes in liquidity conditions and understanding the behaviour of overnight rates. The explanation for this is that only in this way will the central bank be able to estimate the amount of additional liquidity to be injected into or withdrawn from the system, in order for the overnight rate level to return to the mid-range of the interest rate corridor.

In a perfect market, interbank rate volatility reflects only unanticipated influences

The demand for reserves is known in advance over the entire maintenance period, i.e. a calendar month. If the market of reserves functioned perfectly and banks acted in a risk-neutral way, then assuring liquidity through meeting demand for reserves would stabilise the overnight rate. In this way, banks would react by large amount interbank borrowing or lending to a departure of the overnight on a given day from the interest rate level anticipated for the following day based on the set of information available on the same day. Under such circumstances, given the above assumptions, fluctuations in the interbank rate levels would only reflect the effects of unanticipated changes in liquidity. If the central bank neutralised successfully the changes in liquidity unanticipated by banks, then the interest rate level would remain constant.

Due to credit ceilings…

The above conditions, however, cannot be met for a number of reasons. First, the interbank market is far from being perfect. Banks set credit ceilings vis-à-vis each other, i.e. they do not lend each other indefinitely. So it may happen that, on the aggregate level, the demand for reserves is equal to supply, but individual banks are facing liquidity deficits while others are accumulating liquidity surpluses. Another factor which may inhibit expectations of future interest rates from perfectly being priced in rates for a given day is that reserve balances on commercial banks' settlement accounts may not dip into the negative. This latter hurdle is usually ineffective in Hungary due to the 7 per cent reserve ratio.

…and banks' risk averse behaviour…

Second, banks are not risk neutral. They try to avoid using overnight repo to meet the reserve requirements for prudential and other reasons which involve internal regulations. In addition, the central bank ceiling used for repo may also contribute to the situation where banks try to reduce the probability to zero of having to obtain additional liquidity at above market rates due to an unexpected liquidity shock.[25] Risk aversion also depends on how efficiently banks are able to manage their own liquidity. The greater the uncertainties, the higher the excess holdings linked with prudential considerations. As the end of the maintenance period is coming closer, the need to meet the reserve requirement on the days remaining is increasingly constraining the room for liquidity management, as the number of days left, i.e. the time available for offsetting any excess/deficiency, reduces.

…demand for reserves in only moderately interest elastic

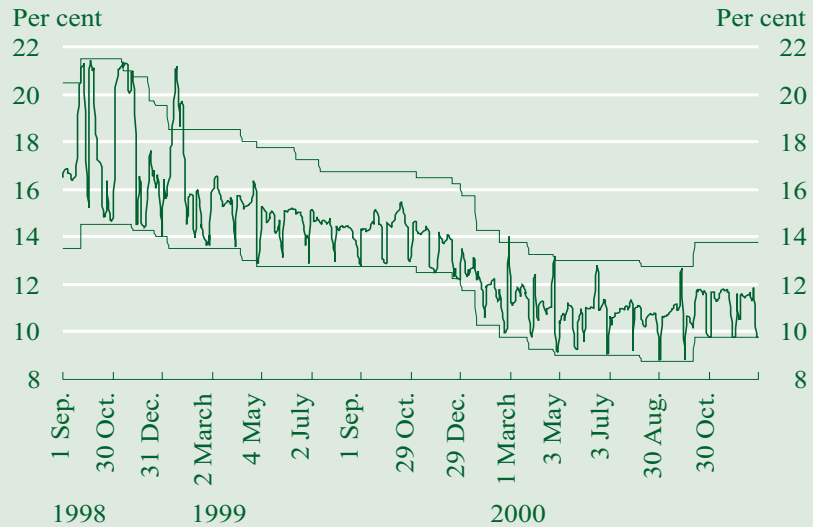
From the reasons discussed above it follows that the demand for reserves in Hungary is only moderately interest elastic and, moreover, interest elasticity diminishes as the time remaining form the maintenance period reduces. A fact providing evidence for the

[25] Commercial banks' cautious behaviour within the maintenance period suggests that their cost perception is asymmetrical. Banks judge it to be a greater problem to obtain the necessary liquidity in repo at the end of the maintenance period than to dispose of their excess liquidity by placing it into overnight deposits, although in one case they have to borrow at a rate 2 per cent higher than the policy rate and lend at a rate 2 per cent below the policy rate.

low interest elasticity of demand for reserves is that movements in overnight rates within the maintenance period follow a more or less stable pattern, and that interbank rates usually fall to the bottom of the interest rate corridor towards the final few days of maintenance periods. (see Chart 5).

Chart 5

The overnight interest rate corridor and movements in overnight rates between September 1998–December 2000



When interest elasticity is low, the buffer function of the averaging mechanism is weaker

To the extent that the interest elasticity of demand for reserves is lower, the reactions of the overnight rate level to the banking systems' reserve position will be more sensitive. Consequently, the role of reserve averaging as a buffer will decline, as banks are less willing to manage their daily liquidity positions subject to the expected interest rate path if demand for reserves is less interest sensitive. Therefore, we are faced with two options if we want to understand the behaviour of overnight rates. Either we have to seek explanatory variables or indicators which characterise well the daily liquidity position of the banking system, or to build a model which takes into account that the link between liquidity conditions and overnight rates will change as the end of the maintenance period is coming closer.

In the following, we will define indicators which, meeting different criteria, are suitable for evaluating the liquidity position of the banking system for a given day. Then we will examine which are those indicators that, having passed our tests, describe well the behaviour of overnight rates and are suitable for forecasting it. Table C provides a brief summary of the indicators. (The following chapters contain descriptions of the notations and expressions used in the Table.)

Table C

Indicators of banking sector reserve surpluses

Indicator	*Definition*	*Formula*	*Ex ante/ex post*
Excess for a given day	Difference between compliance on a given day and the reserve requirement.	$s_t = R_t - \overline{R}$	None
Cumulative excess	Difference between average compliance up to a point in the period and the reserve requirement.	$s_t^{(2)} = \frac{1}{t}\sum_{j=1}^{t} R_j - \overline{R}$	Ex post
Effective reserve surpluses	Difference between banks' daily compliance and the remaining requirement.	$s_t^{(3)} = R_t - \overline{R_t^h}$	Ex post
Effective reserve surpluses	The amount which the banking system can withdraw from the account without the expected compliance falling below the requirement.	$s_t^{(3)} = \overline{\overline{R_t^h}} - \overline{R_t^h}$	Ex post and ex ante
Liquidity indicator	The amount which the banking system can withdraw from the account in the remaining days of the period without the expected compliance falling below the requirement.	$x = \frac{(n-t)}{\sum_{i=1}^{n-t} i}(\overline{\overline{R_t^h}} - \overline{R_t^h})$	Ex post and ex ante

2.5.1 Indicators of compliance with the reserve requirements

The excess reserve indicator compares daily reserve level with the reserve requirement

One of the important indicators of liquidity conditions for a *given day* measures *excess or deficient reserve position*, which can be calculated as the difference between compliance on a given day and the reserve requirement.

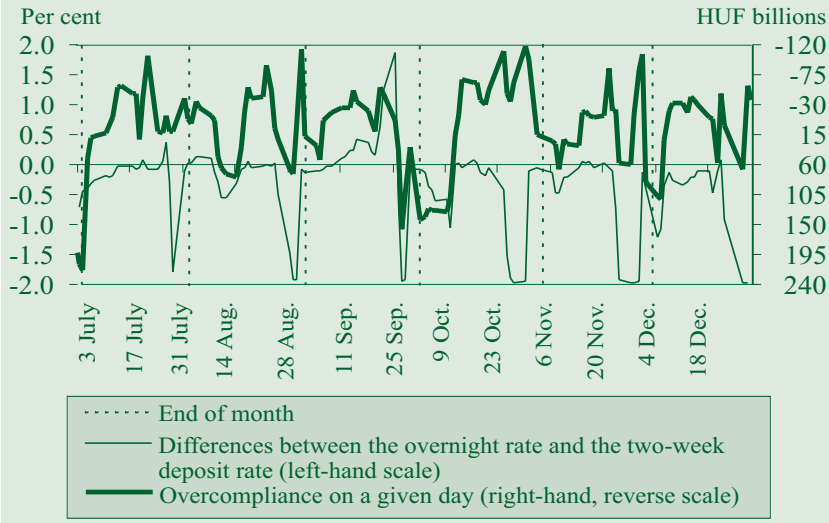
$$s_t^{(1)} = R_t - \overline{R}$$

where $\overline{R}$ is the reserve requirement,
R_t is the daily compliance and
t is the number of days passed in the maintenance period.

However, because participants have to satisfy the reserve requirement on average over a calendar month, this indicator does not take into account (i) reserves accumulated on the days passed in the

Chart 6

Overcompliance on a given day and the overnight rate in 2000 Q2



* The overnight rate is shown as the gap between it and the two-week deposit rate.

maintenance period and (ii) the liquidity effects expected during the remainder of the maintenance period (see Chart 6).

The indicator which shows *cumulative excess or deficient holdings* during time elapsed in the maintenance period satisfies criterion (i). It can be calculated as the difference between the averages of daily compliance since the start of the maintenance period and the reserve requirement:

$$s_t^{(2)} = \frac{1}{t}\sum_{j=1}^{t} R_j - \overline{R}$$

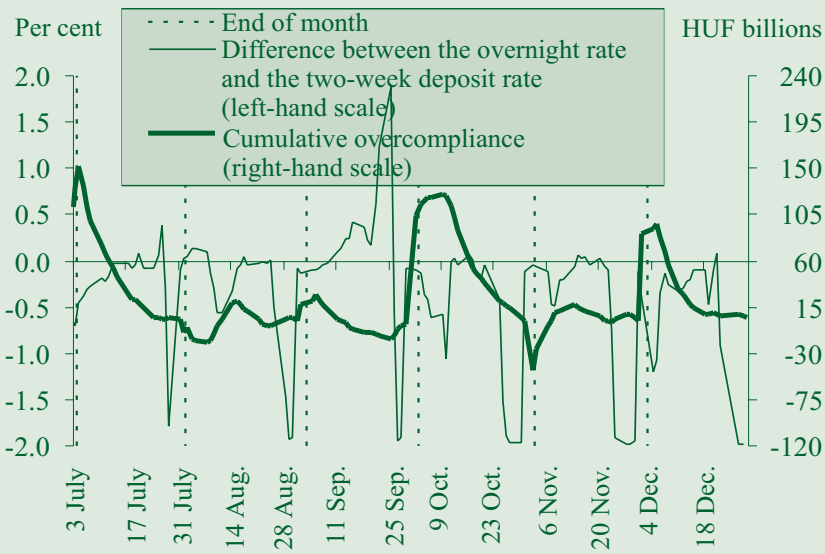
Cumulative excess reserve holdings are a better gauge of banking sector reserve position

We have observed empirically the values of the indicator of cumulative excess reserve holdings. We have found that the banking sector generally complies with the reserve requirement 'from the top', i.e. banks tend to hold cumulative excess reserves during the month and that cumulative excess holdings shrink in the majority of cases (see Chart 7). By accumulating excess reserve holdings at the start of the month, banks try to secure a significant portion of reserves in advance and to protect themselves from potential negative liquidity shocks that may arise towards the end of the month.

The requirements banks need to satisfy during the maintenance period can be established on the basis of their past compliance with the reserve requirement. The *balance of reserve requirements* equals the daily average requirement to accumulate reserves

Chart 7

Cumulative excess holdings and the overnight rate in 2000 Q2



from the given day until the end of the maintenance period. When calculating the indicator, account of the actual compliance until the day of observation is taken, and the amount to be accumulated during the remainder of the period is divided by the number of days remaining, as follows:

$$\overline{R_t^h} = \frac{n\overline{R} - \sum_{j=1}^{t} R_j}{n - t}$$

where n is the length of maintenance period in days.

The balance of reserve requirements shows how much reserves banks will need to place on their settlement accounts on a daily average starting from day *t+1* until month-end, in order for their monthly compliance to meet the reserve requirement.

Comparing banks' compliance with the reserve requirement on a given day relative to the remaining requirement, we obtain an indicator which takes into account both actual compliance with the requirement during the period passed up to now and the remaining length of the maintenance period, as follows:

$$s_t^{(3)} = R_t - \overline{R_t^h}$$

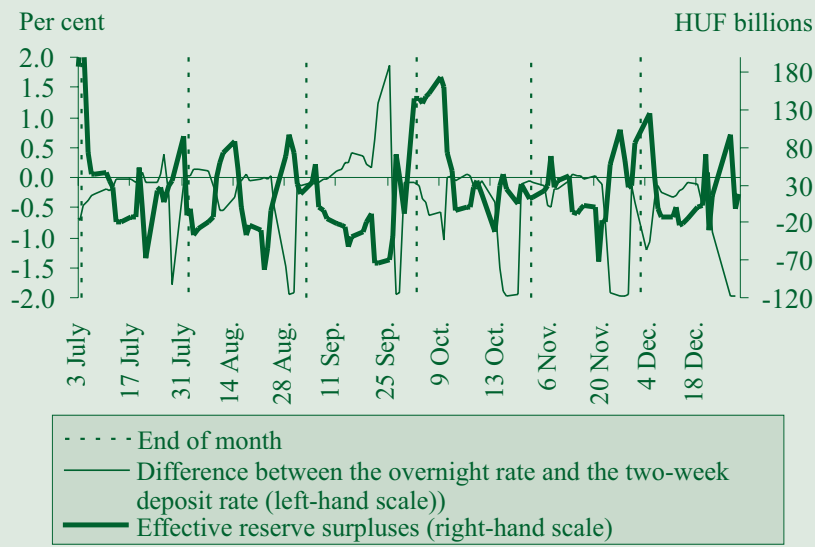
If the value of effective reserve surpluses is positive, then banks are able to meet the requirement even by reducing their reserve position

This gauge of compliance with reserve requirements we call *effective reserve surpluses*. If the value of effective reserve surpluses is positive, then banks will be able to meet the reserve requirement during the remainder of the maintenance period even by reducing their reserve holdings. If, however, the value of reserve surpluses is negative, banks will need to step up compliance with the requirement in order to satisfy the monthly average requirement (see Chart 8).

Let the amount of reserve requirements be HUF 400 billion and the length of maintenance period 30 days. If the average of compliance is HUF 410 billion in the first 20 days, and the total amount of actual daily reserve holdings is HUF 415 billion, then the amount of excess holdings on a given day is HUF 15 billion, which exceeds the HUF 10 billion of cumulative reserve holdings by HUF 5 billion. Due to the cumulative excess reserve holdings, banks will need to hold only HUF 380 billion on average on the accounts during the remaining 10 days in order to meet the reserve requirement. The amount of the banking sector's reserve surpluses therefore is HUF 415 billion – HUF 380 billion = HUF 35 billion.

Chart 8

Effective reserve surpluses and developments in the overnight rate in 2000 Q2



2.5.2 Effective reserve surpluses and the liquidity indicator

The indicators of compliance with reserve requirements presented so far do not take into account liquidity shocks expected to occur during the remainder of the month and those that will certainly occur. A different interbank rate level pertains to the actual level of reserve surpluses if banks expect their settlement account balances to

rise during the remainder of the maintenance period (liquidity expansion) and yet another one if liquidity is expected to fall.

Part of the factors affecting liquidity can be forecast with full certainty

The items affecting liquidity *known with great confidence* include the maturing amounts outstanding in sterilisation instruments. In the case of three-month NBH bills, the maturing stock of outstanding instruments is known for the entire maintenance period in advance, while the two-week deposit is known two weeks in advance, and overnight deposits, repo and swaps are known one day in advance. The maturing instruments tend to increase interbank liquidity and, provided that no allotment of the instruments is made, then the amount of maturing instruments will boost banks' reserve compliance. The larger part of maturing instruments generally is rolled over, but this is not taken into account when calculating effective reserve surpluses and the liquidity indicator, as our purpose is just to define the amount which banks are able to invest in sterilisation instruments while satisfying the reserve requirement.

The autonomous factors can be forecast with varying certainty

The *autonomous* sources of interbank liquidity are the expected changes in the KESZ balance and in cash in circulation. No absolutely reliable information is available about these two factors; their expansionary effect on liquidity, however, can be *estimated* with relative certainty. Therefore, this forecast is taken into account when calculating expected reserve accumulation. Intervention in the foreign exchange market is known two days in advance under the t+2 accounting convention. It can be another autonomous source of interbank liquidity. The forecasts of intervention are very uncertain, therefore, we assume no further intervention when quantifying the liquidity shocks.

Let $l_{t+i}^{(t)}$ denote the change in liquidity for day $t+i$ at a t point of time. Then, compliance with reserves for day $t+i$ can be expressed with the equation below:

$$R_{t+i} = R_{t+i-1} + l_{t+i-1}^{(t)} = \ldots = R_t + \sum_{j=1}^{i} l_{t+j}^{(t)}$$

Expected average compliance

The size of *expected average compliance with reserve requirements* during the remainder of the month can be defined on the basis of the expected daily operation, as follows:

$$\overline{\overline{R_t^h}} = \frac{1}{n-t} \sum_{i=1}^{n-t} R_{t+i}$$

When calculating the expected remaining average compliance with reserve requirements, we assume that banks do not place two-week and overnight deposits with the central bank during the days remaining in the maintenance period, nor are NBH bills issued. Our purpose with this method is to define the level of banks' effective

reserve surpluses. The indicator defines the size of average account balances expected during the remaining period on the basis of information about the shocks known or predictable with great confidence during the remainder of the month.

Effective surplus reserves

The banking sector's *effective reserve surpluses* can be defined as the difference between the average of reserve compliance expected during the remaining period and the average of compliance needed on the remaining days, as follows:

$$s_t^{(4)} = \overline{\overline{R_t^h}} - \overline{R_t^h}$$

Let us assume that the banking sector *permanently* withdraws an amount from the settlement accounts on day *t+1*, and places it into assets maturing beyond the end of the maintenance period. Then, this indicator shows that the amount outstanding in maturing sterilisation instruments will be just enough to satisfy the reserve requirement without the need to have recourse to repo or overnight deposit.

This will not be equal to the amount which the banking system would withdraw on day *t+1* or on day *t+2* and so forth. Consequently, the above indicator assumes a one-off, permanent withdrawal of liquidity.

In addition to the level of the effective reserve surplus, the time schedule of investing liquidity surpluses influences the amounts that can be invested. In the following, let us denote the amount of investments reducing reserve compliance on individual days with x_{t+i}. Here, we assume investments whose maturities fall within a later maintenance period (for example, the purchase of an NBH bill). Then, actual compliance on the first day will differ from R_{t+1} forecast earlier by precisely x_{t+1}. With the withdrawal of amount x_{t+2} on the following day, compliance will differ from R_{t+2} by $x_{t+1}+x_{t+2}$, and so forth. Series x must be such that reserve compliance should still hold on overage over the maintenance period, i.e. it should be granted that:[26]

$$\overline{R_t^h} = \frac{1}{n-t}\sum_{i=1}^{n-t}\left(R_{t+i} - \sum_{j=1}^{i} x_{t+j}\right)$$

Rearranging this expression we obtain that series x must satisfy the condition below:

$$s_t^{(4)} = \frac{1}{n-t}\sum_{i=1}^{n-t}\sum_{j=1}^{i} x_{t+j}$$

If all possible free liquidity is withdrawn from the banking system on the first day, then, choosing $x_{t+2}=\ldots=x_n=0$, we obtain the amount of this by substituting into the equation above: $x_{t+1}=s_t^{(4)}$

[26] In the case of banking holidays, the value of the x_{t+j} variable is always zero, as banks cannot place deposits.

We can see that, according to what have been said, the level of effective reserve surpluses shows exactly the amount that the banking sector may withdraw in one amount on day *t+1*, so that it will likely be able to meet the reserve requirement without the need to have recourse to overnight repo.

If the banking system delays it until the last day to withdraw and invest its reserve surpluses, then the amount of reserves that can be withdrawn will be substantially higher: substituting into the formula above and assuming $x_{t+1}=...x_{n-1} = 0$: $x_n = (n-t)s_t$[4].

> This means that, if reserve surpluses of the banking sector are, for example, HUF 15 billion on the 20th day of the maintenance period and the length of the maintenance period is 30 days, then investing the amount on a given day, for example placing it into two-week deposit, will be the same as parking the same amount on the reserve account, and investing HUF 150 billion only on the last day in overnight deposit.

So, with a given level of effective reserve surpluses, the size of liquidity that can be withdrawn strongly depends on the timing of those surpluses. The liquidity indicator differs from the effective reserve surplus in that we have assumed a different path of timing the investment of liquidity. In the case of the liquidity indicator, equal amounts are withdrawn from the accounts on each business day.

The liquidity indicator

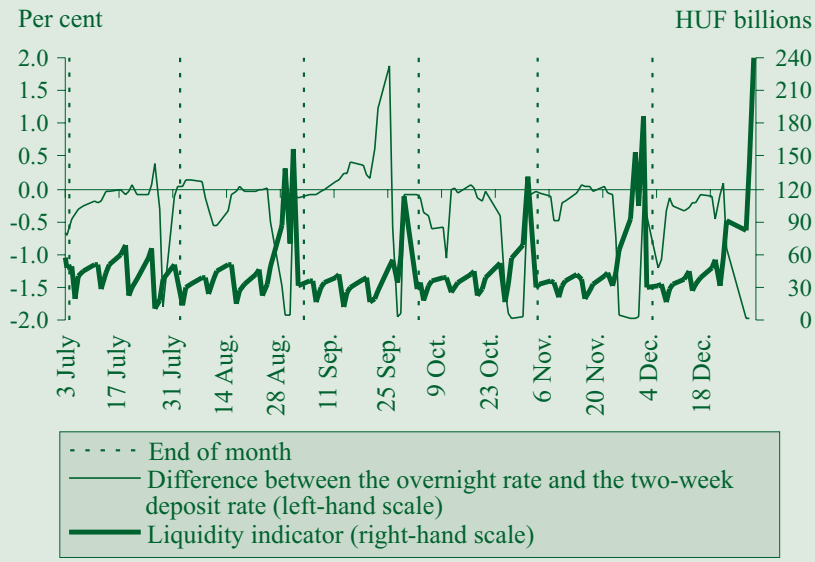
The liquidity indicator shows the amount that the banking sector may withdraw from the accounts on each business day remaining in the maintenance period, without expected compliance falling below the reserve requirement. The gauge can be calculated by substituting into the above formula, using the condition $x_{t+1} = \ldots = x_n = \bar{x}$. After substituting into the formula, the following expression will define the actual value of the liquidity indicator, based on information for a given day:

$$\bar{x} = \frac{(n-t)}{\sum_{i=1}^{n-1} i}(\overline{\overline{R_t^h}} - \overline{R_t^h})$$

The value of the liquidity indicator is always positive due to the structural liquidity surplus of the banking sector. Given the current instruments of monetary policy, commercial banks may place deposits with the central bank or purchase NBH bills once a week, with a Wednesday value date. The value of the liquidity indicator constantly rises between two subsequent investments, as, provided that banks do not place overnight deposits or liquidity does not ebb away dramatically, banks' account balances will not be lower by the daily average amount which the liquidity indicator suggests. On the Wednesday value date, in contrast, banks place considerably more deposits than suggested by the liquidity indicator, therefore the value of the indicator generally falls. Due to the above distinct features, the indicator takes a saw-teeth like pattern (see Chart 9).

Chart 9

The liquidity indicator and developments in the overnight rate in 2000 Q2



There are similar patterns between the within-month outturns for the liquidity indicator and the position of the overnight interest rate within the corridor. The most important similarity is the extreme value of the indicator evolving towards the end of the month linked with the accumulation of excess holdings, which generally coincides with the interest rate falling as low as the bottom of the interest rate corridor.

2.5.3 Forecasting the overnight rate

On days close to the end of the maintenance period the interest elasticity of demand for reserves falls

Generally, banks' demand for reserves is only moderately and progressively less interest elastic, as time remaining in the maintenance period reduces. Therefore, the indicators characterising the daily liquidity conditions of the system are believed to be closely related to developments in the overnight rate. The explanation for this is that commercial banks do not react by robust borrowing or investing to the departure of the overnight interbank rate from the two-week deposit rate constituting the mid-band of the interest rate corridor. Owing to this, now and then the overnight rate departs significantly from the mid-band of the interest rate corridor even prior to the final days of the maintenance period.

Volatility in the overnight rate is explained partly by the liquidity indicator and partly by the actual level of reserve surpluses

The results show that the liquidity indicator offers only a partial explanation for the volatility in the overnight rate. There may be several reasons for this. First, if the demand for reserves is to some extent interest elastic, mostly at the beginning of the maintenance period, then we do not expect the indicator and the interest rate level to be in a close relationship. In such circumstances, the overabundance of liquidity does not cause a fall in overnight rates, because banks are almost fully confident that they will be able to unload their excess liquidity by placing two-week deposits or purchasing NBH bills during the remainder of the maintenance period, and that they will not need to place it in overnight deposits bearing lower rates.

Second, there is not always an equilibrium of supply and demand in the market, as there are impediments, institutional (credit limits, the imperfections of the flow of information, not fully competitive market) and behavioural, to the efficient allocation of liquidity. In this case, the indicator capturing the degree of excess or deficient holdings of reserves cannot reflect the overnight interest rate level evolving in a segmented market.

Third, the scope of information used to calculate the liquidity indicator is wider than of that available for market participants. Within the factors affecting liquidity, the effect of changes in the KESZ balance can be estimated with a lower degree of uncertainty for the entire banking system than for a single bank (*information asymmetry*). Therefore, commercial banks' liquidity management practices are probably less forward looking than the liquidity indicator 'suggests'. Consequently, commercial banks' decisions are at times related to the effective reserve surpluses (which are derived as the difference between compliance with reserve requirements on a given day and the average compliance during the remainder of the maintenance period). Therefore, when explaining the behaviour of overnight rates, we should take into account this indicator as well, given that it tends to affect strongly demand in the interbank market.

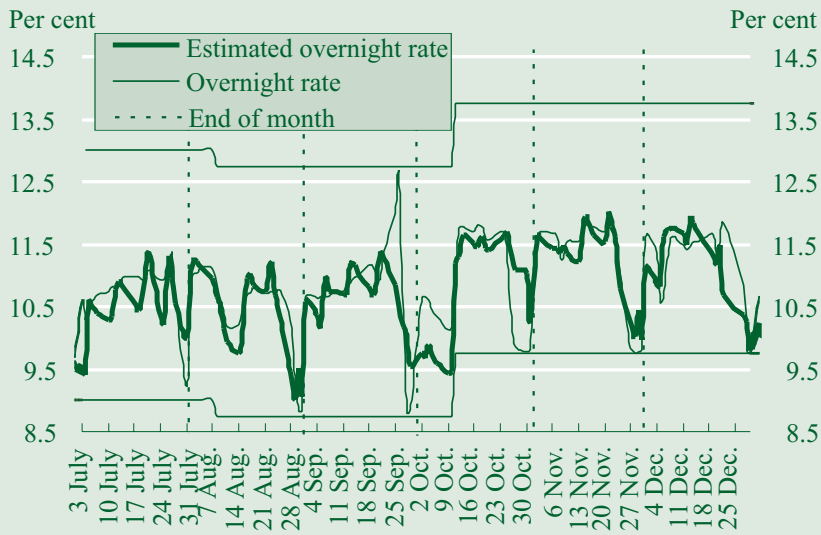
The liquidity indicator and the actual level of effective reserve surpluses combined account for 42% of volatility in the overnight rates within the month. (The detailed statistics of the regression can be found in the Appendix.)

Based on the regression correlation, we can make a forecast of the expected movements in overnight rates in a way that we need to provide estimates of the variables influencing the future reserve position of the banking sector. This requires estimating investments in sterilisation instruments as well. To this end, information obtained up till now about the behaviour of the banking system is taken into account. This means that overnight rates are forecast on the basis of liquidity conditions as a combination of econometric and expert estimates. Based on credit institutions' cautious practice of accumulat-

ing temporary excess holdings, we estimate the size of expected demand for sterilisation instruments. Thus, we obtain the values of reserve surpluses and the liquidity indicator, which helps us forecast the overnight rate (see Chart 10).

Chart 10

Actual overnight rates and estimated values from regression in 2000 Q2



2.6 Chapters from the history of liquidity management by the NBH

2.6.1 Introduction of the two-week deposit

Augusts 1998: increasing the maintenance period to one month

When reforming its monetary policy instruments in August 1998, the Bank lengthened the maintenance period related to compulsory reserves from two weeks to one month.[27] The longer averaging period has greatly helped banks manage their liquidity, as the period to react to liquidity shocks has become longer. The balance on central budget account is the most responsible factor for fluctua-

[27] Prior to September 1998, there were two maintenance periods in one calendar month, the first lasting from the beginning of the month until the 15th, the other lasting from the 16th until month-end.

tions in the settlement account balance. The other advantage of the one-month averaging system over the two-week averaging system is that the budget account balance also follows a characteristic within-month pattern due to the cyclical nature of transfers and tax receipts.[28]

Introducing periodical availability

the one-week deposit facility

Simultaneously with lengthening the maintenance period, the Bank ceased to operate the one-week deposit, and it switched the one-month deposit from a standing into a periodically available facility. Basically, the one-week deposit was a tool to assist liquidity management, at the same time as being the Bank's major dealing instrument. Although the rate on the facility was 50 basis points less than that remunerated on the one-month deposit, it was 300–500 basis points higher than the interest rate on the overnight deposit. Banks mostly used the instrument to offset liquidity fluctuations within the month caused by monthly cycles in KESZ. Lengthening the maintenance period to one month and narrowing the overnight interest rate corridor did no longer justify the keeping of this tool in operation.

The Russian crisis: intervention at the floor of the exchange rate band

The reform of the monetary policy instruments, announced earlier, coincided with the unfolding of a financial crisis in Russia. Although the Bank had not conducted foreign exchange interventions at the ceiling of the exchange rate band since May, the outstanding amount of sterilisation instruments exceeded HUF 940 billion in August 1998. At the end of August 1998, the forint exchange rate reached the floor of the intervention band, and the Bank was forced to conduct continued interventions. The new instruments now being phased in, the swift drop in interbank liquidity created entirely new conditions for commercial banks' treasury systems. Interventions in the foreign exchange market were conducted in waves, so the maturity profile of the one-month deposits, placed evenly earlier, became extremely uneven. The maturity of the one-month deposit was 28 days. As this coincided almost perfectly with the length of the maintenance period, most of deposits already placed matured only in the following maintenance period.

Wide fluctuations in overnight rates spilled over to longer maturities

Compounding the problems, speculation on an imminent reduction in official interest rates began to unfold as the crisis abated, and banks tried to pace their deposits accordingly. All this fed through to hectic movements in surplus liquidity and an increased volatility of the overnight rate. Quick pulsations of liquidity condi-

[28] Taking into account that the tax payments, implying great uncertainty, fall at the end of the month, the NBH proposed that the maintenance period should coincide with a calendar month, but should start on the 16th of each month. In a maintenance period beginning on the 16th, banks would have had more time to handle the shocks caused by tax payments. In addition, it would have caused much lower interest rate volatility, as the flexibility of banks' demand for reserves is higher in the first part of the period

tions and extreme developments in overnight rates spread over to longer maturities, which caused a noise in the monetary transmission mechanism.

In March 1999, the Bank, adapting to the changed circumstances, shortened the maturity of its deposit from one month to two weeks. This step made it easier for banks to manage their liquidity in several ways. First, the maturity of the deposit was now shorter than the length of the maintenance period, which meant that deposits placed at the beginning of the month were released right at the end of the maintenance period. Second, assuming equal amounts of outstanding deposits, the average maturing deposit stock was twice as much, which increased the room for liquidity management, due to the maturity having been cut to a half. Owing to the shorter maturity, banks were less motivated to speculate on official interest rate decisions.

Introduction of the two-week deposit has stabilised rates

Although external conditions meanwhile also settled, interbank rates stabilised significantly following the introduction of the two-week deposit. All this found reflection in surplus liquidity and developments in overnight rates.

2.6.2 The quick tender of January 1999

The quick tender is the most flexible instrument of the central bank

The Bank enlarged its monetary policy instruments with the introduction of the quick tender in January 1999. The quick tender is a flexible tool, the Bank having a great freedom in using it. The facility is announced with same-day settlement date in the morning. Quick tenders can be conducted in various forms, from volume through interest rate to mixed tenders, but they can take the form of deposit or repo tenders as well, their maturity being determined by the central bank arbitrarily. In contrast with most monetary policy tools, quick tenders do not have pre-specified scheduling – they are used in liquidity situations as warranted by externalities.

The Bank altered its monetary policy instruments in September 1998. The maintenance period was lengthened from two weeks to one month, the one-week deposit was abolished and central bank assistance on a standing basis was replaced by periodical availability. This meant that banks had the opportunity to place deposits with the authorities twice a week, on Tuesdays and Thursdays, with a T+1 settlement. The maturity of the Bank's deposit for policy purposes was 28 days.

The Bank conducted heavy interventions at the exchange rate band's floor during the Russian financial crisis. As an effect, commercial banks' deposits with the Bank began to shrink rapidly, their average amount being only HUF 125 billion in December 1998 com-

pared with HUF 500–600 billion in the summer. Owing to the lower amount of deposits, the value of maturing deposits also fell significantly, and so the banking system's ability to adjust the level of settlement account balances was now weaker than earlier. The low level of deposit maturities narrowed considerably banks' room for manoeuvre, with the banking sector becoming more sensitive in the face of liquidity shocks.

Maturity mismatches developed

December is a special month from the perspective of interbank liquidity for two reasons. First, the demand for cash jumps due to the Christmas holiday. Second, the within-month seasonal patterns of tax payments are different and the high number of bank holidays makes it difficult to manage liquidity. As a consequence, the placing of deposits became uneven, with large concentrations around the end of the month.

Speculation on interest rate reduction

Expectations of an official interest rate reduction intensified in the market in the early days of January. The three-month benchmark yield fell 80 basis points within a space of one week relative to its December level. At that time, the rate on the 28-day NBH deposit was some 1.9 percentage points higher than the discount treasury bill yield. Banks, availing themselves of the opportunity, placed some HUF 100 billion more deposits with the Bank than the amount of maturing deposits at the first three operations of the instrument. (On 8 January, the NBH reduced interest rates by 75 basis points.)

Liquidity shortage in the interbank market

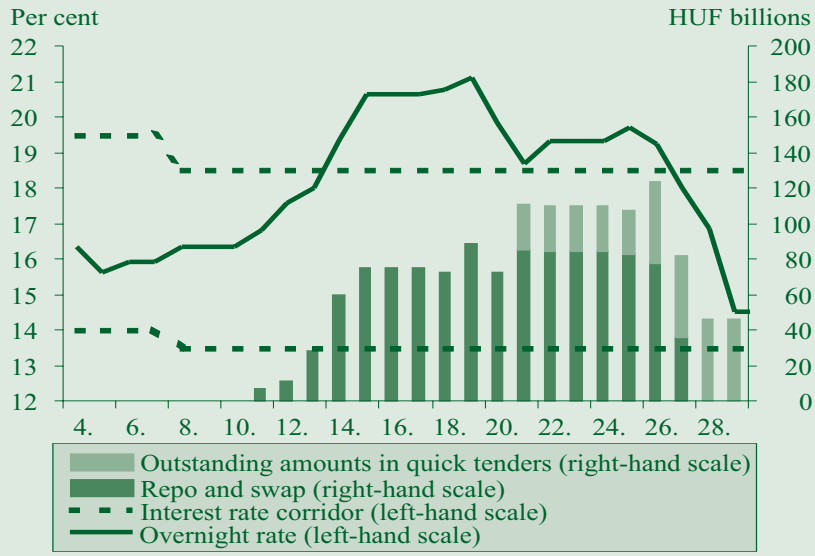
Robust flows into deposits at the beginning of the month and the unexpected, swift increase in KESZ caused a liquidity shortage in the interbank market. This meant that the banking system could not have been able to meet the reserve requirements in the January maintenance period, had it not borrowed from the Bank or had there not been further intervention in the foreign exchange market. Recognising this, from 11 January banks stepped up steadily their outstanding repos and foreign exchange swaps, which exceeded HUF 60–70 billion permanently following the 14th. The size of liquidity shortage was so high in the middle of the maintenance period that, had the authorities not conducted interventions at the ceiling of the exchange rate band, the banking sector could have satisfied the reserve requirement only by borrowing a daily HUF 70–80 billion in repo.

Several banks exhausted their the repo limit, so the overnight rate rose above the repo rate

The banking sector had a total repo and swap limit of HUF 110 billion in January 1999, so, in principle, the system's repo limit would have been enough to manage the liquidity shortage. However, the liquidity shortage affected banks fairly unevenly, with a number of them exhausting their limits. As a consequence, these banks had to borrow in central bank repo through other banks, so the interbank overnight rate hovered above the repo rate for several days (see Chart 11).

Chart 11

The interbank overnight rate and outstanding repo in January 1999



Objective of the quick tender: restore the effectiveness of the interest rate corridor

In order to restore the effectiveness of the overnight interest rate corridor, on 21 January the Bank provided HUF 25 billion and on 26 January HUF 20.7 billion surplus liquidity to the banking system via quick tender. The maturities of both transactions coincided with the end of the maintenance period, their rate being equal to the repo rate. All financial institutions that were counterparties of the Bank had the opportunity to submit their bids for unlimited amounts. The pre-announced quantity was allocated as a proportion of bids submitted. As a result of the two quick tenders, the liquidity shortage eased, and the overnight rate returned into the interest rate corridor.

The rate on the funds offered equalled the repo rate. Thus, comparing it with the situation in which this liquidity could have been allocated to banks under repo, the execution of the quick tender did not affect the earnings potential of the banking system. However, with banks obtaining central bank refinancing above their repo limits, the rearrangement of income among banks ceased due to the use of indirect repo.

2.6.3 The two-week deposit tender

Switch over to two-week tenders

From November 2000 until end-March 2001, commercial banks were allowed to place two-week deposits with the authorities up to the limit announced by the Bank; and the earlier periodical availability was replaced by standard weekly deposit tenders. The Bank announced a maximum amount to be allotted and a ceiling rate at the tender operations. Later, the role of the major policy rate was played by the ceiling rate announced at the tenders. The Bank accepted the bids received for the tenders with the yield specified in the bids, in a rising order of yields, up to the maximum amount announced.

The technique of the two-week deposit tender showed much resemblance with the main refinancing operations of the ECB. Until June 2000, the basis for the allocation of the ECB's two-week refinancing loan was the amounts submitted for the auctions. The modification to this system was motivated by speculation on an interest rate raise by the ECB, as, following the tenfold oversubscription in 1999, oversubscriptions were thirty times as much in the first five months of 2000 and hundred times as much at the latest two of such auctions. Beginning from June 2000, the ECB has announced the amount and floor rate at the refinancing tenders, while it has accepted the bids in a decreasing order of rates, up to the announced amount. The opposing features of tender techniques applied by the NBH and the ECB (setting maximum and minimum rates, the arrangement of bids etc.) can be traced to the fact that, whereas the ECB auctions a loan-type instrument, the NBH auctions a deposit instrument.

The announced amounts were set taking into account the liquidity conditions

Each week the Bank announced different amounts at the deposit tenders. The most important argument in favour of announcing different quantities was that commercial banks smoothed out the effect of liquidity shocks on settlement account balances within maintenance periods prior to the introduction of the deposit tender scheme by placing two-week deposits. When determining the amounts to be allotted, the guiding principle was to maintain the ability of banks to manage intra maintenance period liquidity shocks.

The most important tools of daily liquidity management in this system were the reserve averaging provision and the interbank market. The Bank did not eliminate, but rather reduced, the expected fluctuations in liquidity by offering varying amounts at the deposit tenders. This meant that the volatility of the reserve account balance was allowed to be lower than in the case of equal amounts, owing to the announcement of varying amounts. When determining the amounts to be allotted, an important expectation from the offered amounts was to give banks an opportunity to offset liquidity shocks and to reduce interbank rate volatility as well.

The first step when determining the amounts to offer at tenders was to estimate the expected monthly average of two-week deposits, and the combined daily outturns for the settlement account balances and the two-week deposit stock. These two indicators were estimated on the basis of a daily forecast of the KESZ and cash holdings, while assuming unchanged holdings of NBH bills and zero foreign exchange market intervention.

Several factors argued in favour of ignoring foreign exchange market intervention when forecasting the two-week deposit stock. First, forecasting foreign exchange market intervention on a daily basis is problematic. Second, permanent liquidity surpluses, i.e. those lasting for longer than the maintenance period, arising from foreign exchange market intervention at the ceiling of the exchange rate band, could feed through to an equal increase in NBH bill holdings.

The amounts to be deposited were set in a way to ensure the stability of the weekly average of the settlement account

As a next step, the amounts to be deposited were decided in a way to ensure that, given the average of two-week deposits expected for a maintenance period, the difference between banks' weekly average settlement account balances and the monthly average should be kept to the minimum. This meant that, when announcing the quantities, the Bank attempted to allow the variations in the average settlement account balance to be as small as possible from one allotment to the other within maintenance periods.

Pre-determined average limits for two-week deposits

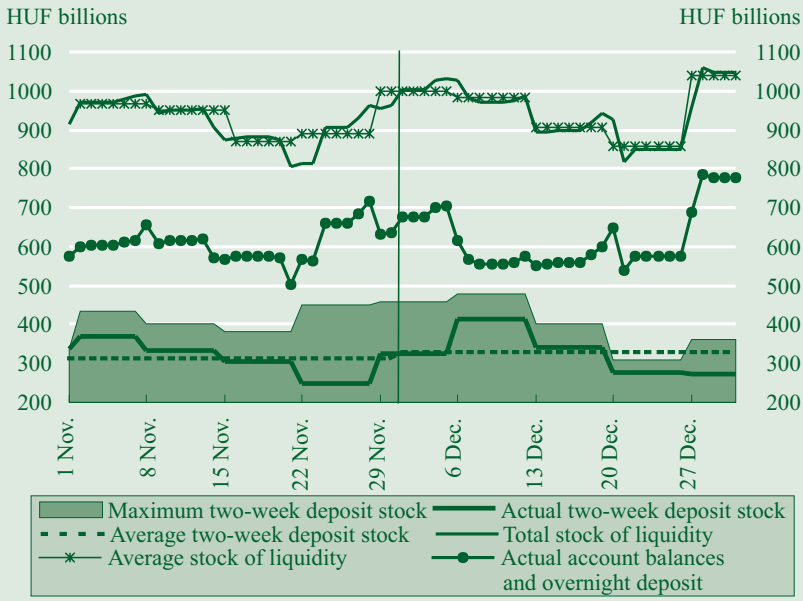
The monthly outturn for the two-week deposit stock which gives the smoothest path for meeting required reserves is the one which smoothes out the effect of exogenous liquidity shocks the most. Having developed this, the announced amounts were adjusted for the possible maximum of the monthly average of two-week deposits to be the value which the Bank had set as a maximum limit. For example, this value was HUF 400 billion in November–December 2000. This meant that, if banks had placed deposits in the amount as announced by the Bank, then an average deposit stock of HUF 400 billion would have developed (see Chart 12).

The objective with the announcement of the amounts five weeks ahead was to aid banks' forward-looking liquidity management practices. But it had negative implications for the efficiency of smoothing between the individual weeks. It stemmed from the imperfect liquidity programming and from the fact that the announcement five weeks ahead did not allow the Bank to react to situations in which the demand at tenders was very different from what the Bank earlier estimated. Net deposit-making (deposit-making less maturing deposits) determine commercial banks' settlement account balances, rather than deposit-making. Therefore, bidding for deposits at an auction executed two weeks previously influenced bidding at a given auction as well.

Appendix 1

Chart 12

Liquidity position of the banking sector, November–December 2000*



* The upper lines represent the banking systems' daily and weekly average liquidity (the sum of the settlement account balance and the two-week deposit stock). The weekly averages apply to the period Wednesday through Tuesday, in order for the weekly outturns for liquidity to be comparable with banks' deposit-making and the amounts announced by the Bank. The curve fluctuating between HUF 500–700 billion shows the outturn for the sum of the settlement account balance and the overnight deposit. The lower third of the table includes the major data relating to the two-week deposit stock.

Appendices

Statistics for regression used to forecast overnight rates

The position of overnight rates within the band (RELPOZ) was estimated using the liquidity indicator (LIKV) and the effective reserve surpluses (SZSTAT3). In contrast with the indicator denoted with ,the variable SZSTAT3 defined effective reserve surpluses as a percentage of average reserve requirement during the remaining days, i.e., using the notations of the previous appendix, we calculated as follows:

$$SZSTAT3 = \frac{s_t^{(3)}}{\overline{R_t^h}}$$

The liquidity indicator is expressed in HUF billions and the actual reserve surplus is expressed in percentages.

Using their position within the interest rate corridor, we normalised the nominal values of overnight rates to values falling between 0 and 1 (RELPOZ, the value of the variable is zero, if the overnight rate equals the overnight deposit rate; and it is 1, if it equals the repo rate). As the relationship between the rates and the explanatory variables is not linear, and because the values of the explained variable fall within the interval noted above, we estimated the regression with the non-linear least squares method – we 'converted' the value derived by the linear combination of the explanatory variables into the (0, 1) interval with the distribution function of logistical distribution.

The *t*-statistics of the coefficients calculated by the programme package are very high expressed in absolute terms; however, based on the auto-correlation in the residual (even with the correction employed), the standard errors calculated on the basis of the programme package are not reliable. The residual tests clearly demonstrate the high level of auto-correlation inherent in the error term. This suggests that the above regression does not include all factors which affect developments in overnight rates. The liquidity indicator

and the level of effective reserve surpluses, therefore, are not the only determinants of developments in interbank rates; however, based on the high R^2 nearly a half of volatility can be related to these factors. The interpretation of the regression coefficients is also made more difficult by the presumed simultaneity between the variables.

Table D

Statistics of the regression applied to estimating the overnight rate (Eviews)

Explained variable: RELPOZ

Estimating method: Least squares; Newey-West HAC correction used to calculate standard errors (truncation parameter = 5)

Number of observations: 613

Estimated equation:

RELPOZ=LOGISTIC[C(1)+C(2)*LIKV+C(3)*SZSTAT3]

	Coefficient	Standard error	t-statistics	Probability
C(1)	0.459957	0.169750	2.709620	0.0069
C(2)	–0.016708	0.003710	–4.503992	0.0000
C(3)	–4.462110	0.577778	–7.722880	0.0000
R-square	0.419497	F-statistics		220.4061
Correct R-square	0.417593	Probability (F-statistics)		0.000000
Standard error of regression	0.181095	Durbin–Watson-statistics		0.633007

The statistics of the regression written for the overnight rate show a better fit, if a delayed value of the explained variable is also included within the regressors. However, this causes the disadvantage that the delayed endogenous variables take over the role of the missing explanatory variables – there is an improvement in the explanatory power only in econometric terms, but it does not explain more in economic terms than the previous estimate. In the case of the regression containing the delayed endogenous variable, we inserted with a dummy the first working day of the month (DUM), and the days remaining in the maintenance period (NAPOK) into the explanatory variables.

Table E

Statistics of retrogression containing delayed endogenous variable

Explained variable: RELPOZ

Estimating method: Least squares; Newey-West HAC correction used to calculate standard errors (truncation parameter = 5)

Number of observations: 587

RELPOZ=LOGISTIC[C(1)+C(2)*LIKV+C(3)*SZSTAT3)+C(4)

*RELPOZ(-1) + C(5)*DUM+C(6)*NAPOK]

	Coefficient	Standard error	t-statistics	Probability
C(1)	–1.538763	0.243255	–6.325726	0.0000
C(2)	–0.018268	0.002708	–6.745365	0.0000
C(3)	–6.078737	0.995793	–6.104419	0.0000
C(4)	0.702480	0.037557	18.70448	0.0000
C(5)	0.218207	0.044482	4.905483	0.0000
C(6)	0.001569	0.000730	2.149822	0.0320
R-square	0.806075	Durbin–Watson-statistics		1.689.100
Correct R-square	0.804406	F-statistics		482.9994
Standard error of regression	0.105164	Probability (F-statistics)		0.000000

Appendix 2

Daily liquidity table

	Forex operations	Treasury transactions	Refinancing operations	Strerilisation instruments		O/N deposit		O/N repo and swap transactions		Net interest payments by theNBH	Other factors	**Monetary base**	**Reserve balances**	**Currency in circulation**	**Changes in the monetary base**
				settlement	maturing	settlement	maturing	new	maturing						
01. 11. 2000												**1,407.1**	**520.4**	**886.7**	
02. 11. 2000		35.6	0.0	–209.5	198.2	–0.2	95.2			1.9	2.2	**1,530.4**	**640.6**	**889.8**	**123.3**
03. 11. 2000		7.5	0.1			–0.1	0.2			0.0	–0.6	**1,537.5**	**643.5**	**894.0**	**7.1**
04. 11. 2000												**1,537.5**	**643.5**	**894.0**	
05. 11. 2000												**1,537.5**	**643.5**	**894.0**	
06. 11. 2000		7.7	–1.3			–0.3	0.1			0.0	–4.9	**1,538.8**	**649.9**	**888.9**	**1.3**
07. 11. 2000		2.6	0.0			–0.3	0.3			0.0	2.2	**1,543.7**	**654.8**	**888.8**	**4.9**
08. 11. 2000		3.8	0.0	–206.0	237.0	–0.2	0.3			2.3	–0.3	**1,580.4**	**693.0**	**887.4**	**36.8**
09. 11. 2000		–36.5	0.0			–0.3	0.2			0.0	0.5	**1,544.4**	**648.4**	**896.0**	**–36.0**
10. 11. 2000		15.2	0.0			–0.3	0.3			0.0	1.2	**1,560.7**	**655.7**	**905.0**	**16.3**
11. 11. 2000												**1,560.7**	**655.7**	**905.0**	
12. 11. 2000												**1,560.7**	**655.7**	**905.0**	
13. 11. 2000		–2.0	0.0			–0.3	0.3			0.0	–0.6	**1,558.1**	**657.0**	**901.0**	**–2.6**
14. 11. 2000		–51.9	0.1			–0.3	0.3			0.0	1.0	**1,507.3**	**607.6**	**899.7**	**–50.8**
15. 11. 2000		–28.3	0.0	–236.4	256.1	–0.2	0.3			2.8	2.5	**1,504.1**	**605.4**	**898.7**	**–3.2**
16. 11. 2000		13.7	0.1			–0.2	0.2			0.0	0.2	**1,518.1**	**612.8**	**905.3**	**14.0**
17. 11. 2000		8.7	0.0			–0.2	0.2			0.0	0.3	**1,527.1**	**615.2**	**911.9**	**9.0**
18. 11. 2000												**1,527.1**	**615.2**	**911.9**	
19. 11. 2000												**1,527.1**	**615.2**	**911.9**	
20. 11. 2000		–9.1	–1.6			–0.1	0.2			0.0	–1.5	**1,514.9**	**609.5**	**905.4**	**–12.2**
21. 11. 2000		–73.7	0.0			–0.1	0.1			0.0	0.8	**1,442.1**	**537.7**	**904.4**	**–72.8**
22. 11. 2000		4.7	0.1	–128.7	184.4	–0.4	0.1			1.6	0.2	**1,504.2**	**601.1**	**903.1**	**62.0**
23. 11. 2000		4.1	0.0			–0.3	0.4			0.0	0.7	**1,509.0**	**600.1**	**908.9**	**4.8**
24. 11. 2000		99.0	0.0			–17.3	0.3			0.0	1.2	**1,592.3**	**680.3**	**912.0**	**83.3**
25. 11. 2000												**1,592.3**	**680.3**	**912.0**	
26. 11. 2000												**1,592.3**	**680.3**	**912.0**	
27. 11. 2000		20.0	–0.1			–39.9	17.3			0.0	–1.6	**1,587.8**	**681.6**	**906.2**	**–4.5**
28. 11. 2000		28.4	0.0			–145.1	39.9			0.0	0.2	**1,511.2**	**606.7**	**904.5**	**–76.6**
29. 11. 2000		3.6	–0.1	–274.4	186.9	–129.0	145.1			1.6	0.2	**1,445.2**	**539.0**	**906.2**	**–66.0**
30. 11. 2000		17.2	–0.2			–162.7	129.0			0.0	5.7	**1,434.3**	**515.3**	**919.0**	**–11.0**

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