János Zoltán Varga

The Effect of Interbank Liquidity Surplus on Corporate and Interbank Interest Rates

Summary: The liquidity position of the banking sector is defined as the net financial claim of commercial banks on the central bank. Liquidity surplus occurs when this amount is positive, while liquidity deficit arises when the amount of net claims is negative. This study presents the causes that can lead to liquidity surplus and discusses the impact of the surplus on the monetary transmission mechanism. Similar to other emerging countries, a permanent surplus can be observed in Hungary; thus the paper also provides an overview of the factors behind the evolution of the surplus and the tools applied by the Hungarian National Bank (MNB) to address it. In addition, as customary in the literature, cointegration regression and error correction models are applied to Hungarian data to investigate the pass-through of corporate lending rates and interbank rates and the effect of the liquidity position on the interest rate transmission. Contrary to theoretical expectations, our results suggest that the interbank liquidity surplus tended to increase the lending rates on non-financial firms in the review period (January 2003 – August 2015 and January 2003 – August 2008). On the other hand, the impact on interbank rates is entirely consistent with international experiences and theoretical expectations in that the forint-denominated liquidity surplus pushes down interbank rates.

Keywords: monetary policy, financial system, interest rate, cointegration
JEL codes: E42, E43, E52, C32

After the crisis, the banking sectors of numerous developed countries found themselves in a situation known all too well by developing countries: commercial banks hold far more claims against the central bank on their balance sheets than would be warranted by the reserve requirements (Beaupain and Durré, 2015; Ganley, 2002; von Heideken and Sellin, 2014; ECB, 2014; Keister and McAndrews, 2009; Saxegaard, 2006). As is the case with a similarly large number of emerging countries, the Hungarian banking system has had excess liquidity practically since the regime change. This study seeks to explore whether the enduring Hungarian liquidity surplus has an impact on corporate lending rates and interbank rates.

The next chapter explains the interpretation of interbank liquidity and presents the reasons behind the build-up of liquidity surplus, as well as the tools available to central banks to address excess liquidity. Next, the paper sets out to discuss the effects of the surplus on corporate and interbank interest rates and proceeds to present a quantitative testing on the effects identified on Hungarian data. The interest rate transmission mechanism is tested by way of cointegration regression and error correction models. The review period is January 2003 – August 2015 and January 2003 –

E-mail address: janos.zoltan.varga@gmail.com

August 2008 for corporate lending rates and January 2000 – August 2015 for interbank rates.

LIQUIDITY AT THE LEVEL OF THE BANKING SYSTEM

Interbank liquidity is defined as the net claim of commercial banks on the central bank. In this case, surplus liquidity means that more liquidity flows from the central bank to the banking sector than vice versa; in other words, the banking sector's net forint claim vis-a-vis the central bank is positive. In the first case, the central bank's balance sheet is liability-driven, i.e. the economy has a demand for central bank liabilities, which is typically satisfied by lending or asset purchases. In the latter case, the central bank's balance sheet is asset-driven, and it offers some kind of assets to banks in order to absorb excess liquidity (Gray, 2006).

The systemically optimal level of interbank liquidity might be the level of reserves consistent with the central bank's targets, such as price stability (Ganley, 2002). However, individual items on the central bank's balance sheet are considered autonomous factors from the perspective of the central bank, and the central bank has no full control over their level (Bindseil, 2014); consequently, central banks need to apply various instruments for managing liquidity. These instruments will be discussed later.

Table 1 shows the schematic balance sheet of the central bank. Cash in circulation, international reserves and government deposits are considered to be autonomous items. Below is a brief description of these items. If the demand for currency increases for any reason in the economy, banks can access the required amount from their accounts held with the central bank, thereby reducing interbank liquidity and increasing the quantity of cash in circulation. Similarly, the tax revenues of the government and its forint denominated government bond issues lower the central bank deposit holdings of banks and simultaneously increase the government's account balance. Given that the vast majority of the obligations imposed on the government in the central budget are paid to domestic actors in forints (e.g. pensions, wages, operating expenses), the resulting decline in the government's balance will entail an increase in banks' deposit holdings; therefore, at the level of the banking sector, the decline in liquidity is only temporary.[1]

Table 1

SCHEMATIC BALANCE SHEET OF THE CENTRAL BANK

Central bank	
Assets	**Liabilities**
International reserves	Cash
Securities	Deposits by the government
Loans to the government	Deposits by banks
Loans to banks	Outstanding borrowing
	Debt securities
	Own funds

Source: own editing

On the other hand, if the government purchases foreign currency from the central bank in order to pay its foreign currency denominated obligations, the liquidity of the banking sector will decline for a sustained period.

It can be stated in general that an increase on the asset side of the central bank's balance sheet is reflected either in banks' central bank deposit accounts or in the government's account. It is important to see that the total level of reserves in the banking system is determined almost entirely by the actions of the central bank, and is not affected by the banking sector's independent decisions (Keister and McAndrews, 2009). While individual banks might decide to shed their central bank claims, this liquidity will end up on the account of another bank, merely generating a realignment on the liability side of the central bank's balance sheet.

Reasons behind the liquidity surplus

The banking sectors of developing and former socialist countries typically have an interbank liquidity surplus; in fact, this phenomenon has been often observed in developed countries as well, especially since the widespread introduction of unconventional monetary instruments after the crisis. As reported by *von Heideken* and *Sellin* (2014), for 13 out of 20 OECD countries[2], the banking system had a liquidity surplus towards the central bank in 2012.

Reasons behind the build-up of the surplus may vary from country to country, and reveal a great deal of information about the macroeconomic situation and global economic position of the specific country, as well as the level of development of its financial institutional system. Essentially, the reasons can be traced back to foreign currency inflows, asset purchase programmes, large scale lending programmes to banks and the monetary financing of budget deficits.

The central bank's appearance as a buyer in the foreign exchange market will increase liquidity. This may be driven by a desire to maintain or achieve a certain exchange rate target or to raise the level of international reserves. This phenomenon can be observed, among others, in Asian emerging economies: in order to avoid the appreciation of the domestic currency as a result of the current account surplus, local central banks purchase foreign currency, increasing their international reserves and injecting excess liquidity into the banking system.[3] Foreign currency revenues from capital inflows can also be liquidity increasing items, provided that the conversion is performed by the central bank. Typically, these items include the government's privatisation proceeds, inflows of foreign direct investment, or international aids and support (e.g. European Union transfers).

Another driver of liquidity expansion is international (foreign currency denominated) borrowing by the government or by the central bank, if the purpose of the loan is something other than the refinancing of a maturing foreign currency debt.

During and after the 2008–2009 crisis, especially in developed countries, central banks provided substantial loans to banks and conducted significant asset purchase programmes with a view to restoring the interbank market, facilitating economic growth and guarding against deflationary pressures. As a result, the banking sectors of the United States and the euro area have a substantial amount of excess liquidity today (Bech and Klee, 2011; Keister and McAndrews, 2009; ECB, 2014).

In addition, in some countries the central bank's loans to the government led to the build-up of interbank surplus liquidity (such as in Poland at the beginning of the 1990s and in Turkey; see for example, Ganley [2002]). By contrast, in developed countries it is forbidden for the central bank to grant an over-

draft to the government or to any other regional local governments.

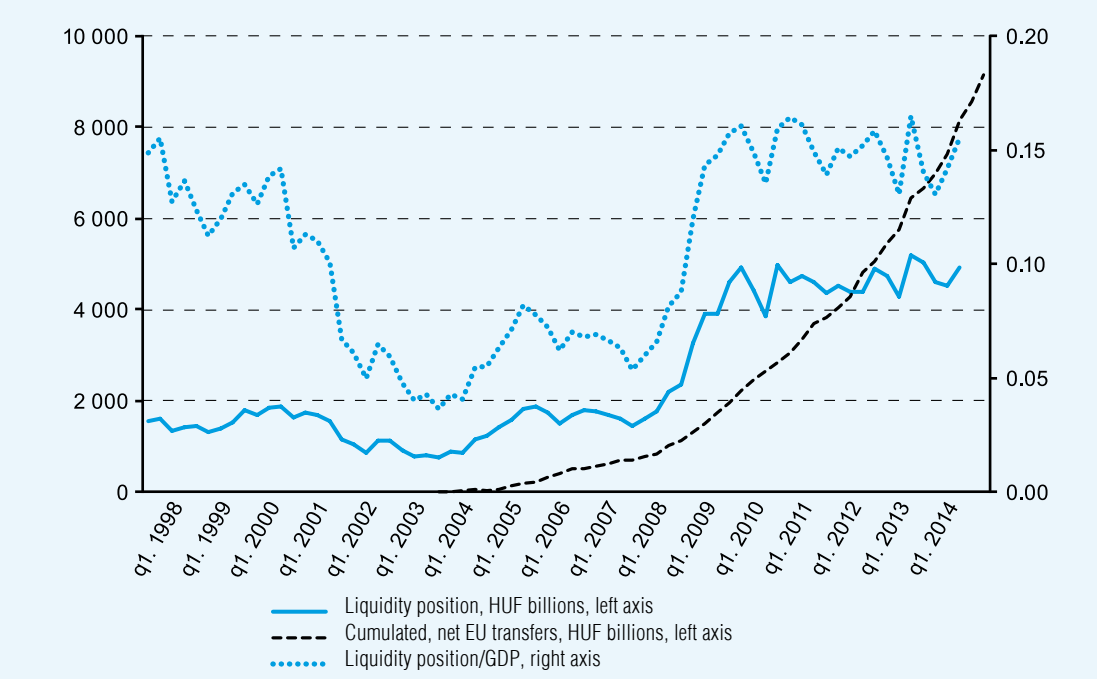
The road to the accumulation of surplus liquidity greatly influences the instruments that can be applied by the central bank to lower the surplus: if the liquidity expansion is mainly due to foreign currency conversion, the asset side of the central bank's balance sheet will largely include foreign currency; consequently, interbank liquidity can be reduced primarily by foreign currency sale. If securities purchases led to the build-up of interbank liquidity, the level of liquidity may be lowered by the sale of accumulated securities on the one hand; on the other hand – and therein lies the main difference –, cash flows from securities automatically drain interbank liquidity. In such cases, the central bank needs to consider, in view of the objectives it wishes to achieve, whether it should reinvest the cash flows or not. Accordingly, since the conclusion of the asset purchase programme in October 2014 in the United States, the primary instruments applied by the Fed to reduce the level of excess liquidity and to influence market interest rates included the full or partial suspension of cash flow reinvestments, asset sales and raising the interest rates on the reserves.[4]

Liquidity surplus in Hungary

The National Bank of Hungary (MNB) uses the following definition for interbank liquidity: *"net HUF claim of credit institutions against the central bank, settled by the actors*

Figure 1

STRUCTURAL LIQUIDITY POSITION OF THE BANKING SECTOR VS. CUMULATED, NET EU TRANSFERS



Note: data on cumulated, net EU transfers are available from 2004 Q1.

Source: MNB, HCSO, own editing

in central bank instruments" (Molnár, 2010, p. 24). Based on this, at present the liquidity position of the Hungarian banking sector can be calculated as follows: sums of three-month, two-week and other deposits less forint loans extended to banks.

These items are shown in the statistical balance sheet of the MNB. Figure 1 indicates changes in the net claim of the Hungarian banking sector on the central bank both at current prices and as a percentage of GDP in comparison to cumulated, net EU transfers.

Since the regime change, privatisation proceeds, foreign direct investment inflows, international borrowing and the drawdown of EU funds have been – and are – the primary reasons behind the accumulation of liquidity in Hungary (Balogh, 2009; Barabás and Hamecz, 1997; Gray, 2006). The early 2000s saw a moderate decline in the liquidity position with a surplus of less than HUF 1,000 billion. Between 2004 and 2006, however, liquidity started to build up again as a result of foreign currency bond issues by the state and transfers from the European Union, and by the first half of 2008 it reached a level of around HUF 1,500 billion. Subsequently, the liquidity level showed a spectacular surge as a substantial part of the funds borrowed from the IMF and the European Commission during the 2008–2009 crisis was used to refinance forint denominated public debt and to replenish the foreign currency reserves directly.[5] In recent years, the liquidity surplus of the banking sector has levelled off at the relatively high level of around HUF 4,000 billion, essentially as a combined result of three effects. They are the following: accelerated drawdown of European Union funding, reduction of the government's foreign currency debt from forint funds, foreign currency sold to banks during the early repayment scheme and the conversion of FX loans.[6] The first effect boosts, while the latter two reduces forint liquidity.

Consequences of the liquidity surplus

The liquidity surplus may generate disturbances in the transmission mechanism of monetary policy. The case of a liquidity shortage is an apt example to demonstrate this. In times of liquidity shortage, the banking sector as a whole is forced to turn to the central bank for the base money required to meet the reserve requirements imposed on banks. As a result, the central bank – as the institution having a monopoly over the issuance of base money – can steer market rates toward its desired interest rate level more efficiently, which allows it to achieve its price level, monetary aggregate or economic growth targets.

In the case of a liquidity surplus, since base money is less scarce at the level of the banking system, it is more difficult for the central bank to maintain full control over the price level (i.e. interest rates). In such cases, the central bank needs to drain excess liquidity from the banking system if it wishes to exercise a more direct influence over the interest rates. The literature distinguishes between four basic techniques for absorbing excess liquidity (based on Bindseil, 2014):

1. Reverse credit operation, i.e. banks place deposits with the central banks. The transaction can be secured (repo) or unsecured. Central banks can only use secured lending transactions to drain substantial amounts of liquidity if the build-up of the liquidity surplus was largely due to asset purchase programmes.
2. The central bank issues debt securities to be purchased by the counterparties. Before the introduction of the two-week and three-month deposits, the MNB's main policy instrument was the two-week bill.
3. Increasing the reserve requirements, i.e. the minimum required level of deposits to be held by banks with the central bank.
4. Extending interest payment to volun-

tary reserves. While technically speaking, this procedure does not drain liquidity from the banking system, it can prevent the drastic fall of interbank rates arising from the oversupply. This technique has been used, among others, by the Fed since the outbreak of the crisis (Bech and Klee, 2011).

In practice, liquidity absorbing operations are offered in unlimited quantity. In theory, even then it might happen that the banking sector rejects the central bank's liquidity absorbing programme if the conditions are not considered acceptable.[7]

The most important instrument applied by the MNB for the management of forint liquidity is the three-month deposit. Counterparties may have unlimited recourse to the instrument, the yield of which corresponds to the key policy rate. In addition, banks may place forint liquidity with the central bank in the form of two-week deposits with a maximum allotment of HUF 1,000 billion at a variable interest rate that evolves, within a pre-determined band, during the tender. In order to contain the volatile fluctuations of interbank interest rates, the MNB maintains an asymmetric interest rate corridor: counterparties can place overnight deposits without limitation at an interest rate equalling the key policy rate minus 125 basis points, and can have unlimited recourse to overnight (secured) loans at an interest rate equalling the key policy rate plus 75 basis points.

The growing interbank liquidity surplus can have two direct consequences for the monetary policy transmission:

❶ Corporate lending rates may deviate from the central bank base rate. The impact of the surplus on the transmission mechanism is less frequently analysed from a theoretical perspective. An exception in this regard is the study of *Agénor* and *El Aynaoui* (2010). The authors found that excess liquidity may induce banks to ease their credit standards, thereby reducing the risk premium charged to corporate customers. This may well lead to a situation where a reduction in the risk premium in the context of excess liquidity may be large enough to fully offset the interest rate increase. Under such circumstances, the corporate lending rate would not increase; indeed, it might even decline.

❷ Interbank rates deviate from the central bank base rate, approaching the bottom of the interest rate corridor. The build-up of interbank liquidity means that the quantity of base money increases, heightening the demand in the interbank market, which, in turn, pushes down interest rates. The term used in the literature for describing the negative statistical relationship between changes in the quantity of money and in short-term interest rates is the liquidity effect.[8] The phenomenon has been documented, for example, in the United States (Bech and Klee, 2011; Judson and Klee, 2010; Carpenter and Demiralp, 2008), in the euro area (ECB, 2014) and in Sweden (von Heideken and Sellin, 2014).

These two consequences will be tested in quantitative terms in the next part of the paper.

Surplus liquidity has another significance consequence: in such cases the central bank becomes a net borrower vis-a-vis the banking sector with continuous interest expenditures, while under a liquidity deficit, the central bank is in a net lender position relative to the banking sector and collects interest revenues. This is reflected in the result of the central bank, and in some countries – including Hungary – the government itself is required to bear the losses of the national bank. The reimbursement of central bank losses by the government practically means that interbank forint liquidity is reduced by the amount of the losses, preventing the base money from starting to grow exponentially owing, *ceteris paribus,* to the enduring liquidity surplus and

the interests[9] payable on the instruments absorbing liquidity (Reis, 2016).

ANALYSIS OF THE IMPACT OF SURPLUS LIQUIDITY ON HUNGARIAN CORPORATE LENDING RATES AND INTERBANK RATES

This phase is intended to analyse the impact of a protracted period of liquidity surplus on domestic corporate lending rates and interbank rates.[10] For the analysis of the interest rate pass-through, we applied the cointegration regression and error correction models proposed by the literature (see for example, De Bondt, 2005; Horváth et al., 2005).

Generally speaking, cointegration occurs when a linear combination of the reviewed time series is stationary; in other words, the time series does not evolve around a trend but fluctuates around a constant value and the magnitude of the fluctuation has no trend either (Lütkepohl and Krätzig, 2006).[11] When the time series is cointegrated, on the one hand, the cointegration regression can be considered to be the long-run equilibrium model between the variables; on the other hand, in such cases there is an option to set up an error correction model to capture the dynamics of short-term non-equilibrium scenarios (Engle and Granger, 1987). In our case this means that an error correction model can give an insight into the speed and magnitude of the pass-through of a change in the central bank base rate to corporate lending rates.

Corporate interest rates

At first, we examine the impact of interbank surplus liquidity on corporate lending rates. In line with the methodology applied by *Gambacorta et al.* (2014), the analysis covers the interest rates on corporate loans exceeding EUR 1 million. The MNB publishes this data on a monthly basis from January 2003, and for the purposes of this study, the term "corporate loans" is used in this sense. The review period is January 2003 – August 2015. *Figure 2* indicates changes in the central bank base rate, the interbank rate, the corporate lending rate and the 10-year government bond yield from January 2003. *Figure 3* shows the deviation of the corporate lending rate and the 10-year government bond yield from the central bank base rate. The interest premium increased consistently during the review period up until a recent, steep decline that might be attributed to the low interest rate loans disbursed under the Funding for Growth Scheme in the amount of HUF 1,600 billion.

Firstly, various time series were tested for unit roots, as indicated in *Table 2.* Apart from the time series derived from the difference between the central bank base rate and the interbank rate, we found that the null hypothesis – i.e. the existence of a unit root – could not be rejected at a 1 per cent significance level for any other time series, i.e. they cannot be considered stationary.[12]

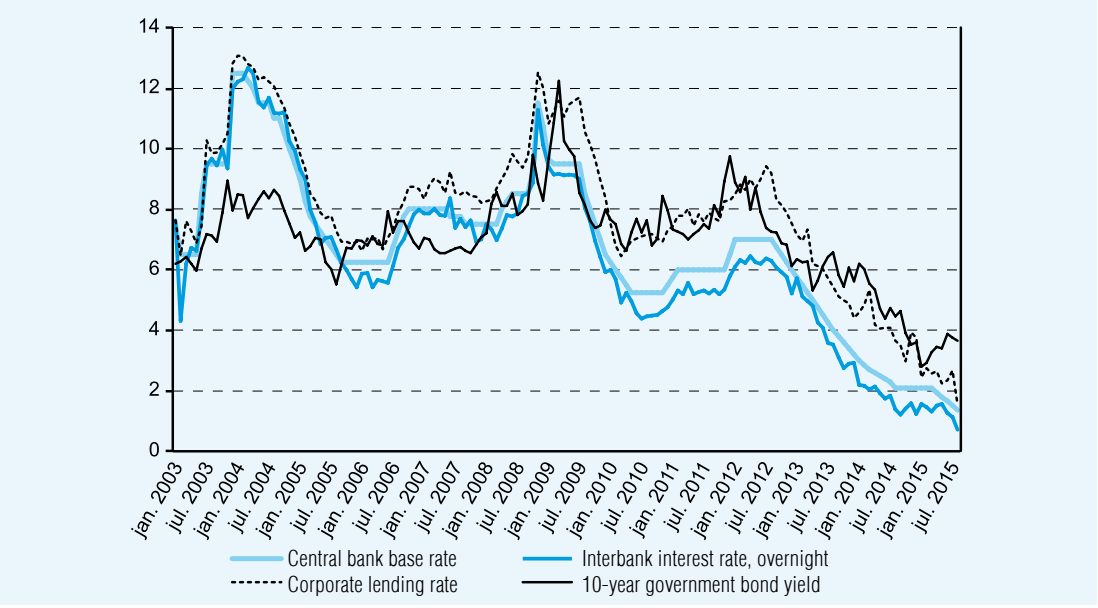
As a starting point for the quantitative analysis, we estimated a cointegration regression for the corporate lending rate and the base rate as follows:

$$LENDINGR_t = C + \beta \times BASERATE_t + e_t \qquad (1)$$

where $LENDINGR_t$ is the corporate lending rate and $BASERATE_t$ is the interest rate on the main policy instrument, both expressed in percentages. The results of the estimate and of the cointegration tests are presented in *Table 3.* Evidently, according to the cointegration tests this long-term relationship between the central bank base rate and corporate lending rates was not stationary in the review period. This means that the error term has a trend, and its value increases over

Figure 2

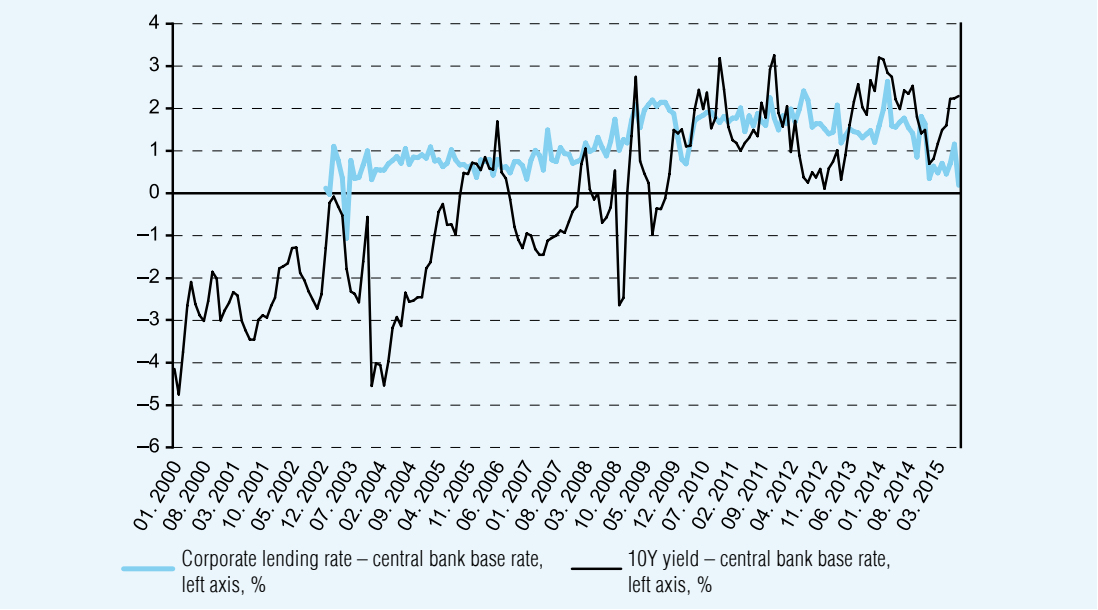
CHANGES IN THE CENTRAL BANK BASE RATE, THE (OVERNIGHT) INTERBANK INTEREST RATE, THE CORPORATE LENDING RATE (ON LOANS ABOVE EUR 1 MILLION) AND THE 10-YEAR GOVERNMENT BOND YIELD



Source: MNB

Figure 3

DEVIATION OF THE CORPORATE LENDING RATE AND THE 10-YEAR GOVERNMENT BOND YIELD FROM THE CENTRAL BANK BASE RATE



Note: data on corporate loans above EUR 1 million are available from January 2003..
Source: MNB, own calculation

Table 2

P VALUES OF UNIT ROOT TESTS

Unit root tests		
Name of time series	**Extended Dickey-Fuller**	**Philips-Perron**
Base rate	0.8540	0.8570
Interbank interest rate	0.8767	0.7831
Corporate lending rate	0.9420	0.8189
Liquidity position of the banking sector	0.7831	0.7831
10-year government bond yield	0.4242	0.4242
Central bank base rate – interbank interest rate (overnight)	0.0210	<0.01

Note: null hypothesis: the time series has a unit root

Source: own calculation

Table 3

RESULTS OF THE ESTIMATES OF THE INITIAL AND THE EXTENDED MODELS

Initial model, dependent variable: *LENDINGR*				Cointegration test (*p* values)	
Variable	**Coefficient**	**Standard error**	***p* value**	**Engle-Granger**	**Phillips-Ouliaris**
INTERBANK	0.866702	0.020928	<0.01		
C	2.426151	0.144956	<0.01		
Adjusted R^2	0.919041			0.3933	0.0182
Extended model, dependent variable: *LENDINGR*				**Cointegration test (*p* values)**	
Variable	**Coefficient**	**Standard error**	***p* value**	**Engle-Granger**	**Phillips-Ouliaris**
INTERBANK	0.994178	0.026698	<0.01		
10Y	0.212104	0.031754	<0.01		
SLP	0.332690	0.033395	<0.01		
C	–1.196399	0.192375	<0.01		
Adjusted R^2	0.980151			<0.01	<0.01

Note: in the case of cointegration tests the null hypothesis is that the time series are not cointegrated.

Source: own calculation

time. Consequently, Equation (1) does not describe the long-term relationship between the key policy rate and the corporate lending rate adequately.

Below, this model is expanded with the *SLP* variable, which indicates the liquidity position – i.e. net claim – of the banking system on the central bank, expressed in HUF thousand billions, and with the variable, which denotes the 10-year government bond yield. Formally, the model is written as follows:

$$LENDINGR_t = C + \beta_1 \times BASERATE_t + \\ + \beta_2 \times SLP_t + \beta_3 \times 10Y + e_t \qquad (2)$$

Table 3 shows the results of the expanded model as well, which indicates that the model expanded by the liquidity position and the 10-year government bond yield is cointegrated and can be viewed as a long-term relationship between the variables estimated on the basis of the review period.[13] The positive coefficient of the liquidity position is surprising in that it suggests that the surplus liquidity increases the interest rate charged on corporate loans. We will return to this issue later.

In order to test the stability between the variables, we applied the error correction model (ECM) derived from the cointegration regression of the expanded model. Accordingly, we estimated the following equation:

$$\Delta LENDINGR_t = \lambda e_{t-1} \\ + C + \sum_{i=1}^{p} \alpha_i \times \Delta LENDINGR_{t-i} \\ + \sum_{j=0}^{q} \beta_j \times \Delta BASERATE_{t-j} + \varepsilon_t \qquad (3)$$

where $\Delta LENDINGR_t$ is the first difference of corporate lending rates, $\Delta BASERATE_t$ is the first difference of the central bank base rate, e_{t-1} is the remainder term of the cointegration regression, i.e. (2), while p and q are the lengths of the lags defined on the basis of the Akaike information criterion. The results are presented in *Table 4*. As we can see, the value of λ – the coefficient of e_{t-1} – is –0.58, which expresses the stability of the model as follows: if corporate lending rates deviate from the equilibrium rates for whatever reason, about 58 per cent of the difference will be corrected within a month.

Illes and *Lombardi* (2013) and *Gambacorta et al.* (2014) have recently compared the differences between corporate lending rates and interbank rates in the periods preceding and following the crisis in selected European countries and in the United States.

They found that the difference increased after the default of Lehman Brothers in all countries under review, which can be attributed to banks' increased risk premium expectations and the deterioration of their loan portfolios. As it was mentioned above, the liquidity position of the Hungarian banking sector surged during the period, as a substantial part of the financial assistance provided by the IMF at Hungary's request after the outbreak of the

Table 4

ERROR CORRECTION MODEL OF CORPORATE INTEREST RATES

Error correction model, dependent variable: $\Delta LENDINGR_t$			
Variable	**Coefficient**	**Standard error**	***P* value**
$\Delta LENDINGR_{t-1}$	–0.093098	0.077547	0.2319
$\Delta LENDINGR_{t-2}$	–0.097009	0.050746	0.0579
$\Delta BASERATE_t$	0.763694	0.062075	<0.01
$\Delta BASERATE_{t-1}$	0.198275	0.099445	0.0481
e_{t-1}	–0.584147	0.091841	<0.01
C	–0.006597	0.026251	0.8019
Adjusted R^2	0.651653		

Source: own calculation

crisis was used to refinance forint denominated public debt. Therefore, it cannot be ruled out that the rising of corporate interest premiums is due to the increase in impaired loans, a generally observed phenomenon in Hungary in the period, the problems[14] of foreign currency lending and the ensuing decline in willingness to lend, while the increase in structural liquidity position only coincides with it. As data pertaining to the impaired loans of the Hungarian banking sector are only available from 2010 Q1, this assumption cannot be tested and ruled out directly. However, we attempted to test it indirectly, by estimating a cointegration regression for data pertaining to the period between January 2003 and August 2008 as well – the period preceding the collapse of Lehman Brothers and the IMF agreement –, i.e. the period when imbalances had not yet surfaced across the banking sector (Kovács, 2009). The results are presented in *Table 5*. We found that the variables representing the ten-year government bond yield and the liquidity position of the banking sector both remained significant at the 5 per cent significance level. There is evidence, therefore, that the increase in interbank liquidity elevated corporate lending rates even in the shorter, pre-crisis period.

The effect of liquidity surplus on interbank rates

Next we examine the effects of the liquidity position of the banking sector on the evolution of interbank rates. For the purposes of this study, interbank rates are interpreted as overnight interest rates, with the application of the MNB's calculations of monthly averages weighted by the volume of transactions. *Figure 4* indicates changes in the liquidity position of the banking sector and in the difference between the base rate and the interbank interest rate. The deterioration of the banking sector's risk perception and the increase in its portfolio of impaired loans certainly have an impact on the level of the interbank lending rate relative to the key policy rate; however, the possibility that this would result in the former's trend-like lagging behind the base rate can be excluded. More likely, excess forint liquidity increases demand in the interbank market, thereby steering the interest rate toward lower levels.

The effect exerted by the liquidity position on interbank rates was examined in two ways; the review period was January 2000 – August 2015 in both cases.

In the first case, the dependent variable was

Table 5

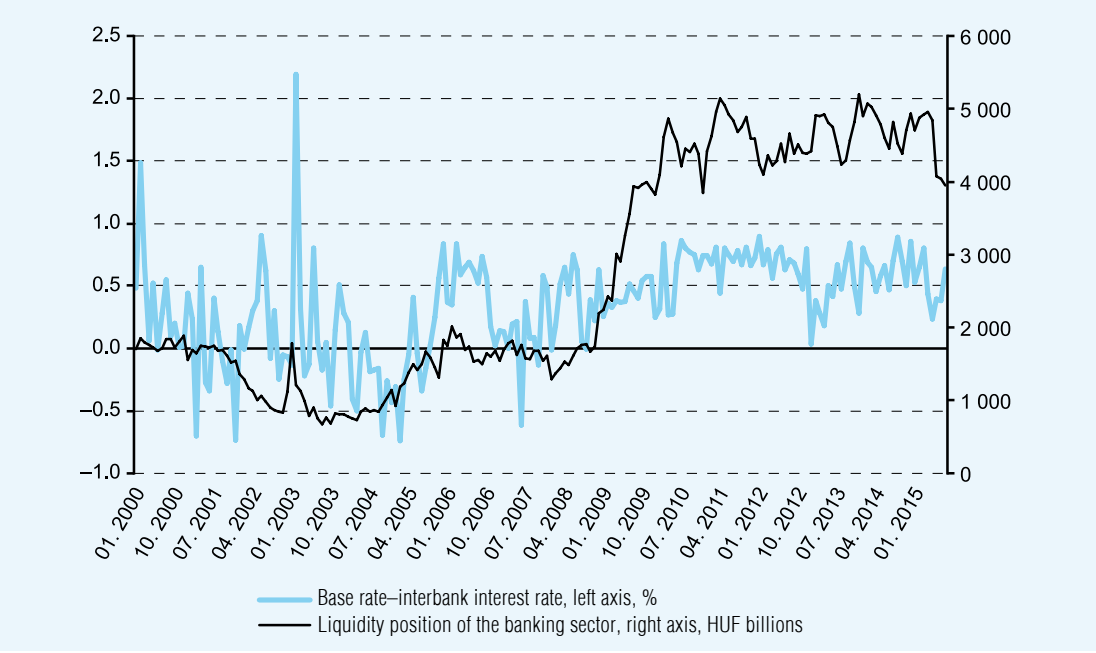
RESULTS OF THE COINTEGRATION REGRESSION IN THE PERIOD OF JANUARY 2003–AUGUST 2008

	Dependent variable: *LENDINGR*			Cointegration test (*p* values)	
Variable	Coefficient	Standard error	*p* value	Engle-Granger	Phillips-Ouliaris
Y10	0.150791	0.067928	0.0300		
BASERATE	1.002967	0.038933	<0.01		
SLP	0.338963	0.148034	0.0253		
C	–0.847096	0.502085	0.0964		
Adjusted R^2	0.969558			<0.01	<0.01

Source: own calculation

Figure 4

CHANGES IN THE BANKING SECTOR'S LIQUIDITY POSITION AND THE DIFFERENCE BETWEEN THE OVERNIGHT INTERBANK RATE AND THE CENTRAL BANK BASE RATE



Source: MNB, own calculation

the interbank rate, while the explanatory variables were the central bank base rate and the liquidity position, respectively. Accordingly, we estimated the following equation:

$$INTERBANK_t = C + \beta_1 \times BASERATE_t + \beta_2 \times SLP_t + e_t \qquad (4)$$

where is the interbank rate, is the central bank base rate – both expressed in percentages –, and is the structural liquidity position of the banking sector in HUF thousand billions. The results of the estimate are presented in *Table 6.*

In the second case, the dependent variable was the difference between the central bank base rate and the interbank rate, where the following model was estimated:

$$INTERBANKS_t = C + \sum_{i=1}^{p} \beta_i \times INTERBANKS_{t-i} + SLP_t + e_t \qquad (5)$$

where is the difference between the central bank base rate and the interbank rate (base rate minus interbank rate) expressed in basis points, is the structural liquidity position of the banking sector in HUF thousand billions, while p is the length of the lag, defined on the basis of the Akaike information criterion. The results of the estimate are presented in *Table 7.*

It is evident from the results of the two tables that, based on the models, the effect of interbank liquidity on interbank rates cannot be excluded even at a 1 per cent significance level in the specific review period. The coefficient of the liquidity position is negative in the first model and positive in the second model; in other words, both estimates suggest that the build-up of liquidity increases supply in the interbank market, exerting a downward pressure on the interest rate (naturally, still within the bounds of the interest rate corridor).

Table 6

THE EFFECTS OF INTERBANK LIQUIDITY SURPLUS AND THE CENTRAL BANK BASE RATE ON INTERBANK RATES

Dependent variable: *INTERBANK* Variable	Coefficient	Standard error	*p* value	Cointegration test (*p* values)	
				Engle-Granger	Phillips-Ouliaris
BASERATE	1.010292	0.014061	<0.01		
SLP	–0.135864	0.027645	<0.01		
C	–0.078367	0.166741	0.6389		
Adjusted R^2	0.986072			<0.01	<0.01

Source: own calculation

Table 7

THE EFFECT OF LIQUIDITY SURPLUS ON THE DIFFERENCE BETWEEN THE CENTRAL BANK BASE RATE AND THE INTERBANK RATE

	Dependent variable: $INTERBANK_t$		
Variable	Coefficient	Standard error	*P* value
$INTERBANK_{t-1}$	0.361798	0.081185	0.0000
$INTERBANK_{t-2}$	0.036867	0.086096	0.6691
$INTERBANK_{t-3}$	0.079450	0.070122	0.2591
$INTERBANK_t$-4	0.176495	0.066093	0.0085
SLP	5.669573	2.048391	0.0064
C	–2.659608	4.586400	0.5629
Adjusted R^2	0.539080		

Source: own calculation

In summary: the quantitative results demonstrate that the liquidity position of the Hungarian banking sector – the sustained surplus liquidity and its accumulation in the review periods – exerted considerable effect on corporate lending rates and interbank rates.

CONCLUSIONS

The liquidity position of the banking sector, i.e. the net claim of commercial banks on the central bank, has shown a substantial surplus historically in emerging countries, and typically as a result of post-crisis unconventional monetary policies in developed countries. Monetary policymakers face serious challenges in managing the surplus, which threatens with disturbances in the interest rate channel of the transmission mechanism: the pass-through of the key policy rate to interbank rates and eventually to corporate lending rates may slow down or might even materialise partially only. With that in mind, the study presented the instruments available to central banks for the management of liquidity, and described developments in the liquidity position of the Hungarian banking sector, as well

as the instruments applied by the MNB in order to address excess liquidity. In addition, we investigated the pass-through of corporate lending rates and interbank rates and the effect of the liquidity position on the interest rate transmission. As customary in the literature, cointegration regression and error correction models were used for the testing. Our results suggest that the long-term relationship between the central bank base rate and the corporate lending rate was not attained in the review periods (January 2003 – August 2015 and January 2003 – August 2008). Once interbank liquidity was included in the model, the relationship was restored in that interbank surplus liquidity increased corporate lending rates. This is not consistent with the results of theoretical models, and we cannot rule out the possibility that the impact mechanism is more complex than originally assumed, and that growing corporate premiums reflected the fact that the surge in forint liquidity in Hungary coincided with the deterioration of real economy conditions. However, the effect on interbank rates is fully consistent both with international experience and with the theory that build-up of forint liquidity exert a downward pressure on interbank rates.

Notes

[1] Changes in the government's account balance may still render difficult the forecasting of daily liquidity (Molnár, 2010).

[2] Euro area banking sectors are considered as a single banking system.

[3] For example, the central bank's balance sheet total exceeds the amount of GDP in Hong Kong and is close to 100 per cent of GDP in Singapore, but even in China, the indicator is around 50 per cent (*Filardo* and *Yetman,* 2012).

[4] For a brief review of the strategy applied by the Fed's competent body, the Federal Open Market Committee (FOMC), in order to normalise the level of liquidity, see *FOMC* (2014), and for an empirical assessment of the response of the interest path to the exit strategy, see *Marquez et. al* (2013).

[5] The drawdown amounted to EUR 14.3 billion, of which EUR 8 billion was used to repay the maturing forint debt of the government (*ÁSZ,* 2012).

[6] The foreign currency provided to banks for the conversion of FX loans reduces forint liquidity from June 2015, extended over a period of years, i.e. it does not take place overnight (*Hoffman et. al.,* 2015).

[7] It happened in Argentina that banks decided against having their excess liquidity absorbed by the central bank because they considered the maturity of the instrument offered too long (Gray, 2006).

[8] One of the first verbal explanations of the relationship is generally associated with Milton Friedman (Friedman, 1968). For the mathematical model of the liquidity effect, see for example, *Christiano* and *Eichenbaum* (1992).

[9] The interest earned on the central bank instruments held by banks also increases interbank liquidity.

[10] For a quantitative analysis of household mortgage loans, see for example, *Pitz* and *Schepp* (2013).

[11] More precisely, stationarity means that the value of the first and second order moments of the time series are time invariant, formally: $E[y_t] = u_y$ for all $t \in T$, and $E[(y_t - u_y)(y_{t-h} - u_y)] = y_h$ for all $t \in T$ and all integers h such that $t-h \in T$ (Lütkepohl − Krätzig, 2006, p. 11).

[12] It is not surprising that the time series indicating the difference between the base rate and the interbank rate is stationary, given that the interest rate corridor keeps interbank interest rates within a specific band.

[13] It should be noted that cointegration can be observed even if the initial model is expanded by the *SLP* variable only; therefore, the inclusion of the *Y10* variable is mainly warranted by economic considerations.

[14] For an analysis of the relationship between extreme exchange rate movements and banking sectors lending in foreign currency, see for example, *Kiss* and *Schuszter* (2015).

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