Interest rate pass-through: the case of Hungary

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Table of contents

Abstract

In this paper we analyse the interest rate pass-through in Hungary, with the help of ECM and TAR models, using both aggregated and bank level data. According to the linear ECM results, the corporate loan market, which is characterised by the strongest competition, adjusts its prices fully and quickly to the short-term money market rate. The adjustment of deposit rates and household loan rates is characterised by incompleteness and/or sluggishness. We analyse the potential non-linearities of banks' pricing by TAR models. The results suggest that the speed of adjustment of bank rates depends on the size of the changes in the money market rate and the distance of bank rates from their long-term equilibrium level. The sign of yield shocks and the volatility of the market rate also turn out to be influential to the speed of adjustment.

1 Introduction

The decisions of banks about the yields on their assets and liabilities have an impact on the expenditure and investment behaviour of deposit holders and borrowers and hence, on the real economy. Interest rates can influence the real economy through three main mechanisms of the interest rate channel. The reaction of companies and households depends on the magnitude of the *substitution effect*, i.e. the change in the relative costs of alternative credit and deposit possibilities. Changes in the interest rates alter the costs and incomes of economic agents and, consequently, their net income (*income effect*). Finally, they affect the value of real and financial assets and, therefore, the wealth of companies and households (*wealth effect*).

The way changes in central bank interest rates are passed through to changes in banks' yields determines the strength of these effects to a great extent. Thus, the effectiveness of monetary policy depends on the degree and speed of interest rate adjustment to changes in policy-controlled interest rates.

Both theoretically and empirically, the interest rate channel of monetary transmission has received great attention in the past. There are several papers on the stickiness of bank retail rates and the sluggishness of bank responses to changes in market conditions in the euro countries. The results of these studies show that interest rate transmission differs both across countries and instruments. Cottarelli and Kourelis (1995) studying several European countries find evidence of complete pass-through for most countries. In their study, the long-term adjustment parameter on average is 0.97 and falls within the range of 0.75–1.25 in most of the cases. In Borio and Fritz (1994) this value is between 0.8 and 1.1. Burgstaller (2003) finds similar results for Austria as Bredin (2001) does for Ireland. De Bondt (2002), who studies adjustments for the euro countries, concludes the long-term pass-through for bank lending rates is close to 100%.

Differences in the speed of adjustment proved to be much more considerable: duration of adjustment varied between 2 months and 3 years. Mojon (2000) measures the degree of pass-through in five European countries: Belgium, Germany, France, The Netherlands and Spain. He assumes complete pass-through in the long-run and focuses on the short-run reactions. He finds (1) sluggish responses of retail rates, (2) the response of short-term rates to be faster than that of long-term rates, and (3) a higher (short-term) pass-through when money rates increase compared to when they decrease. De Bondt (2002) also finds considerable stickiness in short-term adjustment of bank rates. He also shows that there is convergence in the pass-through of the euro countries after the establishment of the Monetary Union.

There are also some papers on the adjustment of bank rates to inter-bank rates in Hungary. Világi and Vincze (1995) use AutoRegressive Distributed Lag (ARDL) models to examine the pass-through in the period 1991-1995 and find sluggish adjustment of interest rates and emphasise that the adjustment is far from complete, even in the long run. Based on visual inspection of stabilizing and decreasing spreads, Árvai (1998) concludes that in the period 1992-1998 the reaction of commercial banks' interest rates had the tendency for somewhat better adjustment, especially after 1996. Várhegyi (2003) mainly focuses on the strength of competition, but also touches upon the speed of adjustment of bank rates to the two-week interbank rate. By regressing differenced bank rates on contemporaneous and lagged values of differenced MMR she concludes that corporate loan and deposit rates adjust at a faster pace than household rates, although the paper does not incorporate the long-run dynamics of bank rates. In a recent paper Crespo-Cuaresma et al. (2004) studies three new EU countries with an ARDL model. They find complete pass-through for the short-term corporate loan rate and incomplete pass-through for the household deposit rates in Hungary.

Our paper differs from the existing empirical literature on the Hungarian pass-through not only because of the difference in the sample periods, but also because of the different methodologies. In this study we apply panel data analysis besides analising aggregate data. We apply various error-correction (ECM) models to investigate the pass-through from local currency (Forint) money market rates (MMR) to local currency interest rates in the Hungarian banking system. Besides the standard linear ECM, we augment the model with Threshold AutoRegressive (TAR) features to study different kinds of non-linearities in the adjustment process. We study nonlinearities related to the size of disequilibrium and yield shocks, to the sign of disequilibrium and yield shocks, and to volatility. Our sample period covers January 1997–April 2004 for monthly aggregate data and January 2001–January 2004 for monthly bank-level data. In the later case we use data for 25 banks in a panel framework. The selection of the sample period is motivated by data availability and comparability and by the fact that changes in the banking system and in the monetary regime make data of previous years uninformative.

We focus on the pass-through from short-term MMRs and not from the policy rate because MMRs are much closer related to the cost of funding. However, since inter-bank rates adjust very quickly and efficiently to the central bank interest rate, we can extrapolate our findings to changes in the policy rate.

Comparing our results with those of Árvai (1998) and Világi and Vincze (1995) the interest rate transmission has improved since the mid 1990s due to the improvement of macroeconomic and financial environment. Our results are in line with those of Crespo-Cuaresma et al. (2004), despite the different estimation method used and the different time-span of the data, who find complete pass-through for the short-term corporate loan rate and incomplete pass-through for the household deposit rates in Hungary.

We would like to highlight that our paper focuses on the first stage in the transmission mechanism, hence, no direct conclusions can be drawn about the strength of the interest rate channel. The functioning of the channel is considerably influenced by the interest rate sensitivity of consumption and investment expenditures, and by the importance of banking instruments in the balance sheets of economic agents. These two factors depend mainly on the structure and magnitude of households' and companies' net wealth and the significance of non-banking financial intermediation. In the case of Hungary, we have to mention an important additional factor, namely the access to foreign exchange loans that can substitute loans denominated in the national currency.

The rest of the paper is organised as follows. In Section 2 we discuss several theories that provide explanations for the sluggish and incomplete adjustment of bank rates and provide an overview of the literature that emphasises the importance of the structure of the financial system. In this section we also highlight the main structural characteristics of the Hungarian banking system and compare them to those of the euro countries. In Section 3 we list several stylised facts that can be established before the econometric analysis. Section 4 introduces the linear econometric model and presents the results, and Section 5 covers the TAR estimation applied to investigate the potential non-linearities in the adjustment process. Section 6 concludes the paper.

2 Determinants of interest rate pass-through

Imperfections of the pass-through raise two different, although not independent questions. The first refers to the degree of pass-through, namely the extent at which changes in the MMR are passed through to banking rates in the long run. The second aspect is the speed of the pass-through, namely how long the adjustment takes.

Below we review the determinants of the interest rate transmission, with primary focus on the characteristics of the financial system, and we touch upon theories of bank rate stickiness.

2. 1 Role of the financial system

The varying strength and speed of monetary interest rate transmission can be largely traced back to differences in the structural properties of financial systems,[1] with special regard to

- disintermediation,
- intensity of competition in the banking sector,
- capitalisation and liquidity position of banks,
- monetary policy and interest rate volatility.

Disintermediation

The degree of disintermediation and the role of non-bank financing have an impact on the elasticity of both loan demand and deposit supply with respect to the money market rate. On the asset side, loan demand is expected to react more intensely to interest rate changes in an economy with developed capital and money markets, as companies may substitute bank loans with other forms of financing. Similarly, households' access to alternative investment opportunities of deposits affects the market rate elasticity of deposit supply, and consequently the degree of pressure on bank deposit rates.

Competition among banks

Intensity of competition among banks also influences the interest rate elasticity of loan demand and deposit supply. A low degree of competition, both among banks and with non-bank financial markets, implies a higher spread and has an influence on banks' pricing behaviour. However, this effect might differ depending on the direction of change in the MMR. On the asset side, under limited competition interest rates on loans might react more intensely to increases and more sluggishly to decreases of the money market rate, and the opposite holds for the liability side, namely for deposits.

Empirical research on the relationship between competition and pass-through provides ambiguous results. Cottarelli and Kourelis (1995) find that differences in market concentration among countries do not explain the differences in pass-through significantly.

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[1] See Cottareli and Kourelis (1994), Ehrmann et. al. (2001), Mojon (2000).

In contrast, Mojon (2000) concludes that sharper competition among banks contributes to faster adjustment of bank rates.

Capitalisation and liquidity position of banks

Well-capitalised and liquid banks are less forced to adjust to changes in monetary policy and have the possibility of swallowing the shocks, at least temporarily. For example, a better liquidity position and capitalisation provide a better opportunity for banks to smooth their interest rates.

Monetary policy and interest rate volatility

Changing interest rates on bank instruments incur adjustment costs to banks. Due to these so-called menu costs, the adjustment of bank rates depends on banks' assessment of whether a change in the policy rate is temporary or permanent. If a change is considered to be temporary, a bank might decide to smooth interest rates. Hence, the pricing behaviour of commercial banks is influenced by their perception of the nature of changes in interest rates. Accordingly, higher volatility in interest rates is likely to lessen the degree/speed of adjustment, as each shift in the market rate is probably regarded as temporary. Mojon (2000) as well as Cottarelli and Kourelis (1995) find evidence in their multiple country empirical study for interest rate volatility influencing the pass-through.

2. 2 Theories of bank rate stickiness

Theories concerning the pricing behaviour of banks constitute a special sub-area of the theories of pricing.[2] Explanations about price and wage stickiness are also applicable for bank rates.

According to the classical theory, with perfect competition and complete information the price is equal to the marginal cost and the derivative of price with respect to the marginal cost is equal to one. If the assumptions of perfect competition and complete information do not hold, then this derivative declines below one. This idea can be applied to bank rates. For instance, the more the market structure moves away from perfect competition towards monopolistic competition, the more loan rates exceed the marginal cost of funds. Some theories, which explain why bank rates do not move one for one with the market rates are based on, for example, ideas of adverse selection, switching cost, consumer irrationality and risk sharing. Lowe and Rohling (1992) present an excellent summary of these theories.

One should note that under certain circumstances and assumptions the bank rates might even overreact or forego changes in the policy rate. According to one argument, bank rates can change prior to changes in marginal funding. Banks may, for instance, anticipate a rise in funding costs and increase loan rates in advance. This argument has higher relevance if banks finance longer-term loans with shorter-term deposits, which is usually the case. According to our other argument, changes in bank rates can exceed changes in the marginal cost of fund. If the required yield of a loan responds one for one with the marginal cost of fund, leaving the profit rate unaffected, then the loan rate should also

[2] There are two different approaches to model pricing: (1) when price changes are time-dependent and (2) when decisions on price changes depend on state-variables (state-dependent pricing). Since the cost of fund, i.e. the alternative cost, influences pricing decisions mainly at a credit institution, modelling the loan rates as a state-dependent variable seems more plausible.

change by the same magnitude in a risk-free world. If we assume that borrowers can default, the loan rate should cover not only the cost of fund, but also the expected loss caused by non-payers. The higher the loan rates, the more the expected loss caused by the group of non-payers. Consequently, loan rates should increase more than the cost of fund to cover extra loss.[3]

2. 3 Implications of the theories for Hungary

We begin our empirical analysis by reviewing the Hungarian financial system from the point of view of the interest rate pass-through. It is especially important to study the structural factors influencing the interest rate pass-through, because most of these factors are such institutional characteristics, which can only change gradually (see, for example, Mojon; 2001). Because these slowly-changing, country-specific factors will not disappear by the time Hungary introduces the euro, the Hungarian pass-through may converge slowly to the EMU country pass-through. Even in the EMU the pass-through is found to differ substantially across countries (see, for example, Mojon; 2001). Some of the above-discussed factors support the hypothesis of fast interest rate pass-through in the Hungarian financial system, while some factors imply a slow and gradual pass-through. Below we evaluate the effect of these factors and make inferences on the pass-through in the future based on the expected changes in these structural characteristics.

Disintermediation

As pointed out earlier, the phenomenon of disintermediation affects both the asset and the liability sides of banks. Below, we discuss both effects.

In order to evaluate households' access to alternative investment opportunities, that is the interest rate sensitivity of the deposits, one should take a look at the financial portfolio of households. In 2002 bank deposits accounted for about 31% of households' total financial assets. Table 1 shows that this indicator has similar values in other European countries.

[3] Expressing this in a simple formula: $(1 + r_l) \cdot (1 - EN) = 1 + r_{required}$, where r_l is the loan rate, EN is the expected ratio of non-performing loans. $\dfrac{\partial \ r_l}{\partial \ r_{required}} = \dfrac{1}{1 - EN} > 1$, so the loan rate should increase more than the required yield does. Thus, if we take into account that the ratio of non-performing loans is not constant but is increasing in the loan rate, then the derivative should be even higher.

Table 1

Households' bank deposits relative to their total financial assets, 2002

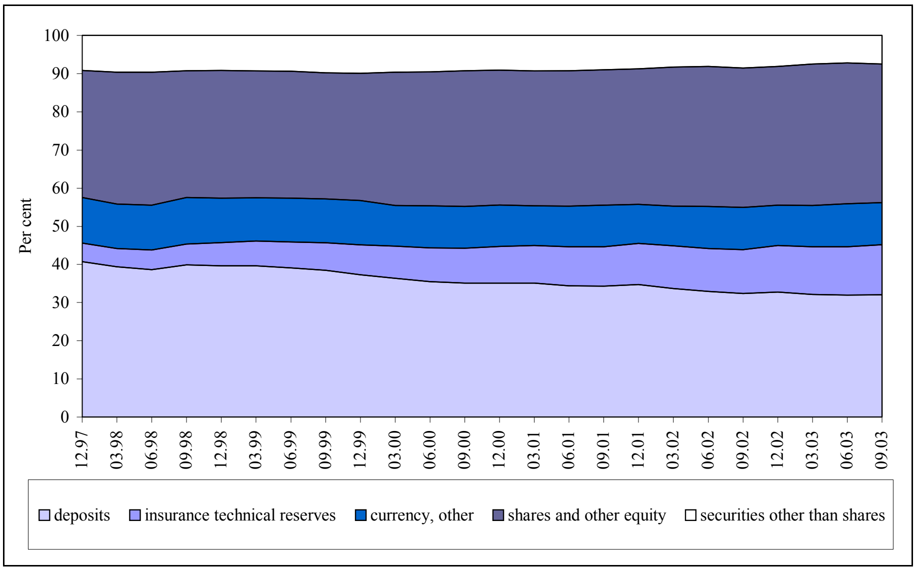
Country	%
Austria	52.1
Belgium	26.1
Finland	32.5
France	28.3
Germany	33.3
Netherlands	19.7
Norway	32.4
Portugal	44.1
Spain	36.5
Sweden	13.6
Hungary	31

Sources: Eurostat and MNB

Moreover, the share of bank deposits in the total financial assets had declined in the previous years: in the last 5 years the share of bank deposits fell by about 10%, while the share of many profitable non-bank investments grew. This reallocation was not in favour of direct investments on the capital market, but mostly in favour of life insurance related investments, which were subsidised by tax deduction opportunities. This shows that investment opportunities other than bank deposits are not only available for households, but that households did substitute part of their deposits by alternative investments.

Chart 1

Financial assets of the household sector



Source: MNB

From the asset-side point of view, the consequences of the strength of competition between banks and non-bank financial institutions are ambiguous. Capital markets play a marginal role in corporate financing. In Hungary, the ratio of stock market capitalisation to GDP is less than 30% of the EMU country average. However, the financial systems of these countries are also dominated by banks. In Hungary, the corporate bond market is especially underdeveloped and we do not expect substantial progress in the near future. In addition, financial intermediation is continuously deepening.

On the other hand, more than 30% of the loans to this sector come from abroad, mostly from banks (see Table 2). Consequently, corporations, especially large corporations, can relatively easily substitute their domestic bank loans with foreign loans, of which the interest rate is not affected by domestic monetary policy.

Table 2

Distribution of corporate and household loans and deposits by currency denomination

	Non-financial corporations		Households	
	Loans	Deposits	Loans	Deposits
Domestic banks, HUF	44	54	97	87
Domestic Banks, foreign currency	29	12	3	13
Foreign banks, foreign currency	27	34	-	-
Total	100	100	100	100

Source:MNB

Competition among banks

Both the Herfindhal index and the market share of the top 5 banks show that in international comparison concentration and competition in the Hungarian bank sector are of medium level. The value of the Herfindhal index is about 1000 (see Table 3), so the market can be viewed as being almost competitive. However, this aggregate indicator hides the differences across the sub-markets, namely, between the corporate and household business line. The low value of the Herfindhal index (700–800 in previous years) in the corporate business line indicates sharp competition and elastic corporate loan and deposit rates. At the same time, competition is rather limited in the household sector. The Herfindhal index for this sector is much higher, above 2000.[4] However, concentration indices do not necessarily show the strength of competition, because other factors, such as entry rules and regulations, affect the competition as well. (Móré and Nagy; 2003 and Mojon; 2000). Várhegyi (2003) argues that taking into account the efficiency and profitability of the Hungarian bank sector modifies our view on competition: the relatively low efficiency coupled with high profitability indicates weaker competition. Based on the difference of the concentration between the household and corporate sector, we expect to have more complete and faster pass-through in corporate rates than in household rates.

[4] The largest Hungarian bank (OTP Bank) dominates the household market, and deposits of households are also concentrated at this bank.

Table 3

Concentration of the banking sector in the EMU countries (2002)

	Share of top 5 banks in terms of total assets (%)	**Herfindhal index**
Austria	46	548
Belgium	82	
Denmark	68	
Finland	79	2000
France	45	
Greece	67	1125
Netherlands	83	1700
Ireland	46	486
Germany	20	150
Italy	54**	
Portugal	81**	1000
Spain	53	870
Average in the EMU region	39	640
Sweden	63	
UK	30	
USA*	27	
Japan*	30	
Hungary	**58**	**950**

Source: ECB(2002)

*2000

**Share of the five largest bank-groups

Capitalisation and liquidity position of banks

The Hungarian banking sector has structural excess liquidity, which is unequally distributed among banks. This excess liquidity ensures more freedom to banks in their pricing policy, for example a more liquid bank is less forced to adjust its deposit rate quickly and perfectly to the increased market rate. Obviously, competition for deposits influences this pricing decision as well.

Excess liquidity has been declining in recent years, which is advantageous for the planned shift from passive-side regulation to active-side regulation. The anticipated further shrinking of liquidity and the shift to active-side regulation will probably improve the efficiency of the pass-through.

Monetary policy and interest rate volatility

The market rate in Hungary as well as the central bank base rate changed by relatively large steps in the recent years. This fact motivates the banks to adjust their rates more quickly than in other countries enjoying a more stable financial environment. Higher changes in the market rates enforce faster reaction compared to smaller ones (25–50 basis points), which are more absorbable by the interest rate margin. On the other hand, the variability in the sign of the changes in the market rate counts against a fast interest rate pass-through, since it is rational for banks to disregard temporary changes in the market rate in the presence of menu costs.

Hungary's future entry into EMU is causing a downward trend of the domestic interest rate because of the interest rate convergence. This trend is not very stable, since the exact time of the entry is uncertain. Furthermore, deviations from the trend are possible as is exemplified by the rate hikes at the end of 2003 (see Table A.1 in the Appendix). The expected downward trend could result in upward rigidity of bank rates, but other factors might counterbalance this effect.

In addition to the characteristics discussed in the theoretical part of this paper, we find it important to emphasise some further typical characteristics of the Hungarian banking system that probably influence and determine the pass-through.

Credit risk

Adverse selection might be more relevant in the Hungarian banking sector than in countries with a more advanced financial system because in Hungary potential borrowers usually have rather short credit history or no credit history at all. Credit history can help banks to make inferences about the risk of customers, but the not yet very deep financial intermediation and the lack of a positive inter-bank credit register system for the household sector further limits the available information about credit risk.

Term structure of loans and deposits

We study the pass-through by analysing the interest rate movements of new loans, although from the point of view of the transmission mechanism it is not only these loans but the entire set of loans that matters. The speed of interest rate transmission is influenced not only by the adjustment of new loan/deposit rates, but also by the term structure of existing loans/deposits. The higher the weight of short-term instruments and instruments with variable interest rate in the portfolio, the faster the pass-through. In comparison to the European average, loans and deposits have shorter average terms in Hungary (more than 90% of corporate loans and deposits and household deposits have shorter than one year repricing period). This is typical of countries with higher inflation and higher interest rate volatility. With the anticipated decline in inflation and the strengthening of economic stability, the duration of loans is expected to become longer, indicating a possible slowdown in the interest rate pass-through in the future.

3 Stylised facts

In order to analyse the pass-through with econometric models, we use data at different levels of aggregation, i.e. we have panels of interest rates of individual banks from among 23 banks for the period January 2001–January 2004 and also estimate dynamic models based on aggregated interest rate data calculated as a weighted average of individual bank rates. Based on these and additional, instrument-level rather than bank-level, data we can already formulate some stylised facts about the pass-through.

3. 1 Aggregated deposit and loan rates

Monthly data on aggregate time series are available for corporate short-term loans and deposits (up to 1 year), household short-term deposits with a fixed maturity up to 1 year and consumer credit up to 5 years (for more detail, see Appendix B on data). Some important stylised facts emerge from the developments in average loan and deposit rates.

1. The spread between loan rates and the MMR (3-month inter-bank rate, the BUBOR) and between the inter-bank rate and deposit rates seems to be related to the movements of the MMR. Specifically, the spread between loan rates and the MMR is correlated negatively (the correlation coefficient is -0.23 for the corporate and -0.61 for the consumer loan rate), while the spread between deposit rates and the money market rate is correlated positively with the MMR itself (the correlation coefficient is 0.61 for household and 0.41 for corporate loan rates) (see Chart 2 and Chart 3). This indicates imperfect pass-through, although it is not entirely clear whether this can be ascribed to incomplete or only sluggish adjustment.

2. The relationship between the MMR and the different spreads seems to differ over the various segments of the market. On the liability side, there is a clear difference between the household and corporate business lines. The spread of short-term household deposit rates is characterised by higher volatility and stronger association with the MMR than that of corporate deposit rates, suggesting that household deposit rates adjust less or at a lower speed to changes in the MMR. Household deposit rates are on average lower than corporate deposit rates. This is due to the more intense competition in the market of corporate funds and to the price insensitive deposit supply of households. However, in some periods of significant falls in the MMR, for example in February 2002 and January–February of 2003, corporate deposit rates temporarily fell below household deposit rates, due to the sluggish adjustment of the latter. This leads to the conclusion that commercial banks smooth the reactions of deposit rates to the fluctuations of the MMR to a higher extent with respect to non-corporate customers.

Chart 2

Spread between short-term corporate loan rates and the 3-month BUBOR

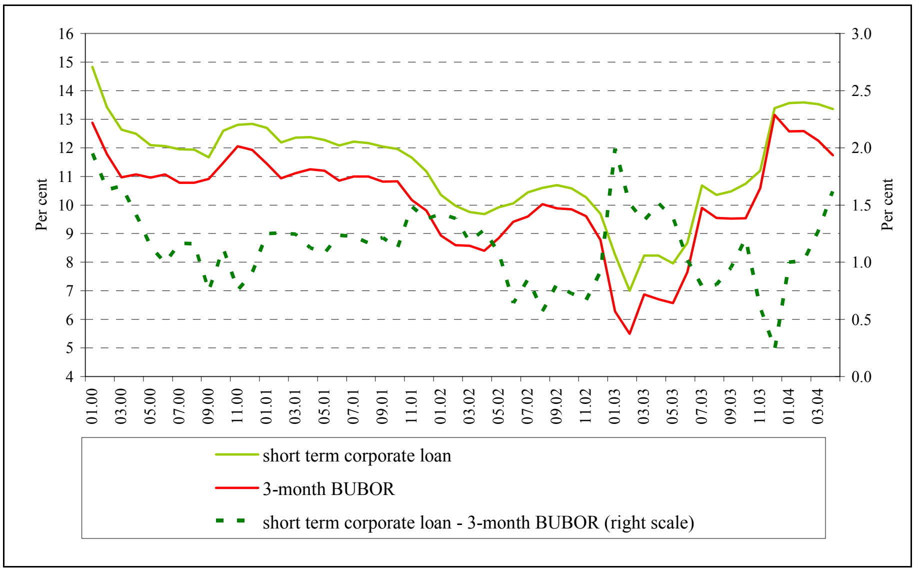
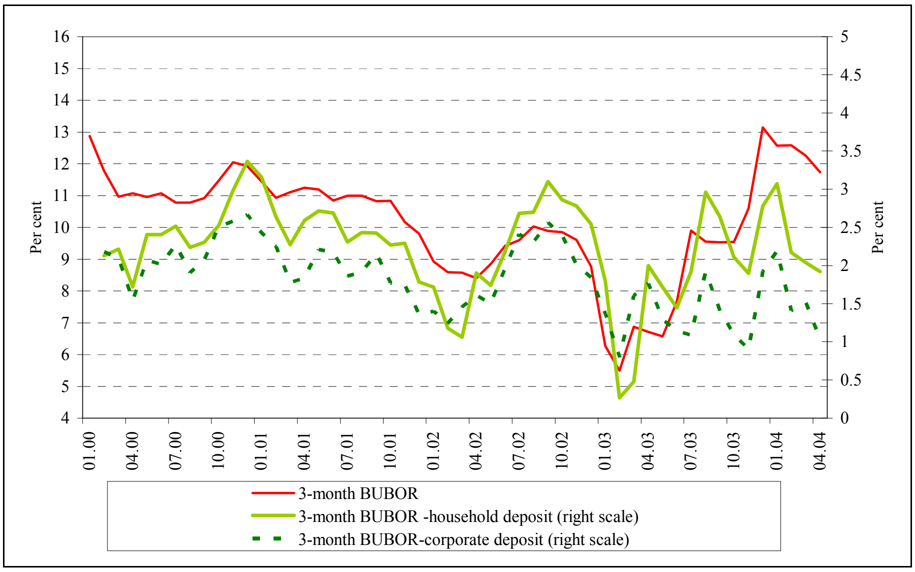


Chart 3

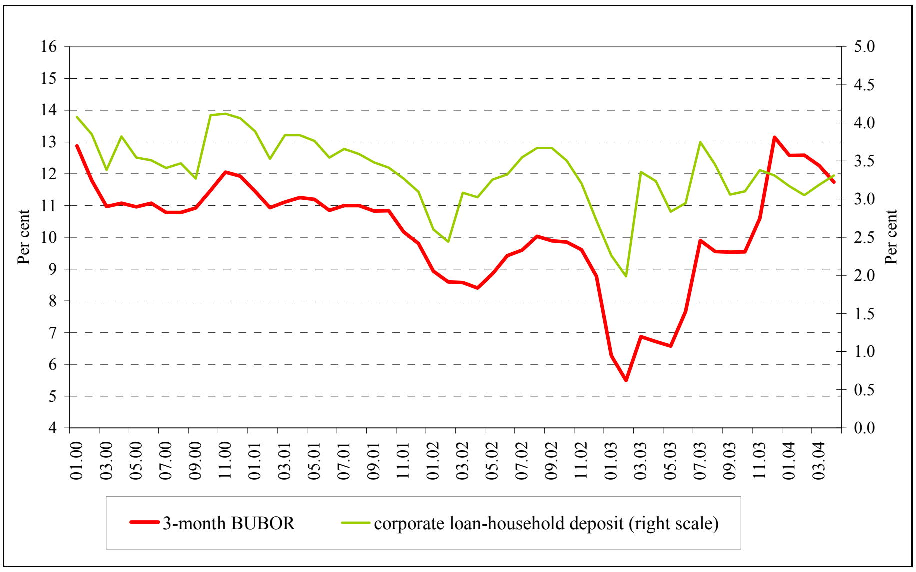
Spread between deposit rates and the 3-month BUBOR



On the other hand, the spread between household deposit rates and the MMR appears to be more volatile than the spread between corporate loan rates and the MMR. Consequently, the margin between household deposit rates and corporate loan rates, i.e. the spread between the cost of the most important liability and the revenue from the most important asset, also shows a negative and strong correlation (-0.68) with the MMR (see Chart 4). *This might indicate that commercial banks' profit is also positively correlated to the MMR changes, that is, a higher MMR implies a higher margin for the banks.* For example, in the case of an interest rate hike gains arising from the widening household deposit spread exceed losses deriving from the narrowing corporate loan spread.

Chart 4

Spread between short-term corporate loan rates and the 3-month BUBOR



3. It is noticeable that in the second part of 2003 commercial banks reacted to increases in the MMR with a lag and, consequently, the spread of the corporate loan rate fell to an unusually low level. Besides the intensity of competition, banks' perceptions of the changes in the outlook for central bank rates and their effect on expectations might also explain this relatively slow adjustment to an increase. The downward path of interest rates and the process of convergence to EMU, which characterised the previous years, might have resulted in an upward rigidity of interest rates, as market participants perceived the rate hikes as transitory. Presumably this phenomenon played an important role in the sluggish adjustment to the 300 basis point interest rate hike of November 2003. Market information[5] also supports the idea that the unusually large change in the policy rate was partly regarded as transitory, as it was directly triggered by a speculative and significant depreciation of the Forint.

It is necessary to mention that January 2003 should be regarded as an exemption, due to the speculative attack. Incomplete adjustment of deposit and loan rates in that period coincided with the central bank's intention. In January 2003, a speculative attack was mounted against the strong edge of the Forint's band. The MNB purchased a considerable amount of euros during the two days of the attack, in order to prevent the market rate from appreciating further. The central bank responded to the influx of speculative capital by slashing interest rates: during the two days of the speculative attack it lowered the interest rate on the two-week deposit facility, its main policy instrument, by 200 basis points, to 6.5%. However, effective interest rate cuts by the Bank were much greater than

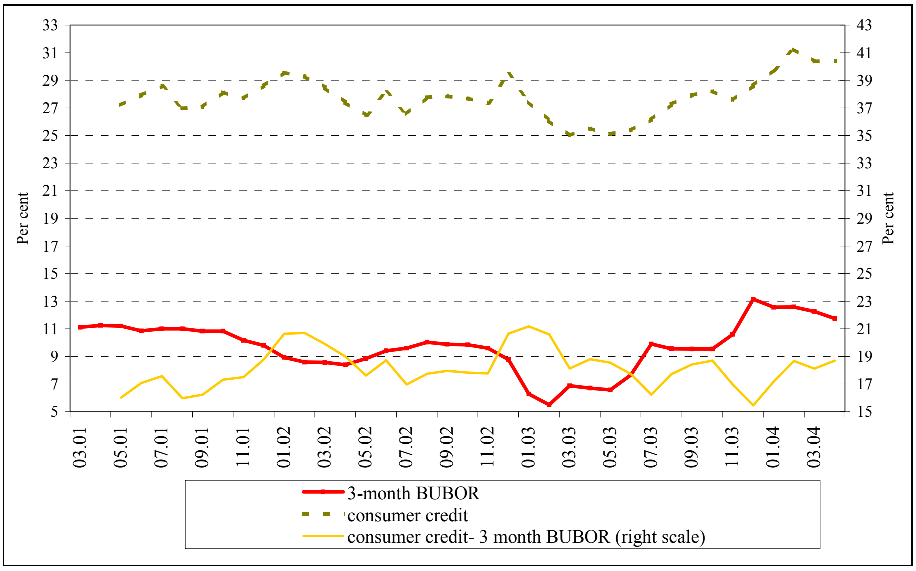
[5] For example, Reuters poll.

that, as quantity restrictions were also imposed on the two-week facility. Thus, excess liquidity could only be channelled into O/N deposits that continued to be freely available. The widening of the overnight interest rate corridor from ±1% to ±3% also entailed a drop in yields on the O/N deposit facility with a temporary 500 basis point decline in effective yields. However, the additional reduction in interest rates in response to the cut in the main policy rate was deliberately a temporary phenomenon. The MNB accomplished a substantial reduction in the effective interest rate by using alternative instruments, and not by changing the policy rate, in order to communicate the temporary nature of this decline.

4. We also investigate the developments in interest rates on consumer credit. Consumer credit rates – in contrast with short-term corporate loan rates – contain a very high, 15–20 percentage point spread to the market rates. The interest rate on consumer credit is apparently less correlated to the market rate, although a part of consumer credit has longer maturity, hence direct comparison with the MMR might be somewhat misleading. However, one can assume that the lower the weight of costs of fund relative to other factors, such as the risk premium content of the interest rate, the weaker the relationship between the commercial bank interest rate and the MMR.

Chart 5

Spread between consumer credit rates and the 3-month BUBOR

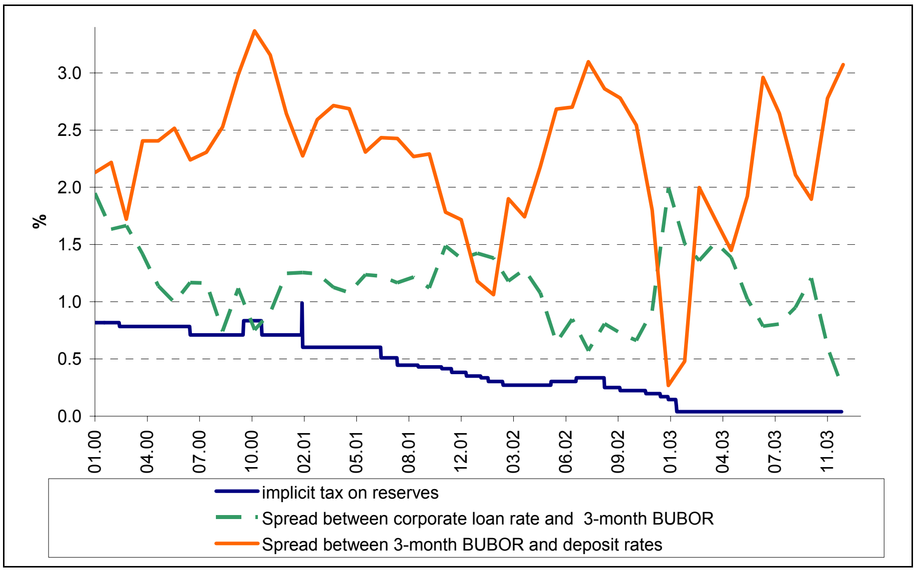


5. Obviously, a lower than MMR interest rate on required reserves imposes a burden on banks' earnings. During the observed period the required reserve ratio and the interest rate paid on reserves changed toward a gradual elimination of the implicit tax on banks through reserve requirements, while possibly having a diminishing effect on spreads. The official indicator of this implicit tax shows the minimum spread between deposit and loan rates, which led to zero profit after complying with the minimum reserve requirement. The approximately 80 basis point decrease in this indicator could have led to a reduction in the spreads between loan rates and deposit rates, but only the spread between the corporate loan rates and MMR has a downward trend over the period January 2000–November 2003. Thus, the decline in the corporate loan spread might be attributed mainly to the negative

correlation between the corporate loan spread and the MMR and the upward trend of the MMR in the sample period.

Chart 6

Implicit tax on reserves and the spreads



Spread levels in international comparison

The magnitude of spread between the MMR and corporate loan rates is similar to, or even lower than that of other European countries. Based on Mojon (2000), in European countries corporate loan rates contain a 2–3 percentage point spread over the MMR. This spread was 1.5 percentage points on average in Hungary in the period 2000-2003, having decreased from its 1996–1999 peak of around 2 percentage points. This reduction might be regarded as somewhat surprising, since the share of riskier loans to SMEs (small and medium-sized enterprises) has increased continuously in the past few years, and for these loans banks charge higher non-interest costs than for those to SMEs. It is possible that a fall in the spreads of individual instruments offsets the effect of changing composition.

On the liability side, however, spreads are somewhat higher than in the euro area. The average corporate deposit rate was 1.8 and the household deposit rate was 2.4 percentage points lower than the MMR on average in the period under review. These spreads prove to be high in comparison to the 1–2 percentage point spreads in the countries of the euro area.

3. 2 Instrument-level short-term corporate loan rates of individual banks

We also use data on some non-aggregated interest rates to make inferences about the size and timing of price adjustments of individual banks. Minimum and maximum offer rates of some banks in relation to short-term corporate loan rates are available. These data are not of the quality to be analysed with sophisticated econometric techniques, but they well illustrate the price adjustment. The main advantage of using interest rate data at the instrument level arises from the fact that whereas aggregate loan rates can change even if individual loan rates do not change but the weights do, this problem does not occur for data on instrument level loan rates. However, the data cover information only about the range of loan rates and not about the exact interest rates of contracts. Most of the studied short-term loans are overdrafts and operating loans. Our main results based on this data can be summarised as follows:

1. The observed rates react to the change in the policy rate within 1–2 months.

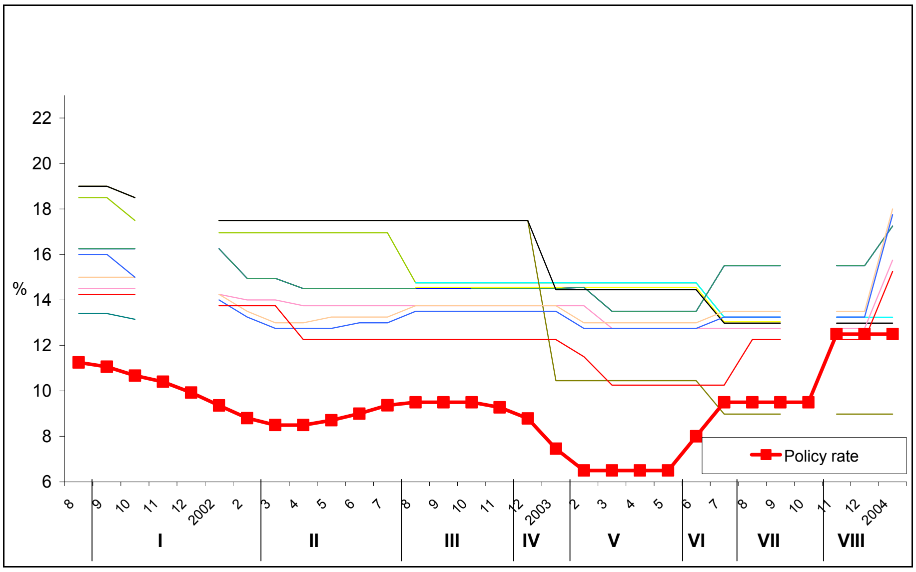
2. Overdrafts are often insensitive to the policy rate and are often quasi-fixed at a high level. This pricing policy biases the interest rate adjustment toward a gradual adjustment.

3. Transitory changes in the policy rate have no impact on the range of offer rates.

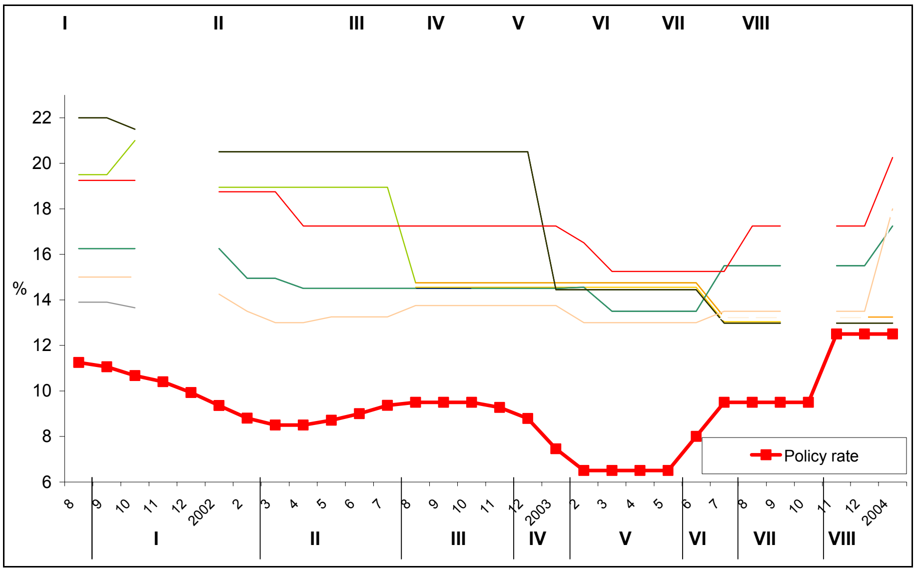
Chart 7

Minimum and maximum offer rates on some short-term corporate loans and the policy rate

Minimum offer rates



Maximum offer rates



Source: Bankinfo Center

Note:

-Data for 3 months are not available.

-The monthly policy rate is the monthly average of the central bank base rate.

We exclude the quasi-fixed rates from our analysis and focus on the relatively sensitive instruments (see the evolution of the interest rate bands of these in Chart 7). The reference rate for these flexible rates is often the policy rate itself, or one of the short-term market rates (1-month BUBOR/3-month BUBOR), consequently, it is not surprising that the policy rate and the range of some individual rates are highly correlated. According to changes in the policy rate, the period of July 2001–January 2004 can be divided into 8 sub-periods. These distinct periods are clearly indicated in Chart 7.

The first period starts with a decline in the policy rate on 10 September 2001 from 11.25% to 11%, which was followed by further (altogether six) cuts that resulted in an 8.5% policy rate by 19 February 2002. This huge (2.5%) change in the policy rate induced a change of 1%–2% in the bands of the rates. Loan rates reacted within 1-2 months.

In the next period the policy rate was raised to 9.5% in two steps, leaving the observed band of loan rates almost unaffected. This may have resulted from the strong competition among corporate business lines of banks and from strong expectations of a general downward trend of the interest rate. The foundation of these strong expectations was the process of convergence to EMU. However, even if we observe unaffected minimum and maximum rates, actual loan rates could change within their bands (the bands are on average more than 2% wide, so a minor increase in the exact interest rates can be achieved without altering the band).

Neither the policy rate nor the band of the loan rates changed in periods three, five and seven, while in period four the policy rate declined substantially from 8.5% to 6.5%. The reaction of loan rates ranged from a 1% to a 6% decline.

In period six the policy rate increased by 3% in two steps, which induced banks to adjust their rates at a relatively high speed. The highest increase of the bands was 2%.

Most of the loan rates reacted in January 2004 to the next 3% increase of the policy rate, which took place on 28 November 2003. Changes in loan rates ranged between 3% and 4.5%. Thus, it was a reasonably full adjustment with a considerable lag. We think that by that time market participants had lost their confidence in the previously robust convergence in interest rates. In Sub-section 3.1., we show that the spread between the aggregate loan rates and the market rates narrowed in December. Analysing the individual loan rates, we conclude that the decline in the spread was only transitory, which is a sign of sluggish but not incomplete adjustment.

4 Linear econometric modelling

4. 1 Method of estimation

Let us consider the simplest Error-Correction Model (ECM) as a starting point to measure the connection between the market interest rate and the interest rate on loans or deposits:

$$\Delta i_{n,t} = \alpha_n + \beta_0 \, \Delta r_t + \gamma \, (i_{n,t-1} - \mu_n - \delta \, r_{t-1}) + \varepsilon_{n.t} \, , \qquad (1)$$

where $i_{n,t}$ denotes loan or deposit interest rates of the *n*th bank at period *t*, and r_t is the MMR of month *t*. The main advantage of using the model in this form is that both the long-run and the short-run parameters can be obtained directly. In the expression for the long-term equilibrium relationship $(i_{n,t-1} - \mu - \delta \, r_{t-1})$, δ means the long-run equilibrium relationship and μ refers to the spread between the MMR and bank rates.[6] The speed of adjustment parameter is γ, which has sensible economic interpretation if it is negative. The time required for the adjustment to the long-run equilibrium can be expressed, for example, by the mean adjustment lag.[7] This measure takes into account the proportion of the adjustment which took place in the first period (immediate adjustment: β) and the total adjustment in the long-run. The mean adjustment lag can be expressed as follows: $\frac{\delta - \beta}{\gamma\delta} = \frac{1 - \beta/\delta}{\gamma}$. If the pass-through to the long-run equilibrium takes place completely in the first period (i.e. if $\beta = \delta$), this measure becomes 0 and it tends to infinity if γ tends to zero. If $\delta = 1$, i.e. in the case of complete pass-through, the expression reduces to $\frac{1-\beta}{\gamma}$. The mean adjustment lag in this form is applicable only in the case of (1), and the formula is not valid for the next model (2), the extended version of model (1). Consequently, we also present another indicator of sluggishness, namely the duration of 80% adjustment, expressed in months.

Expanding equation (1) with further short-term dynamics we get:

$$\Delta i_{n,t} = \alpha + \sum_{k=0}^{K} \beta_k \, \Delta r_{t-k} + \sum_{l=1}^{L} \xi_l \, \Delta i_{t-l} - \gamma \, (i_{n,t-1} - \mu - \delta \, r_{t-1}) + \varepsilon_{n.t} \qquad (2)$$

We estimate equations (1) and (2) using the two-step approach of Engle and Granger (1987), i.e. first we estimate the expression for the long-run equilibrium $(i_t = \mu + \delta \, r_t)$ and then we substitute the error correction term into equation (1) or (2).

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[6] Subtracting r_t from both sides of the long-run equilibrium expression we get $i_t - r_t = \mu - (1-\delta) \, r_t$. Now, it is easy to see that the spread $(i_t - r_t)$ is constant in the case of complete pass-through (if $\delta = 1$), but in the case of incomplete adjustment (that is, if $\delta<1$) the higher the MMR the lower the spread on the loan market. In the deposit market the opposite holds.

[7] See, for example, Hendry (1995, p. 212-216).

We estimate the above discussed equations both on aggregated and bank level data. The motivation for estimating the model on aggregated data is threefold. First, the sample period is longer; second, for the household instruments we have reliable data only on the aggregate level; finally, we exclude some of the banks from the panel analysis due to serious data failure or because they had an insignificant market share or focused mainly on non-market-based loans. Aggregate data comprises information about the interest rates of all banks that exist in a certain month.

Based on the Augmented Dickey-Fuller tests, we find that all time series for corporate and household deposit and loan interest rates follow an I(1) process and so does the 3-month BUBOR. Weak exogeneity tests support the use of single-equation ECMs for the aggregate as well as for the panel data. During model selection we proceed from the more general model (2), fixing the maximum lags at 3, and through excluding the insignificant variables we arrive at the final model.

Estimation techniques applied for the ECM based on aggregate data

In the aggregate level analysis, the long-term coefficients are estimated using the ARDL approach developed by Pesaran and Shin (1997), while the standard errors are calculated using the so-called Bewley's regression (Bewley; 1979) (see Appendix C).

Estimation techniques applied for the panel ECM

In order to find the proper panel ECM specifications, we test the assumption of equal slope and intercept parameters over the cross-sectional units (banks).[8] The F-tests suggest the use of bank-specific constants (banks work with different interest rate spreads) and same slopes for the long-run equilibrium equation, both for corporate loans and for deposits. When estimating the second stage, in the case of the short-term dynamics, we can accept the null of common slope and common intercept and the estimated common constant turned out not to differ significantly from zero.

In light of the above results, we use three estimation methods.

1. First, we estimated the long-run equation with fixed effect, and the ECM with a common effect model (see as FE-OLS).

2. Second, we estimated both the long-run equation and the ECM with the same method under the fixed effect specification, substituting $(i_{n,t-1} - \mu - \delta r_{t-1})$ into the ECM (see as FE-FE).

3. The second method might be biased due to the lagged dependent variable in the ECM, but by increasing the sample in the time dimension the magnitude of bias diminishes. Although our panel seems to be sufficiently long to neglect the bias, we also estimated the ECM equation with GMM (Generalized Methods of Moments) using the approach of Arellano and Bond (1991) (we refer to this as FE-GMM).

[8] We also estimate the ECM separately for each bank (we do not show these results here). This is important, on the one hand, to gain some insight into the adjustment behaviour of each bank separately, keeping in mind the fact that the estimates – especially the long-run equilibrium parameter – are based on a quite limited number of observations. On the other hand, it provides ideas on cross-sectional heterogeneity and on the final choice of the panel model. We find high and reasonably fast pass-through among the 25 banks and very similar parameters. So, average pass-through parameters can be interpreted properly in models with common slope coefficients.

4. 2 ECM results

4. 2. 1 Results from aggregate-level analysis

We use the same short-term loan and deposit data as the one discussed in Subsection 3.1. for the aggregate-level analysis. Aggregate data are available for the period January 1997–April 2004 except for consumer credit, which has a shorter time-span: data are only available from May 2001 to April 2004.[9] As Table 4 shows, the results are consistent with the conclusions derived from the stylised facts but, in addition to providing general insights into the adjustment behaviour, now we can measure and interpret long-run and short-run adjustment separately. The results suggest a clear difference in the adjustment of corporate and household interest rates. Corporate loans and deposits have somewhat higher long-run pass-through, but the short-run adjustment parameters differ markedly, implying that the mean adjustment lag is significantly lower than in the household segment. The corporate loan market is the only market with a long-run pass-through parameter close to unity, that is, complete adjustment. In all other markets the long-run parameter is significantly lower than one, which suggests incomplete pass-trough, although in the case of consumer loans the null of complete adjustment cannot be rejected because of the very high standard errors probably arising from the very short sample.[10] In the corporate loan and deposit markets the pass-through is reasonably quick; the greatest part of the adjustment takes place within two months. This fast and quite high degree of adjustment is probably due to high competition in the corporate segment.

We would like to point out that the difference between the pass-through of corporate and household deposits turns out to be mainly due to the difference in the short-term reactions, and not so much due to the difference in the long-run pass-through.

The incomplete and slow adjustment of consumer credit and the very high spread (around 20 percentage points) can be explained partly by the low interest rate elasticity of demand.

These results are in line with those of Crespo-Cuaresma et al. (2004), despite the different estimation method used and the different time-span of the data, who find complete pass-through for the short-term corporate loan rate and incomplete pass-through for the household deposit rates in Hungary.

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[9] For January and February 2003 we introduce two time dummies, because in the period January 17–February 25 the interest rate corridor was kept wider. However, these dummies turn out not to be significant, so we exclude them from the final model.

[10] The fact that the point estimate of δ is lower for consumer credit than for any other instruments, but due to the fact that its 95% confidence interval is about eight times wider than that of corporate or household deposits, for which we reject the null, we accept that it clearly illustrates this.

Chart 8

Reaction of bank rates to a 1 percentage point change in the 3-month BUBOR

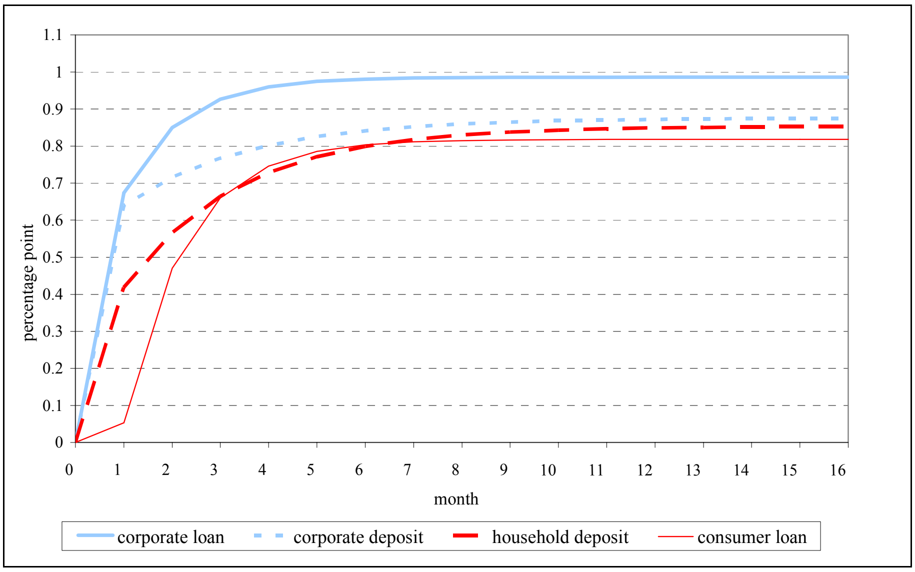

Table 4

Results for the ECM estimated on aggregated data

(January 1997–April 2004)

	Corporate loans	**Corporate deposits**	**Consumer loans**[a]	**Household deposits**
Long term equation				
Constant (μ)	1.26***	-0.56*	20.03***	-0.76***
δ	0.98*** (0.03)	0.87*** (0.02)	0.81*** (0.17)	0.86*** (0.02)
Complete pass-through? (δ =1?)	Yes	No	Yes	No
Adjusted R^2	0.95	0.95	0.1	0.96
Short term dynamics (ECM)				
α	0.00	0.00	0.00	0.00
Contemporaneous adjustment β_0	0.67***	0.64***	0.05	0.41***
γ	0.56***	0.32***	0.54***	0.34***
Mean adjustment lag [11]	0.56	0.83	1.71	1.50
80% adjustment (months)	2	2	4	3
Adjusted R^2	0.88	0.72	0.44	0.64
Number of observations	88	88	36	88

* significant at 10%, ** at 5%, *** at 1%

[a] For consumer loan interest rates, data are available from May 2001

[11] Based on Hendry's (1995, p. 212-216) calculations for the mean adjustment lag.

4. 2. 2 Results of the panel data analysis

Our panel results are similar to those on aggregate data, and the results are very similar in the case of all the three estimation techniques. Table 5 clearly shows that short-term corporate loan rates appear to fully and quickly adjust to the MMR. Most of the adjustment to the long-run equilibrium (80 per cent) takes place within two months. The long-run adjustment parameter is close to one and we cannot reject the null-hypothesis of complete long-run adjustment at the 5% level. According to the panel results presented in Table 6, the pass-through of MMR changes to corporate deposit rates, although high, is incomplete. The immediate adjustment parameter is similar to that of corporate loan rates, and the speed of adjustment parameter is somewhat lower.

As it is not entirely clear which instrument is to be considered as the effective MMR, we perform a similar analysis using different measures. The additional measures are the 1-month BUBOR and 1, 6, and 12-month treasury bills. The results are very similar to those with the 3-month BUBOR (we do not present these results here, but refer the reader to Tables 12 and 13 for corporate loan market and Tables 15 and 16 for the corporate deposit market in the Hungarian version of our paper; Horváth et al.; 2004).[12]

Table 5

Results for the panel regression (corporate loans)

	FE-OLS	**FE-FE**	**FE-GMM**
Long term equation			
δ	0.95*** (0.02)	0.95*** (0.02)	0.95*** (0.02)
Complete pass-through? **(δ =1?)**	Yes	Yes	Yes
$\overline{R}^2$	0.85	0.85	0.85
ECM			
β_0	0.67*** (0.04)	0.67*** (0.04)	0.69*** (0.04)
β_1	0.10** (0.04)	-	-
γ	-0.61*** (0.03)	-0.61*** (0.03)	-0.57*** (0.08)
Mean adjustment lag	-	-	0.48
80% adjustment (months)	2	2	2
N	748	748	748
$\overline{R}^2$	0.42	0.45	0.41

* significant at 10%, **: significant at 5%, ***: significant at 1%.
Monthly data, January 2001-January 2004.

[12] These tables can be understood without any knowledge of Hungarian.

Table 6

Result of panel regression (corporate deposit)

	FE-OLS	**FE-FE**	**FE-GMM**
Long term equation			
δ	0.87*** (0.02)	0.87*** (0.02)	0.87*** (0.02)
Complete pass-through? **(δ =1?)**	No	No	No
$\bar{R}^2$	0.71	0.71	0.71
ECM			
β_0	0.66*** (0.03)	0.54*** (0.03)	0.70*** (0.04)
β_1	0.22*** (0.03)	0.22*** (0.03))	-
γ	-0.29*** (0.03)	-0.28*** (0.03)	-0.30*** (0.12)
Mean adjustment lag	-	-	0.65
80% adjustment	2	2	2
N	820	820	820
$\bar{R}^2$	0.53	0.52	0.48

* Significant at 10%; ** Significant at 5%; *** Significant at 1%.
Monthly data, January 2001–January 2004.

5 Analysis of non-linear adjustment

There are a number of theoretical reasons for the non-linear adjustment of bank rates. If conditions of perfect competition are violated, the pricing behaviour of banks might depend on properties such as the size and/or the direction of interest rate shocks, and their effects on expectations. Below, we examine three cases which might result in non-linear pass-through.

5. 1 Method

1. First, we investigate whether the adjustment process depends on the *sign* of the MMR change and/or the *sign* of the deviation from the long-term equilibrium. Asymmetric adjustment might be entailed by the low interest rate elasticity of loan demand and deposit supply, due to the profit maximising behaviour of banks under market imperfections and adjustment costs (see Section 2). A usual finding in the literature (e.g. Hannan and Berger; 1991, Sander and Kleimeier; 2002) is that loan rates are more rigid downward, while deposit rates tend to be sticky upward.

2. Adjustment of bank rates might also differ depending on the *size* of MMR change and/or deviation from the long-term equilibrium. Due to presence of menu costs and the intention of banks to smooth interest rates for their customers, banks may react more intensely to wider changes in the money market rate. In this case the adjustment might be significantly faster above a certain threshold. This effect was investigated, for example, by Sander and Kleimeier (2003).

3. Third, we analyse the effect of yield *volatility* on the pass-through. Higher volatility, and hence higher interest rate uncertainty, might attenuate the adjustment, as banks judge the changes in the money market rate as transitory. This effect was demonstrated by Mojon (2000) in an analysis of European countries. However, in our view, higher volatility is often accompanied by larger changes in yields, which hastens the adjustment process. The final outcome, emerging from these two opposite effects, is highly uncertain.

We apply TAR models, in which the adjustment parameters differ depending on the position of the so-called indicator variable. Non-linearities enter only in the ECM equation, where it is assumed that non-linearities influence only the speed of adjustment. These threshold effects were investigated, for example, by Sander and Kleimerier (2003), where the authors constructed two regimes with different gamma parameters. We introduce two regimes not only for the speed of adjustment, but also for the contemporaneous adjustment parameters. The general form of our model is the following:

$$\Delta i_{n,t} = \alpha + \beta_0 \, \Delta r_t + \beta_0^* \, \Delta r_t I_t + \gamma \, (i_{n,t-1} - \delta \, r_{t-1} - \mu) + \gamma^* \, (i_{n,t-1} - \delta \, r_{t-1} - \mu) G_t + \varepsilon_{n.t} \,, \tag{3}$$

where

$$I_t = \begin{cases} 1, & if \quad y_t > c_2 \\ 0, & if \quad y_t \le c_2 \end{cases} , \tag{4}$$

and

$$G_t = \begin{cases} 1, & if \quad x_t > c_1 \\ 0, & if \quad x_t \le c_1 \end{cases}. \tag{5}$$

The indicator variables (x, y) in the different specifications:

1. Size asymmetry: $y_t = |\Delta r_t|$ and $x_t = |i_{n,t-1} - \delta r_{t-1} - \mu|$ (6)

2. Sign asymmetry: $y_t = \Delta r_t$ and $x_t = -(i_{n,t-1} - \delta r_{t-1} - \mu)$ and $c_1=c_2=0$. (7)

3. Volatility asymmetry: $x_t = y_t = stdev(r)$, and $c_1=c_2=c$ (8)

Volatility is measured by the 2-month standard deviation of the 3-month benchmark yield.[13]

In the case of the sign asymmetry, the thresholds are set to zero, ($c_1 = c_2 = 0$), that is the estimation is reduced to a simple OLS with dummy variables. When analysing size and volatility asymmetry, the threshold values are also estimated by the so-called sequential conditional least squares. This means that we estimate a simple OLS under different thresholds, and then the model with the smallest standard error is chosen.[14] The set of possible threshold values were established in such a way that each regime contains at least 15 per cent of the total observations. We estimate the model on both aggregated and panel data. As the different methods produced very similar results in the case of the linear model, we estimate the TAR ECM equations only with one method, the FE-OLS specification.

We do not present the results for the consumer loans due to the very limited number of available observations.

5. 2 Results of TAR estimations

5. 2. 1 Size asymmetry

Both aggregated and panel data estimations confirm that the pricing of corporate loan and deposit rates is non-linear, but depends on the size of MMR change and the deviation from the long term equilibrium (see Table 7). In the case of corporate loan rates, both the speed of adjustment and the contemporaneous adjustment parameters are significantly higher above a certain threshold. According to the panel results, a change in the MMR which is higher than 60 basis points entails three times larger contemporaneous adjustment than in the case of lower MMR changes. Moreover, the speed of adjustment parameter is significant only when the error correction term exceeds 30 basis points. In the case of corporate deposit rates, the panel results suggest non-linearity only for the speed of the adjustment parameter, while aggregated results show asymmetry for both relationships. Aggregate data show non-linearity in the contemporaneous parameter for household deposit rates. We note here that for the contemporaneous adjustment parameters, the

[13] We estimate the model with alternative volatility measures, e.g. one and three-month standard deviation of daily changes in 3-month benchmark yields. The results were quite similar to those for the 3-month benchmark yield, so we only present results for the latter.

[14] See Franses and van Dijk (2000) p. 84, for further details.

thresholds for which standard error of regression is minised turn out to be rather high values, around 60-80 basis points.

Table 7

Size asymmetry - TAR results

	Panel data (Jan. 2001–Jan. 2004)		Aggregate data (Jan. 1997–Apr. 2004)		
	Corporate loans	Corporate deposits	Corporate loans	Corporate deposits	Household deposits
β_0	0.28**	0.20**	0.56***	0.22**	0.14**
β_0^*	0.46***	0.56***	0.14**	0.46***	0.35***
c_1 (%point)	0.59	0.67	0.82	0.70	0.82
γ	-0.16	-0.30***	-0.46**	-0.25***	-0.45***
γ^*	-0.80***	-	-0.25**	-0.30***	-
c_2 (%point)	0.28	-	0.52	0.24	-
N	748	820	89	89	89
*** Significant at 1%; ** 5%; * 10%.					

5. 2. 2 Sign asymmetry

Our results on asymmetric sign responses (presented in Table 8) are partly in line with other empirical studies which report downward stickiness in the loan market (see, for example, Mojon; 2000 and Sander and Kleimeier; 2002). Panel and aggregate results turn out to be similar for corporate loan and deposits rates. Despite the strong competition in the corporate loan market, corporate loan rates proved to be sticky downwards, i.e. the speed of adjustment is higher in the case of below-pricing, namely when the error correction term is negative. The contemporaneous adjustment parameter is higher when the MMR increases than when it decreases. However, in the case of corporate deposits we are unable to detect any asymmetric reaction, despite the fact that with low competition one might expect upward stickiness.

One might expect downward stickiness in loan rates and upward rigidity in deposits rates due to the profit maximizing behaviour of banks, if loan demand and deposit supply are inelastic with respect to the MMR. However, taking into account the strong competition in the corporate segment and the fact that our linear model shows quick and complete pass-through for the corporate loan rates, our results might be regarded as somewhat surprising. International experience also suggests that strong competition should mitigate asymmetry of the pass-through. Another remarkable result is that household deposit rates react more intensely to MMR decreases than to increases. These unpredicted results might be partly attributed to the fact that the average size of MMR rate increases is higher than that of MMR falls.

Table 8

Sign asymmetry – TAR results

	Panel data (Jan. 2001–Jan. 2004)		Aggregated data (Jan. 1997–Apr. 2004)		
	Corporate loans	Corporate deposits	Corporate loans	Corporate deposits	Household deposits
β_0	0.59***	0.62***	0.53***	0.61***	0.26***
β_0^*	0.19**	0.16	0.24***	0.04	0.28***
γ	-0.54***	-0.44***	-0.71***	-0.27*	-0.38***
γ^*	-0.16*	0.12	0.34*	-0.09	0.09
N	748	820	89	89	89

*** Significant at 1%; ** 5%; * 10%.

5. 2. 3 Volatility asymmetry

Although our results vary somewhat over the different types of instrument, at least one of the adjustment parameters turns out to be significantly higher above a certain level of yield volatility (see Table 9). This indicates that the effect of higher interest rate changes on the pass-through exceeded the adverse effect of higher interest rate uncertainty. It is important to emphasise that we cannot distinguish between the effect of higher uncertainty on expectations and the effect of larger changes in yields, which is a consequence of higher interest rate volatility. This makes the interpretation of our results difficult. The year 2003 serves as a good illustration. In this period, money markets could be characterised by high uncertainty about the convergence process, which was reflected in the increased risk premiums and volatility of yields. Higher volatility was accompanied by wider movements in yields. Monetary policy reacted by unusually large policy rate changes to the risk premium shocks. Even though the pass-through did not decline in this period, the higher volatility of error correction terms, i.e. the fluctuations of spreads between bank rates and the money market rates, shows an unpredictable environment for banks.

Table 9

Volatility asymmetry –TAR results

	Panel data (Jan. 2001–Jan. 2004)		Aggregated data (Jan. 1997–Apr. 2004)		
	Corporate loans	Corporate deposits	Corporate loans	Corporate deposits	Household deposits
β_0	0.43***	0.22**	0.50***	0.36***	0.15*
β_0^*	0.34***	0.52***	0.23***	0.37***	0.32***
γ	-0.54***	-0.37***	-0.55***	-0.24***	-0.25***
γ^*	-0.21***	0.01	-0.14	-0.41**	-0.24***
c (%point)	0.09	0.06	0.14	0.08	0.12
N	748	820	86	86	86
*** Significant at 1%; ** 5%; * 10%.					

To sum up, different factors, which might lead to non-linear adjustment, prove to be interrelated to each other, which makes it difficult to interpret the results.

6 Conclusions

In this paper we analysed the interest rate pass-through in Hungary. First, we highlighted stylised facts of the markets for various loans and deposits. Second, we analysed the adjustment of bank rates with econometric models. These models can capture important aspects of the adjustment, such as adjustment in the long-run, the speed of adjustment to the equilibrium and short-term responses.

Our results suggest a clear difference in the pricing of household and corporate instruments. In the case of corporate deposits and loans, both the degree and the speed of adjustment exhibit a stronger transmission than the corresponding household interest rates do. Corporate loans and deposits have higher long-term pass-through and faster short-term adjustment, which is also reflected in the significantly lower value of mean adjustment lag than in the case of the household loan and deposit markets. This result is probably due to the fact that in the corporate segment – in contrast with the household sector – competition is very intense. The corporate loan market is the only market for which we found complete pass-through, while in all other markets the estimated long-run parameter is significantly lower than one. The adjustment of consumer credit interest rates proved to be exceptionally incomplete and slow, probably reflecting the low interest rate elasticity of loan demand and the high proportion of risk premium. Comparing our results with those of Árvai (1998) and Világi and Vincze (1995) the interest rate transmission has improved since the mid 1990s due to the improvement of macroeconomic and financial environment. Our results are in line with those of Crespo-Cuaresma et al. (2004), despite the different estimation method used and the different time-span of the data, who find complete pass-through for the short-term corporate loan rate and incomplete pass-through for the household deposit rates in Hungary.

European empirical studies conclude that short-term corporate loan rates adjust completely in the long run, although some studies have the opposite conclusion. Hence, corporate loan rates in Hungary behave similarly to other European countries' loan rates, in terms of long term adjustment. Regarding the short-term adjustment of corporate loan rates, we find the Hungarian rates to adjust very fast; the recent ECB study (de Bondt, 2002) find the first period adjustment to be less than 50% for the EMU countries, whereas we estimated this adjustment parameter to be much higher, about 60-80%.

In contrast to the corporate loan rates, much less empirical studies analys the adjustment of deposit rates and household loan rates. These few studies find that even the long term adjustment of these rates is very slow: ranges between 40-70%. Even so, consumer credit rates in Hungary founnd to be more rigid in international comparision.

We analysed the potential non-linearities of banks' pricing with threshold ECM models. The results suggest that the speed of adjustment of bank rates depends on the size of the changes in the MMR and the distance of bank rates from their long-term equilibrium. We found the adjustment to be significantly faster for changes above a threshold level than for smaller ones. This phenomenon can be explained by the presence of menu costs. The sign of yield shocks also turned out to be influential for the speed of adjustment. In line with international experience, we found that corporate loan rates are characterised by downward rigidity, probably due to the profit maximising behaviour of banks. Surprisingly, the sharp competition in the corporate loan segment could not fully counterbalance this downward rigidity. We also found that household deposit rates adjust more rapidly to upward than to downward shifts in the MMR. This seemingly counterintuitive finding can be explained by the fact that the average size of positive shocks exceeded the average size of negative ones in the sample period. We also analysed how the volatility of money market rate affects the pass-through. At least one of the parameters determining the speed of adjustment changed towards faster adjustment when the volatility of the market rate exceeded a certain level. Intuitively, higher volatility should be accompanied by higher uncertainty and hence more sluggish adjustment. However, high volatility can be the consequence of large shocks, for which we found faster adjustment. The size effect and the effect of uncertainty are hardly separable. We think that in the volatile periods, especially in 2003, the effect of uncertainty was dominated by the size effect. However, faster pass-through could not completely offset the effect of higher money market rate shocks, which resulted in higher volatility of the spread between bank rates and the money market rate.

Our conclusions are, of course, related to the sample period we used. However, we believe that some tendencies could change the pass-through in the future. The relatively weak competition in the household sector is expected to improve, likely resulting in a faster and more complete pass-through. Deficiencies in the deposit rate adjustment might be improved by the anticipated further shrinking of excess liquidity in the financial system coupled with the shift to active-side regulation from the present passive-side regulation. As excess liquidity disappears, competition for deposits is expected to sharpen. Progress with the adjustment of household loan rates depends mainly on the future trends in the markets of consumption loans and housing mortgages. The extraordinary high spreads of consumer credit rates might motivate banks to enter this segment and step up competition, leading to lower spreads and improved pass-through. Up to recent times, most of the mortgage loans were government-aided with fixed rates, so policy rate changes could and can hardly have any effect on these rates. The regulation of government-subsidised loans changed in December 2003. Since then, the maximum rate of newly granted subsidised loans has depended on the market rate with same maturity. Obviously, this change in the regulation improves the pass-through. And a final hypothesis is that as the average maturity of loans extends in accordance with declining inflation and interest rate uncertainty, the average loan rate is expected to become less dependent on the policy rate.

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Appendix A

Table A. 1

Central bank interest rate (January 2000–December 2003)

Date	Central bank rate (Two-week deposit rate)
01-01-00	14.25
04-01-00	13.75
19-01-00	12.25
17-02-00	11.75
23-03-00	11.25
25-04-00	11.00
08-08-00	10.75
08-01-01	11.50
05-02-01	11.25
10-09-01	11.00
25-10-01	10.75
13-11-01	10.25
11-12-01	9.75
08-01-02	9.50
22-01-02	9.00
19-02-02	8.50
22-05-02	9.00
09-07-02	9.50
19-11-02	9.00
17-12-02	8.50
01-01-03	8.50
16-01-03	7.50
17-01-03	6.50
25-02-03	6.50
11-06-03	7.50
19-06-03	9.50
28-11-03	12.50

Appendix B

Data

We estimate the econometric model on interest rate data of 23 individual banks and on aggregate data as well.

3. 1. Aggregate data

Data are available on short-term corporate loan and deposit rates, short-term household deposit rates and consumer credit rates.[15] We exclude household mortgage rates from our analysis because the majority of mortgage loans were government-aided[16] and were not subject to market-based pricing. Household mortgage loans are not the only government-subsidised loans supplied by banks, since the corporate sector was subsidised with government guarantee on loans as well. Unfortunately, we have no detailed data on these loans and, consequently, we cannot isolate and eliminate them. In the case of consumer credit, we use the average credit cost indicator instead of contract rates, since this indicator captures non-interest costs as well. These additional costs are significant: the average credit cost indicator exceeds the contract rate by about 5%–6%. The aggregate data on short-term corporate loan rates and on household and corporate deposit rates are from the period January 1997–April 2004,[17] whereas data on consumer credit rates are available for a shorter period, namely May 2001–April 2004.

3. 2. Panel data

Our panel data include short-term corporate deposit rates of 23 banks and short-term corporate loan rates of 21 banks for the sample period, January 2001–January 2004. At the end of 2003 the number of credit institutions in Hungary was 41, but we excluded those which were founded during the observed period. Those banks were also excluded which had an insignificant share of the corporate business line, or had serious data failure, or focused mainly on non-market-based loans.

The definition of the different loan categories has changed several times.[18] This limits the comparability of some data from different years. An example of the changing definition is that while the category of the new loans included both prolonged and repriced loans in 2001, in 2002 repriced loans were excluded. In 2003 this category only contained newly granted loans, hence neither prolonged nor repriced loans. Consequently, the weighted

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[15] Data are available at http://www.mnb.hu.

[16] Government-subsidised mortgage loans have a significant share in household loans: from 2002 about half of long-term household loans were government-aided mortgage loans. Their share increased over the period, reaching its highest value by the 2003.

[17] A structural break appears in the time series of market rates and of the spreads between bank rates and market rates at the end of 1996. Due to this, we consider a sample period from January 1997.

[18] The prescribed data service differed in the following periods: January–April 2001, May–December 2001, January–December 2002 and the period starts in January 2003.

average of loan rates could change due to modifications in the data service. The weighted average of loan rates should change if the portfolio of loans changes, for instance, the portfolio shifts towards loans with lower risk and with lower risk premium. Consequently, the weighted average loan rate can change even if its components do not change, but the weights do.

It should be noted that the loan rates examined are not equal to the APRC, since we only have data on contract rates which do not contain some additional costs. As a result, the loan rates under examination should not react to the changing market rate, if the additional costs do. In that case our data do not reflect accurately the price adjustment of banks, so we underestimate the pass-through. Banks may have good reason to apply a pricing policy which affects not only loan rates, but additional costs as well: the demand for loans might be less sensitive to additional costs due to the complications of comparing different loans with additional costs.

Appendix C

Bewley regression[19]

For the parameterisation of the long-run equilibrium relationship we first estimate an AutoRegressive Distributed Lag (an ARDL(p,q)) model where, based on Schwarz information criterion, the optimal lag structure is chosen as p=1 and q=1.

$$i_t = \alpha + \sum_{i=1}^{p} \phi_i i_{t-i} + \sum_{j=0}^{q} \varpi_j \, r_{t-j} + u_t \qquad (9)$$

From this model the long-run equilibrium parameters can be derived in the following way:

$$\widehat{\mu} = \frac{\widehat{\alpha}}{1-\widehat{\phi}_1 + .. + \widehat{\phi}_p} \text{ and } \widehat{\delta} = \frac{\widehat{\varpi}_0 + \widehat{\varpi}_1 + ..\widehat{\varpi}_q}{1-\widehat{\phi}_1 + .. + \widehat{\phi}_p}. \qquad (10)$$

The standard errors around the parameter estimates can be obtained in several ways. One of them is by using Bewley regression, which can be expressed as below:

$$i_t = \mu + \delta r_t + \sum_{i=1}^{p-1} d_i \Delta i_{t-i} + \sum_{j=1}^{q-1} c_i \Delta r_{t-j} + u_t \qquad (11)$$

The equation can be estimated using $1, r_t, \Delta r_t, \Delta r_{t-1}, ..\Delta r_{t-q+1}, i_{t-1}, ...i_{t-p}$ as instrumental variables.

It can be proved that the point estimates for μ and δ derived from the Bewley regression are the same as those calculated using the ARDL model. However, Bewley regression provides unbiased and consistent values for the standard errors, and hence can be used directly for hypothesis testing.

[19] Based on Bewley (1979) and Pesaran and Shin (1997).