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Interest Rate Pass-Through in New EU Member States: The Case of the Czech Republic, Hungary and Poland

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Abstract:
The characteristics of the interest rate pass-through in the Czech Republic, Hungary and Poland are studied making use of autoregressive distributed lags (ARDL) models. Significant differences are found across market interest rates and countries concerning long-run elasticities of market interest rates to changes in the key policy rate. While the null hypothesis of complete pass-through cannot be rejected for any interest rate in Poland, deviations from complete pass-through are present for several interest rates in the Czech Republic and Hungary. Except for the case of the short-term loan rate for enterprises in Hungary, no significant deviation from symmetry in the speed of adjustment to equilibrium is found in the data.

Keywords: Interest Rates, Pass-Through, Monetary Transmission Mechanism, ARDL Models, Transition, Accession, Acceding Countries

JEL Classification: E43, E50, E52, C22, G21, O52

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Introduction

The transmission of monetary policy actions to macroeconomic variables, such as real GDP and its components, unemployment and inflation, is usually separated into various channels. A rough classification of the main channels differentiates them by means of the variables through which the monetary policy action is propagated to the real economy. The traditional models, in particular those dealing with the interest rate, the exchange rate, and the asset price channel, focus on macroeconomic variables. The more recently developed microfoundation of the transmission mechanism focuses on the credit channel, with the bank lending channel and the balance sheet channel as important sub-channels.

During most of the first decade after systemic transformation, most transition countries have relied on exchange rate policies that took the exchange rate as a nominal anchor for the economy, as the exchange rate channel was considered the strongest and most effective channel of monetary policy in transition economies. This was based also on the observation that the monetisation of the economy, as measured, for instance, by the level of money stock to GDP or domestic credit to GDP, was relatively low, which implied that the interest rate channel and the credit channel were not considered particularly effective. In recent years, however, monetary policy in Central European EU Acceding Countries shifted towards floating exchange rate regimes by substantially widening or completely abandoning currency bands. At the same time, direct inflation targeting (DIT) was introduced in some of these countries. This monetary policy shift increased the reliance on the interest rate and the credit channel, while not necessarily completely ignoring the exchange rate channel. This is exactly the case of the three EU acceding countries that will be included in this study, i.e. the Czech Republic, Hungary and Poland. By now, they all follow a (managed) floating exchange rate regime (within wide currency bands) and combine this with an inflation targeting strategy.

There are several good reasons to study the monetary transmission mechanism in these EU acceding countries. First, a genuine and precise understanding of how fast and to what extent a change in the central bank's interest instrument modifies inflation lies at the

heart of inflation targeting. Second, with joining the European Monetary Union at the horizon, it is important to find out more about whether the euro area would grow more inhomogeneous with respect to monetary transmission mechanism. Third, financial sector institutions may be able to improve their various decision-making processes if they can acquire a better understanding of the interrelations between the various kinds of interest rates.

This chapter contributes to the comprehensive topic of monetary transmission mechanism in EU acceding countries by focusing on the interest rate pass-through as the first stage of both the interest rate and the credit channel. More precisely, this paper investigates the transmission of monetary policy actions to various components of the interest rate structure. Nominal or real changes in interest rate policy will be considered as monetary policy action. The impact of these monetary policy actions on interbank money market rates, on interest rates for nonbank deposits and loans, denominated in local currency, as well as on interest rates for government securities will be empirically analysed. The characteristics of the interest rate pass-through are investigated for the period stretching from the mid-1990s up to the end of 2002.

Theoretical Background: The Interest Rate Term Structure and the Expectations Channel

Monetary policy has long been a Mecca of economic research as many economists had put pen to paper in an attempt to scrutinise its effect on the real economy. Popular wisdom asserts that although ineffective in the longer run, monetary policy is a powerful tool in influencing economic activity at shorter horizons. According to the stylised fact given in Christiano et al. (1996), in the US, monetary policy actions impact on the real sector with an average delay of 4 months and their effect can last up to 2 years. This finding is also borne out in Romer and Romer (1989). Another salient feature of monetary policy, put forth in Barth and Ramey (2000), is that small changes in short-term interest rates could result in large changes in output (amplification effect). These findings are, however, rather suggestive than conclusive as the lag of the pass-through to the real economy appears to change over time and across countries.

Nonetheless, Bernanke and Gertler (1995) deem the mechanism through which monetary policy actions are transmitted to the real economy as a black box. The interest in resolving this conundrum has given rise to a large body of theoretical literature and to a plethora of empirical papers that take pains in matching theory with real data. The most traditional explanation is the interest rate channel developed in textbook IS-LM models. However, the early observation that the interest rate channel cannot neatly explain output fluctuations entailed by monetary policy actions has given birth to the credit channel literature. Thirdly, asset prices are also believed to constitute a bridge between nominal and real variables. Finally, and importantly, monetary policy can also exert its effect through changes in exchange rates.

However, the focus of this paper is only the very first step in the monetary transmission mechanism: the interest rate pass-through from short-term interest rates towards long-term rates.[4] The connection between short- and long-term nominal interest rates is provided by the term structure. The slope and the dynamics of the term structure can be explained by a combination of theories. First, the longer is the horizon of an investment, the less liquid it is, and thus the higher is the interest rate required by investors. Second, short-term and long-term interest rates could be determined independently on segmented markets. But most importantly, it is a widely held view that the expectation conjecture is at the heart of the shape of the yield curve. According to this position, long-term interest rates are obtained as an average of expected future short-term interest rates. So, expectations as to whether, say, an interest rate hike is high enough to curb down inflation will by large dominate the yield curve. This is often referred to as the *expectations channel*, which also plays an important role in the asset price and exchange rate channels.

Another facet of the transmission is how interest rate changes on the money and capital markets influence bank deposit and loan interest rates. The reaction of deposit rates on time deposits hinges on the extent to which other financial assets such as government bills and bonds are substitutes for bank deposits. The speed of the transmission eventually depends on the maturity structure of the stock of deposits and the proportion of fixed and

[4] For a macroeconomic model comprising a more general monetary transmission mechanism for the same economies studied here, see Golinelli and Rovelli (2003).

variable interest rates. As deposits represent part of banking resources, loan rates are often expected to follow changes in deposit rates, provided volatility of the credit risk premium imbedded in loan rates is stable over time.

An Overview of the Empirical Literature

Before going into further detail regarding empirical studies on CEE countries, it seems useful to overview the available empirical results for industrialised countries. This would provide a good background for our empirical investigation aimed at establishing the interest rate transmission in the Czech Republic, Hungary and Poland. Mizen and Hofmann (2002) seek to uncover how the official base rate affects deposit and mortgage rates of commercial banks and building societies in the UK. Using monthly data for 1986-1999, the estimations indicate that there is complete pass-through from base rates to deposit rates. By contrast, changes in the base rate feeds into mortgages rates only in an incomplete manner. Results also reveal the existence of asymmetries in the adjustment process towards the estimated long-term relationship, which connects the base rate and the retail rates.

The full pass-through found by Mizen and Hofmann (2002) is in strong contrast with other studies, which usually give evidence concerning the incompleteness of the pass-through with which base rates are transmitted to bank deposit or lending rates. For instance, Bredin et al (2001) take a look at the case of Ireland using monthly data. By estimating the long-term cointegration relationship between the one-month wholesale money market rate and a series of retail lending rates such as mortgage rate, consumer lending rate and corporate lending rate for SME, the pass-through is found to vary between 0.54 for the consumer lending rate and 0.94 for the prime rate of banks over the period 1980 to 2001. Similarly, whereas the effect of a change in the policy rate is transmitted into prime rates in 2 months, consumer rate reacts only sluggishly, i.e. with a lag of 10 months. Furthermore, Berdin et al (2001) not only reveal structural changes in the long-term relationship but also find structural breaks in the adjustment mechanism towards long-term equilibrium.

Mojon (2000) considers 6 euro zone countries, namely Belgium, France, Germany, Italy, the Netherlands and Spain. The transmission from the money market rate to retail rates

is analysed by means of a VAR model. A score of different rates are used for the retail deposit and lending rates during the period 1979 to 1998. The pass-through turns out to be incomplete and seems rather sluggish, especially for rates of higher maturity. Several sub-periods are studied given the presence of two interest rate cycles, the first one spanning from 1979 to 1988 and the second starting in 1988 and ending in 1998. With the exception of Belgium, it appears that increasing money market interest rates during the first half of the interest rate cycles feeds into lending rates faster and to a greater extent compared with the second stage of the cycles, that is characterised by a decrease in money market rates. The opposite happens to the deposit rates: the pass-through is lower when money market rates are on the rise and it becomes higher with a decline in the money market rates. This phenomenon is termed by Mojon (2000) as the interest rate cycle asymmetry. Furthermore, and more importantly, some light is also shed on the heterogeneity among countries. The pass-through is found to be the strongest in the Netherlands followed by Germany, France and Italy, whilst in Spain and Belgium, changes in the money market rates are transmitted only partly into deposit and lending rates.

Similarly to Mojon (2000), Donnay and Degryse (2001) also make use of the VAR technique and set out to estimate the pass-through between the money market rate on the one hand and several bank lending rates for households and firms and government bond rates, on the other, for a set of 12 EU countries from 1980 to 2000. The estimation carried out using monthly data indicates an incomplete pass-through except for short-term bank lending rates. Government bonds and long-term rates for households react fairly smoothly. On average, the pass-through seems the most important for Spain, Italy, Greece and the Netherlands, while only half of the changes in money market rates are reflected in deposit and lending rates in Ireland, Belgium, Portugal Austria and the UK. Results for France, Germany and Finland are somehow in between these extremes. Especially for Spain, these results are in disagreement with what is found in Mojon (2000), and for the UK they also conflict with outcomes by Mizen and Hofmann (2002).

We now turn to reviewing those contributions aimed at studying the interest rate pass-through in countries of Central and Eastern Europe. Hanousek and Kočenda (1997) seek to determine the causal relationship structure of the Czech money market by running Granger

causality tests on daily data for 1-day, 1 and 2-week, 1, 2, 3, 6 and 9-month and 1-year Prague Interbank Offer and Bid Rates (PRIBOR and PRIBID). The period studied covers 1993 to 1997, and the causality tests are conducted on a year-by-year basis. That is, results for each year can be recapitulated in two separate 9×9 matrices for PRIBOR and PRIBID. For the first 4 years, the causal structure of PRIBOR and PRIBID rates of different maturity shows an incomplete and time-varying pass-through from short-term rates towards longer-term rates. Strikingly, almost every maturity appears to Granger cause the one-day rate, both in the case of the offer and the bid rates. By contrast, in 1997, a stronger and more complete picture emerges as shorter-term rates systematically Granger cause longer-term rates. But the causality is bilateral because rates of longer maturity also cause short-term rates. In addition to this, causality tests are also performed between the aforementioned money market rates and the German mark and the dollar exchange rates. In 1997, at all maturities, interest rates bear a unilateral causal relationship to the German mark, except for the 1 and 2-week and the 1-month rates where the relationship is bilateral. For the dollar, relationships seem bilateral for maturities under 2-month whilst for and above 3-month rates, the relationship runs from interest rates to the dollar exchange rate.

Árvai (1998) studies the pass-through from T-bill rates to bank lending rates for the private sector in Hungary. Following a descriptive analysis of interest rate developments from 1992 to 1998, cointegration analysis is conducted between bank loan rates and T-bill rates over the short and the long run, respectively. In the former case, the 3-month T-bill is used whereas in the latter the 12-month maturity is considered. Because of an obvious structural break occurred in 1995, monthly data are used for the period 1995-1998. The author reports several specifications in which cointegration relationships could be found, but argues that the results are very fragile because of the short time span and the number of specification errors.

A Closer Look at the Interest Rate Pass-Through in Three EU Acceding Countries

The Empirics of the Interest Rate Pass-Through in Acceding Countries

On the basis of the *term structure of interest rate*, the interest rate pass-through has to be examined along the lines "key rate – interbank money market rate – treasury bill rate – government bond rate", "key rate – interbank money market rate – short-term loan rate – long-term loan rate" and "key rate – interbank money market rate – short-term deposit rate – long-term deposit rate". One may expect an increase in the size of the long-run elasticity of various market rates, and in particular of the interbank money market rate, with respect to the key policy rate in all three EU acceding countries over time, on the basis of the argument that the structural changes within the banking sector should enhance interbank competition. Alternatively, one may argue that the continuing strong impact of other factors affecting the interbank rates, like, in particular, the sizeable capital inflow related to (privatization-linked) FDI, hinders the smooth working of the interest rate channel between key rates and interbank rates (despite having floating exchange rate regimes in place).

The three empirical issues concerning the interest rate pass-through in the Czech Republic, Hungary and Poland that we will tackle in this piece of research are the following:

- Is there evidence of complete pass-through from policy rates to various market rates, like the deposit and loan rates to non-banks? That is, do retail rates react one-to-one to changes in key policy rates in the long run? If so, does this long run relationship act as an attractor to the dynamics of retail interest rates?
- How do the estimates of the long-run reaction to the key policy rate behave dynamically? Is there evidence of convergence/divergence across interest rates and/or across acceding countries over time. Can these developments be tracked down to competition issues in the banking sector?
- Is there evidence of asymmetric adjustments to the equilibrium depending upon the direction of change in the policy rate?

Data Description

The data used are monthly time series of per annum interest rates in percentage points. The source of the data is Reuters, Datastream, Bloomberg, national central banks and ministries of finance of the respective acceding countries. Special care was taken to make the time series homogeneous and comparable across countries. The starting date of the empirical investigation is determined by the starting dates of the involved time series, but not earlier than January 1994. All series contain data ranging at least up to December 2002, and in some cases interest rates up to mid 2003 were available.

The following interest rates were used for each country. For the case of the Czech Republic, the *key policy rate* used is the 2-week repo rate, with monthly data existing only from December 1995 onwards. Data on the *interbank money market rate* and the *5 year T-bonds rate* were collected starting from January 1994 and February 1997, respectively. Different long and short term deposit and loan rates to non banks have been used:

- *Non-bank Deposit Rate (>O/N, Average):* Weighted average of all maturities above overnight.
- *Non-bank Deposit Rate (>O/N,=12 months):* Weighted average of maturities above overnight up to one year.
- *Non-bank Deposit Rate (>12 months,=4 years):* Weighted average of maturities above one year up to four years.
- *Non-bank Loan Rate (=12 months):* Weighted average of all maturities below and including one year.
- *Non-bank Loan Rate (>12 months,=4 years):* Weighted average of maturities above one year up to four years.

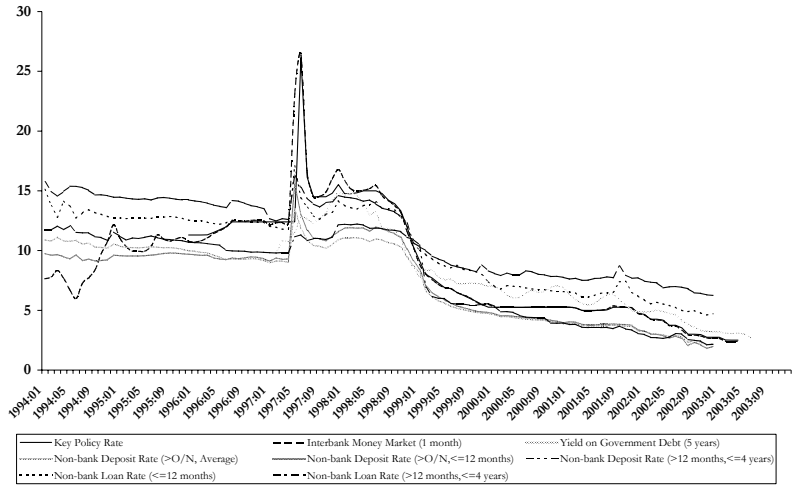
Deposit and loan rates are on stock of deposits and loans to all non-banks, respectively, and refer to the average rate weighted by volumes, end of month values. The data for the Czech Republic is plotted in Figure 1.

In the case of Hungary, data on the *key policy rate* refers to the active overnight repo rate until December 1995, the passive one month repo rate from January 1996 to February

1999 and the 2 week deposit rate thereafter. Data on the *interbank money market rate,* the *12 month and 5 year T-bonds rate* are available from January 1994, September 1995 and March 1997, respectively. The long and short term deposit and loan rates to households and firms that have been used in the analysis are:

- *Household Deposit Rate (O/N):* Rates on sight deposits
- *Household Deposit Rate (>O/N, Average):* Weighted average of all maturities above overnight.
- *Household Deposit Rate (12 months):* Rate on fixed deposits for one year.

Figure 1: Interest rate data, Czech Republic



- *Household Deposit Rate (>12 months, Average):* Weighted average of all maturities above one year.
- *Enterprise Loan Rate (=12 months, Average):* Weighted average of all maturities below and including one year.
- *Enterprise Loan Rate (>12 months, Average):* Weighted average of all maturities above one year.

All deposit rates refer to rates to households, and are on new deposits. All loan rates are to enterprises and refer to new loans. The weighting scheme is based on volumes, and the values are measured at the end of the month. The data for Hungary is plotted in Figure 2.

For Poland, the *key policy rate* refers to the yield on short-term NBP bills ("intervention rate"). Data on the *interbank money market rate,* the *12 month and 5 year T-bonds rate* are available from January 1994 (February 1994 for the 5 year bond). The long and short term deposit and loan rates to households and firms that have been used in the analysis for Poland are:

- *Household Deposit Rate (O/N):* Rates on checking accounts.
- *Household Deposit Rate (>O/N, Average):* Weighted average of all maturities above overnight.
- *Household Deposit Rate (12 months):* Rate on deposits for one year.
- *Household Deposit Rate (>12 months):* Rate on deposits for three years.
- *Enterprise Loan Rate (12 months):* Rate on loans, one year.
- *Enterprise Loan Rate (3 years):* Rate on loans, three year.

All deposit rates refer to rates to households, and are on the stock of deposits. All loan rates are to enterprises and refer to rates on the stock of loans. The
weighting scheme is based on volumes, and the values are measured at the end of the month. The data for Poland is plotted in Figure 3.

Figure 2: Interest Rate Data, Hungary

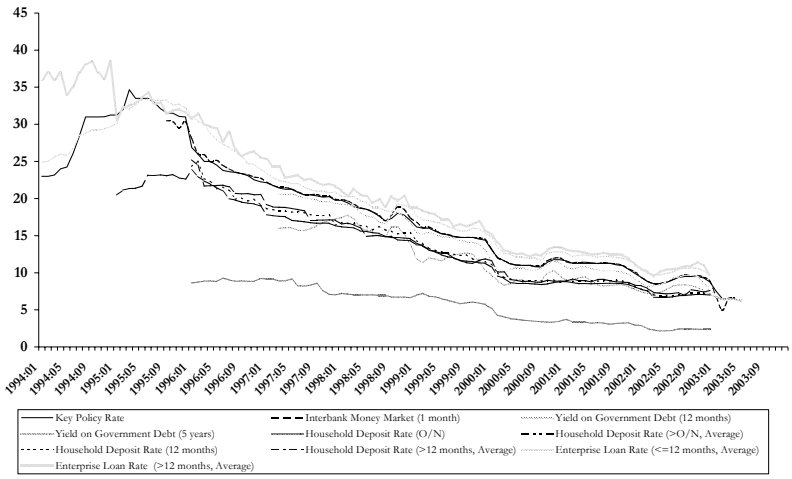
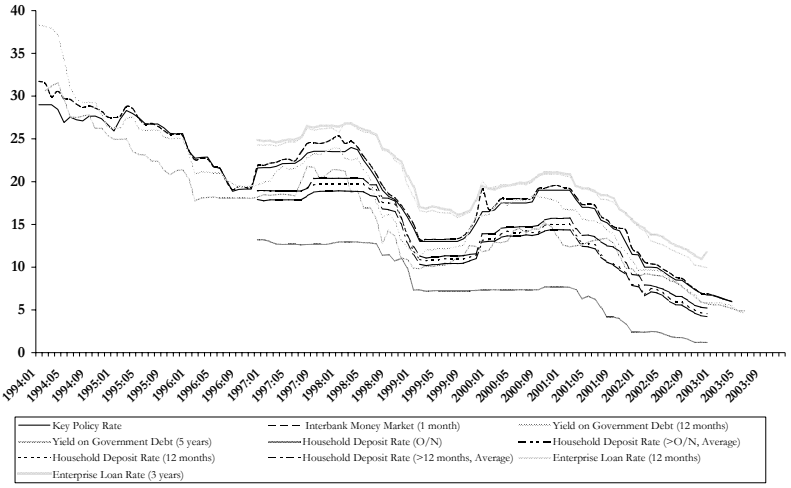


Figure 3: Interest Rate Data, Poland



Methodological Approach: Econometric Framework

Throughout our study, we will assume that the relationship between the policy interest rate and a given market interest rate can be specified as an autoregressive distributed lag (ARDL) relationship such as

$$i_t^m = \alpha_0 + \sum_{j=1}^{p} \alpha_j i_{t-j}^m + \sum_{k=0}^{q} \beta_k i_{t-k}^p + \varepsilon_t, \qquad (1)$$

where i_t^m is the market interest rate, i_t^p is the policy rate and ε_t is a white noise disturbance with constant variance σ_ε. Equation (1) can be rewritten using the lag operator as

$$A(L) i_t^m = \alpha_0 + B(L) i_t^p + \varepsilon_t, \qquad (2)$$

where $A(L) = 1 - \sum_{j=1}^{p} \alpha_j L^j$ and $B(L) = \beta_0 + \sum_{k=1}^{q} \beta_k L^k$. Notice that the long-run relationship implied by this parametrisation is given by

$$i^m = \frac{\alpha_0}{A(1)} + \frac{B(1)}{A(1)} i^p. \qquad (3)$$

The error correction (EC) representation of (1) can be written as

$$\Delta i_t^m = \delta_0 + \sum_{j=1}^{p-1} \mu_j \Delta i_{t-j}^m + \sum_{k=0}^{q} \kappa_k \Delta i_{t-k}^p + \gamma (i_{t-1}^m - \lambda i_{t-1}^p) + \varepsilon_t, \qquad (4)$$

where there is a one-to-one mapping between the parameters in (4) and in (1). Notice that the term in brackets acts as an attractor, and represents the long run equilibrium (i.e. $\lambda = B(1)/A(1)$). Given that the existence of a unit root in the autoregressive representation of all the series included in the analysis cannot be rejected at the usual significance levels using the augmented Dickey-Fuller test, γ can be interpreted as the speed of adjustment to the cointegration relationship given by (3).[5] Several methods have been proposed in the literature to estimate the parameters in (4), starting with the seminal contributions by Engel and Granger (1987) and Johansen (1988, 1995). We will follow the approach suggested by Wickens and Breusch (1988), which implies obtaining estimates for the parameters in (4) directly from the OLS estimates of (1).[6] Numerically similar results are obtained if the Bewley (1979) transformation of (1) is used to retrieve the long run responses of the market interest rates to the policy rate.

Empirical Results: The Interest Rate Pass-Through in the Czech Republic, Hungary and Poland

Tables 1, 2 and 3 present the estimates of λ and γ (the long run multiplier and the speed of adjustment, respectively) for different market rates, using the open market rate as policy instrument. The lag length of the ARDL models was chosen as the pair that jointly minimizes the Schwarz information criterion, setting a maximum of twelve lags for each variable. All the results are based on models including only one market rate and the open market rate. For Hungary and Poland the full range of data was used to obtain the estimates, while estimations for the Czech republic were done for data starting in July 1997 in order to avoid distortions in the estimates caused by the 1997 crisis.[7] For each chosen specification, full interest rate pass-

[5] Detailed results on the results of the augmented Dickey Fuller tests are not reported but can be obtained from the authors upon request.
[6] Gerrard and Godfrey (1998) give evidence that diagnostic tests for EC models are relatively sensitive to the estimation method used and recommend the Wickens-Breusch method based on Monte Carlo simulations.
[7] Estimates for the Czech Republic using the full sample are available from the authors upon request.

through, corresponding to the restriction λ=1 in (4), was tested. The results of the test are indicated in the tables.

The first feature of the results worth discussing is that the cross-country differences in the long-run adjustment are very significant. While the null of complete pass-through cannot be rejected for any interest rate in Poland, there is evidence of incomplete pass-through in Hungary for the deposit rates (both short and long term) and the yield on the 5-year government bond. The point estimates of the long run elasticities range in Hungary between 0.49 for overnight deposit rates and 1.02 for the interbank money market rate. The overshooting effect observed in the interbank money market rate is however quantitatively tiny and only marginally significant.

The results for the Czech Republic give evidence of incomplete pass-through for all rates except for the interbank money market rate. All other estimates of the long-run elasticity of market rates to the key policy rate are significantly below one, and range between 0.64 for the long term loan rate and 0.85 for the long term deposit rate (between one and four years). In all estimations the estimates of γ are negative and significant, indicating that the equilibrium relationship actually acts as an attractor in the (i_t^p, i_t^m) plane. The point estimate for the adjustment rate in the interbank money market rate in Hungary and Poland is the highest among all other interest rates in each one of these countries, while in the Czech Republic the estimate of the correction to equilibrium for the interbank money market rate is significantly lower than that associated to long term loan rates.

Table 1: Czech Republic. Long-run responses and adjustment estimates

	λ	σ_λ	γ	σ_γ	*(p,q)*
Interbank Money Market (1 month)	0.895 [a]	0.054	-0.213	0.035	(8,8)
Yield on Government Debt (5 years)	0.768	0.066	-0.151	0.074	(2,1)
Non-bank Deposit Rate (>O/N, Average)	0.747	0.021	-0.252	0.044	(1,4)
Non-bank Deposit Rate (>O/N,=12 months)	0.838	0.023	-0.239	0.038	(1,4)
Non-bank Deposit Rate (>12 months,=4 years)	0.851	0.039	-0.303	0.047	(1,1)
Non-bank Loan Rate (=12 months)	0.763	0.033	-0.249	0.057	(1,3)
Non-bank Loan Rate (>12 months,=4 years)	0.636	0.010	-0.687	0.144	(1,1)

[a] indicates that complete pass-through (λ=1) cannot be rejected at a 5% significance level.

Table 2: Hungary. Long-run responses and adjustment estimates

	λ	σ_λ	γ	σ_γ	*(p,q)*
Interbank Money Market (1 month)	1.020	0.006	-0.760	0.141	(5,3)
Yield on Government Debt (12 months)	0.980 [a]	0.035	-0.229	0.106	(3,1)
Yield on Government Debt (5 years)	0.837	0.047	-0.222	0.067	(6,3)
Household Deposit Rate (O/N)	0.491	0.033	-0.159	0.038	(1,1)
Household Deposit Rate (>O/N, Average)	0.887	0.008	-0.520	0.042	(12,1)
Household Deposit Rate (12 months)	0.922	0.018	-0.354	0.087	(1,3)
Household Deposit Rate (>12 months, Average)	0.908	0.023	-0.354	0.070	(3,1)
Enterprise Loan Rate (=12 months, Average)	1.014 [a]	0.026	-0.197	0.031	(1,1)
Enterprise Loan Rate (>12 months, Average)	1.021 [a]	0.012	-0.694	0.064	(3,12)

[a] indicates that complete pass-through (λ=1) cannot be rejected at a 5% significance level.

Table 3: Poland: Long-run responses and speed of adjustment estimates

	λ	σ_λ	γ	σ_γ	*(p,q)*
Interbank Money Market (1 month)	1.002 [a]	0.019	-0.322	0.070	(2,5)
Yield on Government Debt (12 months)	0.954 [a]	0.049	-0.201	0.032	(4,2)
Yield on Government Debt (5 years)	0.800 [a]	0.158	-0.086	0.034	(1,1)
Household Deposit Rate (O/N)	0.770 [a]	0.201	-0.048	0.030	(1,1)
Household Deposit Rate (>O/N, Average)	0.941 [a]	0.062	-0.139	0.050	(1,1)
Household Deposit Rate (12 months)	0.979 [a]	0.075	-0.126	0.048	(1,1)
Household Deposit Rate (>12 months)	0.960 [a]	0.040	-0.241	0.063	(1,1)
Enterprise Loan Rate (12 months)	1.023 [a]	0.047	-0.229	0.059	(1,1)
Enterprise Loan Rate (3 years)	0.979 [a]	0.055	-0.172	0.052	(1,1)

[a] indicates that complete pass-through (λ=1) cannot be rejected at a 5% significance level.

The cross-country differences are especially interesting, as the error correction parameter estimates for Poland, the only country with evidence of complete pass-through for all interest rates, tend to be smaller in magnitude than those of Hungary and the Czech Republic, although the equilibrium to which interest rates converge need not be that of complete pass through.

In order to complement the results presented in Tables 1, 2 and 3, we performed an exercise so as to assess both the robustness of the long-run elasticity estimates and the dynamic behaviour of the long-run relationship between the key policy rate and the different market rates. Equation (4) was estimated for the sample ranging up to January 2000 and then recursively re-estimated adding new observations until reaching the end of the available sample. Figures 4 to 6 present the estimates of λ for these different estimation ranges. For the sake of readability, only the point estimates, without confidence intervals, are plotted. There is, however, small variability in the estimates of the standard errors of λ.

Figure 4: Czech Republic: Recursive estimates, long run elasticity

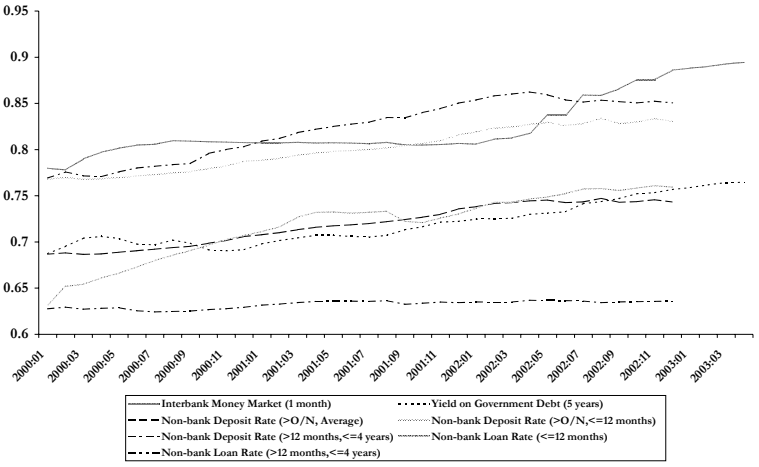


Figure 5: Hungary: Recursive estimates, long run elasticity

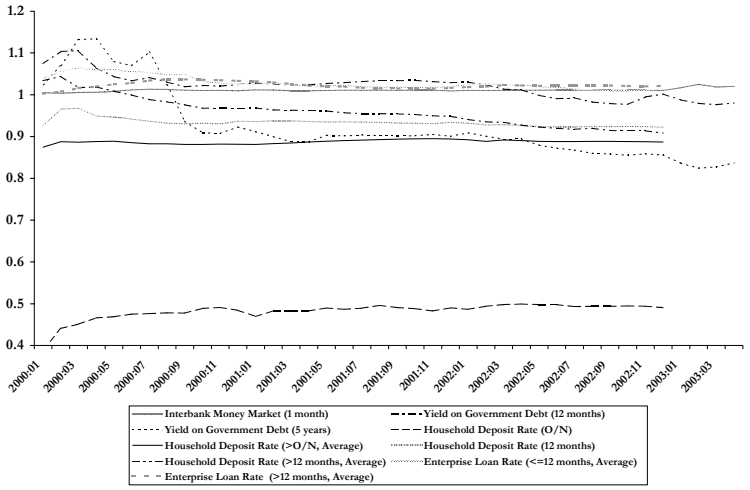
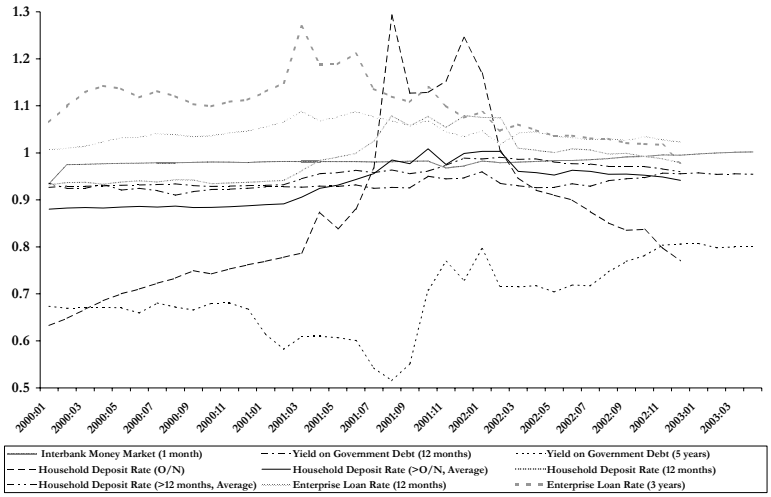


Figure 6: Poland: Recursive estimates, long run elasticity



This exercise also reveals significant cross-country differences in the dynamic behaviour of the long-run elasticities. For the case of the Czech Republic, three clusters of estimates can be found. The interbank money market rate and the deposit rate (short and long term) present higher estimates (although the range is always significantly below one) and a clear trend towards higher completeness of the pass-through, while the estimates of the long-run elasticity long term loan rate do not show clear signs of convergence and are clearly below the rest of the estimates for the whole range of the exercise. In Hungary, only the recursive estimates of the long run elasticity for the overnight deposit rate stay outside the (0.9,1.1) range for the whole period. The results for Poland present a higher degree of variability, with an divergent behaviour of the elasticity point estimate for the household deposit rate from mid 2002. The significant reduction in the variability across estimates for the rest of the rates which is observable for the whole period paints a picture of convergence across pass-through estimates.

Recently, some contributions to the empirics of the monetary transmission mechanism tend to stress the potential asymmetry of the interest rate pass-through. Reactions to changes in the key policy rate may depend upon the size and direction of these changes, thus leading to asymmetric responses in retail interest rates (see e.g. Mojon, 2000, or Mizen and Hofmann, 2002).

A generalization of our EC specification, allowing for an asymmetric behaviour of the speed of adjustment can be given by the following expression,

$$\Delta i_t^m = \delta_0 + \sum_{j=1}^{p-1} \mu_j \Delta i_{t-j}^m + \sum_{k=0}^{q} \kappa_k \Delta i_{t-k}^p + \\ + I(\Delta i_{t-1}^p < 0)\gamma_1 (i_{t-1}^m - \lambda i_{t-1}^p) + [1 - I(\Delta i_{t-1}^p < 0)]\gamma_2 (i_{t-1}^m - \lambda i_{t-1}^p) + \varepsilon_t, \quad (5)$$

where *I(•)* is a Heavyside function taking value one if the argument is true and zero otherwise. Specification (5) allows for two speeds of adjustment to the long-run relationship (corresponding to γ_1 and γ_2) depending on whether the adjustment follows a negative or positive change in the key policy rate.[8] A simple test for symmetry is then given by the F-test for equality of γ_1 and γ_2. A rejection of the null would indicate that the speed of adjustment to the long run equilibrium is significantly different for increases and decreases of the policy rate. The F-test statistics are shown in Tables 4, 5 and 6 for all rates in the three countries of interest, together with the p-value for the test $\gamma_1 = \gamma_2$.

There is overall evidence of symmetry in the adjustment for the interest rate pass-through. None of the rates can reject equality of adjustment speed for increases and decreases on the policy rate in the Czech Republic and Poland. For the case of Hungary, only the short term enterprise loan rate rejects the null (p-value 0.02). In this case, the estimate of γ_1 is –0.26 (standard error 0.04) and that of γ_2 is –0.13 (standard error 0.04). The speed of adjustment to the long-run equilibrium for decreases in the policy rate is thus approximately twice as high as for increases.

[8] In principle, extra asymmetries can be built upon (5) in a straightforward manner by allowing also the short run dynamics (materialized in the μ_j and κ_k parameters) to depend upon the nature of the change in the key policy rate. Given that the results concerning evidence of asymmetry did not change, we present only the estimations based on (5).

Table 4: Czech Republic: Tests for asymmetric adjustment

	Test statistic $\gamma_1 = \gamma_2$	p-value
Interbank Money Market (1 month)	0.215	0.645
Yield on Government Debt (5 years)	0.521	0.473
Non-bank Deposit Rate (>O/N, Average)	0.084	0.773
Non-bank Deposit Rate (>O/N,=12 months)	0.241	0.625
Non-bank Deposit Rate (>12 months,=4 years)	0.055	0.815
Non-bank Loan Rate (=12 months)	0.428	0.515
Non-bank Loan Rate (>12 months,=4 years)	1.902	0.173

Table 5: Hungary: Tests for asymmetric adjustment

	Test statistic $\gamma_1 = \gamma_2$	p-value
Interbank Money Market (1 month)	0.156	0.694
Yield on Government Debt (12 months)	0.111	0.740
Yield on Government Debt (5 years)	0.274	0.602
Household Deposit Rate (O/N)	0.002	0.960
Household Deposit Rate (>O/N, Average)	0.247	0.621
Household Deposit Rate (12 months)	0.089	0.767
Household Deposit Rate (>12 months, Average)	0.121	0.729
Enterprise Loan Rate (=12 months, Average)	**5.484**	**0.021**
Enterprise Loan Rate (>12 months, Average)	0.005	0.944

Table 6: Poland: Tests for asymmetric adjustment

	Test statistic $\gamma_1 = \gamma_2$	p-value
Interbank Money Market (1 month)	0.029	0.866
Yield on Government Debt (12 months)	2.366	0.127
Yield on Government Debt (5 years)	0.114	0.736
Household Deposit Rate (O/N)	2.193	0.142
Household Deposit Rate (>O/N, Average)	0.072	0.789
Household Deposit Rate (12 months)	0.006	0.941
Household Deposit Rate (>12 months, Average)	0.157	0.693
Enterprise Loan Rate (12 months)	0.223	0.638
Enterprise Loan Rate (3 years)	0.672	0.415

Conclusions

Making use of autoregressive distributed lags (ARDL) models, we studied the characteristics of the interest rate pass-through in the Czech Republic, Hungary and Poland.

Concerning the completeness of the pass-through of policy rate changes, as measured by long-run elasticities of market interest rates to changes in the key policy rate, significant differences could be found across countries as well as across market interest rates. While the pass-through seems to be complete in Poland for all market interest rates under study, it is complete only for some market interest rates in Hungary and rather incomplete in the Czech Republic, with the exception of interbank rates. By type of market rate, the pass-through tends to be rather complete for (one-month) interbank rates, (short- and long-term) bank lending rates to non-banks and yields on 12-month government securities.

For (short- and long-term) bank deposit rates to non-banks and yields on 5-year government securities, the pass-through tends to be rather incomplete. It follows that it is a rather difficult strategy to stimulate savings by rate hikes. Generally, the long-run elasticity of 5-year T-bond yields is relatively high, though clearly below 1 and smaller than the

elasticities of interbank rates and 12-month T-bill yields. This result seems to reflect both the downward shift of the yield curve amidst a strong disinflation process and the simultaneous twist of the yield curve from inverse to flat or normal, i.e. positively sloped.

Concerning the dynamic behaviour of the pass-through of policy rate changes, as measured by changes in the size of the long-run elasticities of market interest rates to changes in the key policy rate, significant differences could be found across countries again. In Hungary, the long-run elasticities were very stable from January 2000 to December 2002 (or June 2003), despite the widening of the exchange rate band against the euro in spring 2001 from +/-2.25% to +/-15.00%. In contrast, in the Czech Republic, there was a general upward trend of long-run elasticities of most market rates during that period, albeit from a relatively lower level. This phenomenon may be explained by an increased competition within the banking sector, in particular after foreign take-overs of major commercial banks have taken place via privatisation. Another possible explanation considers the size of the interest rate pass-through as being endogenous to the monetary policy framework. It follows that the pass-through should strengthen with the direct inflation targeting (DIT) being longer in place and gaining credibility, as disinflation or price stability persists. In case of the Czech one-month interbank rate, the long-run elasticity increases not until mid-2002, contrary to most other market interest rates. This may reflect the strengthening of the capital inflow management in spring 2002 via the active use of the special foreign-currency denominated government account with the CNB to deposit privatisation-linked FDI inflows. In Poland, a general convergence of long-run elasticities to unity could be found across market rates. Moreover, the change of the long-run elasticity is particularly remarkable in the case of the loan rates and the T-bond yields. The loan rates showed a significant overshooting during the period of sizeable rate hikes in the year 2000. Probably, this overshooting phenomenon exacerbated the restrictive effect of the very strong monetary policy tightening, thus contributing to the sharp decline of real gross fixed capital investment. The T-bond yield's long-run elasticity witnessed a turning year in 2001. Initially, strong market expectations of sizeable rate cuts, which had triggered a fall in yields, were disappointed by the NBP's reluctance. Its slow small-step policy even led to an upward correction of yields. Then, in view of the sharp

economic slowdown and the strong disinflation, a bond rally started in parallel to further small cuts, increasing the long-run elasticity sharply.

Concerning the possible asymmetry of the pass-through of policy rate changes, no significant deviation from symmetry in the speed of adjustment to equilibrium is found in the data, except for the case of the short-term loan rate for enterprises in Hungary.

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