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The international integration of money markets in the central and east European accession countries: deviations from covered interest parity, capital controls and inefficiencies in the financial sector

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The international integration of money markets in the central and east European accession countries: deviations from covered interest parity, capital controls and inefficiencies in the financial sector

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of the Deutsche Bundesbank

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Summary

Based on the concept of covered interest parity it is shown that the money markets in Poland, the Czech Republic, Hungary, and the Slovak Republic meanwhile display a high degree of international integration with the euro area. Integration has strengthened continuously in the review period of 1999 to mid 2002. The segmentation that could still be observed stems from both restrictions on the short-term movement of capital and the limited development of the financial sectors in the four accession countries. While almost all capital controls have since been removed and will no longer play a role after accession to the EU, the implementation and transmission of the single monetary policy within the Eurosystem will possibly be impeded, if the financial sectors in CEE are then still underdeveloped.

Zusammenfassung

Basierend auf dem Konzept der gedeckten Zinsparität wird gezeigt, dass die Geldmärkte in Polen, der Tschechischen Republik, Ungarn und der Slowakei inzwischen einen hohen Grad an internationaler Integration mit dem Euro-Raum aufweisen. Die Integration hat sich im Untersuchungszeitraum von 1999 bis Mitte 2002 kontinuierlich verstärkt. Für die noch zu beobachtende Segmentierung sind sowohl Beschränkungen des kurzfristigen Kapitalverkehrs als auch die geringe Entwicklung der Finanzsektoren in den Beitrittsländern verantwortlich. Während Kapitalverkehrskontrollen inzwischen fast vollständig abgebaut sind und nach einem EU-Beitritt keine Rolle mehr spielen werden, könnte innerhalb des Eurosystems die Implementierung und Transmission der gemeinsamen Geldpolitik beeinträchtigt werden, wenn die Finanzsektoren in Mittel- und Osteuropa noch unterentwickelt sind.

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The international integration of money markets in the central and east European accession countries: deviations from covered interest parity, capital controls and inefficiencies in the financial sector *)

1 Introduction

This paper is part of a research project on the international financial market integration of the central and east European economies. The accession countries need to have close economic ties with the markets participating in European economic and monetary union in order for EU enlargement to be successful and potential efficiency gains resulting from the single market and the single currency to be achieved. The Copenhagen criteria for membership of the EU have already taken this into account.[1] In addition, Article 121 (1) of the EU Treaty expressly demands that, during the convergence assessments for membership of the Eurosystem, "the reports of the Commission and the ECB should also take account of ... the results of the *integration of markets*".

Previous empirical studies on the integration of central and east European financial markets in the world economy have focused mainly on the integration of stock markets. Gilmore/McManus (2002) come to the conclusion that the stock markets of three leading transition countries show only a weak correlation with US share price indices. By contrast, Jochum/Kirchgässner/Platek (1999), Linne (1999) and Rockinger/Urga (2000) notice at least small signs of increasing integration during the 1990s. The need for efficient payment systems and for the efficient implementation and homogeneous transmission of single monetary policy within monetary union, however, makes it appear wise to take also account of money markets and foreign exchange markets.[2] Whereas at present the exchange rate channel still dominates the transmission mechanism of monetary policy in all accession countries, in the medium term the interest rate channel will acquire increasing

* We would like to thank Zsolt Darvas, Jörg Döpke, Jens Hölscher, Jörg Breitung and the participants of the Deutsche Bundesbank's Friday seminar for their valuable comments.

1 In 1993, among the conditions for membership of the EU, the Copenhagen European Council stated that not only were political criteria to be fulfilled but also that "a functioning market economy as well as the capacity to withstand competitive pressure and market forces within the Union" (economic criteria) should exist. Moreover, membership also presupposes the incorporation of the acquis communautaire, which implies the complete liberalisation of capital movements.

2 See Hölscher (2002).

importance.[3] The efficacy of monetary policy, especially within a monetary union, consequently hinges on the efficiency and integration of the national money markets.

Section 2 of this paper begins by providing an overview of the characteristics of central and east European financial markets and illustrates fundamental structural differences vis-à-vis the EU. Subsequently, *Section 3* introduces the concept of covered interest parity for measuring money market integration. *Section 4* examines the integration of the money markets between four selected accession countries (Poland, Hungary, Czech Republic and Slovak Republic) and European monetary union. In *Section 5* a graphic and econometric analysis is used to find out to what extent transaction costs – as a result of capital controls or the underdevelopment of the domestic financial sector – can be cited as the cause of observed deviations from covered interest parity. *Section 6* concludes by summarising the findings and allows us to draw conclusions for the next steps in the enlargement process of European economic and monetary union.

2 The structure of central and east European financial markets

Measured in terms of the ratio of commercial banks' consolidated assets to GDP or the degree of market capitalisation of domestic enterprises, the financial markets in the central and east European accession countries are still considerably underdeveloped and are a long way behind the reference markets in the European Monetary Union (*see Table 1*). The unweighted average of these variables is only one-quarter to one-fifth of the corresponding levels in the euro area. The growth potential of the financial markets becomes even more striking if one notes that per capita economic output – expressed in purchasing power parities – is only 42% of the EU average.[4]

[3] However, for the foreseeable future the exchange rate channel will retain its position of dominance in the transmission mechanism. A second research paper therefore addresses the international integration of central and east European foreign exchange markets (Herrmann/Jochem 2003).

[4] According to Eurostat's New Cronos database.

Table 1: Key variables of central and east European financial markets (in %)

	Bank assets/ GDP (1)	Market capitalisation / GDP (2)	Private loans/ market capitalisation (3)	Interbank deposits/ balance-sheet total (4)	Bank assets controlled by private owners/ total bank assets (5)	Bank assets controlled by foreign owners/ total bank assets (6)
Bulgaria	38.6	3.8	5.2	7.4	80.0	74.0
Czech Republic	96.7	16.0	2.0	13.8	96.2	90.1
Estonia	67.8	28.0	5.0	13.2	100.0	97.5
Hungary	61.2	19.2	3.7	7.3	91.0	65.5
Latvia	67.2	9.3	2.4	15.3	96.8	62.2
Lithuania	28.9	12.0	7.1	10.7	86.9	83.9
Poland	53.8	14.0	1.7	7.4	75.8	68.4
Romania	25.5	2.8	0.5	5.5	57.9	55.0
Slovak Republic	90.4	22.3	4.3	8.6	95.0	81.0
Slovenia	87.1	30.0	2.8	10.6	59.4	5.7
CEE-10	61.7	15.7	3.5	10.0	83.9	68.3
Euro area	242.8	72.0	1.9	21.0[1]	-	-

[1] Deposits of euro-area MFIs.

Sources: Caviglia/Krause/Thimann (2002); European Commission (2002e); IMF, International Financial Statistics; national central banks.

The financial markets of the accession countries are heavily bank-oriented; this is reflected in a comparatively high ratio of private lending to stock-based market capitalisation. This is joined by direct lending from foreign financial institutions, which plays a fairly considerable role in Poland and Hungary, in particular.[5] The subordinated importance of stock markets is also evidenced by the concentration on a few listed companies and a correspondingly low level of liquidity. The annual trading volume in Poland, owner of the region's largest stock market, is around 60% of listed stock-market capital, or around one-

[5] See Wagner/Iakova (2001)

third of the corresponding sales variable in Germany. However, considerable differences in the development of national stock markets do exist even within the European Union itself, and the financial market structures of the developed accession countries are not dissimilar to those of some of the smaller EU member states, such as Ireland.

Despite the heavily bank-oriented nature of the central and east European financial sectors, interbank deposits, which represent the most important segment of the money market in most accession countries, still play a minor role. This short-term refinancing instrument makes up an average of only 10% of the total capital of central and east European credit institutions, this is only half the comparable figure for the Eurosystem. However, turnover in interbank business has risen distinctly over the past few years; a continuously increasing liquidity of the money markets can be assumed.

Most of the candidate countries have demonstrated remarkable success in the privatisation of the commercial banking sector in the past few years. In all these countries well over half of banks' assets are now privately owned. The role played by foreign investors deserves special mention. With the exception of Slovenia, which protected its domestic financial sector from outside interference for a long time, only initiating the privatisation of the key financial institutions in May 2001, the accession countries pursued a consistent strategy of importing foreign expertise. They specifically recruited large European Union banks, which now account for nine of the ten largest investors in this sector.[6]

To that extent, we can see that considerable quantitative and structural differences exist or, more precisely, that the central and east European financial markets are clearly lagging behind. However, it may also be said that, from an institutional point of view, the central and east European financial markets have already achieved a considerable integration into the world economy and particularly into the European Union. However, the practical implementation of monetary policy not only relies on the regulatory policy environment but also on the behaviour of investors and the actual functioning of markets. This will be especially important following accession to European monetary union, in which the transmission of monetary policy will depend to a decisive degree on the extent to which national money markets are integrated in the Eurosystem.

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6 See Caviglia/Krause/Thimann (2002), p 28.

3 Covered interest parity as a measure of money market integration

There are numerous ways of defining "financial market integration" in the literature.[7] To achieve financial market integration in the *broader sense*, it will suffice if all the conditions for the undisrupted execution of financial market transactions and for the functioning of markets are fulfilled.[8] This definition covers, in particular, all institutional factors such as the regulation of the domestic financial sector, the existence of capital controls, accounting regulations or tax systems, and legal restrictions. However, uniform standards and the absence of artificial barriers alone are not enough to guarantee actual integration. Even in a largely liberalised environment, country-specific risks and other factors can cause a lasting segmentation of financial markets.

A more precise definition of financial market integration should therefore include not only the *necessary conditions* but also the *sufficient conditions*. Financial market integration in the *narrower sense* consequently implies not just the possibility of cross-border transactions but also requires investors to be willing to enter into such transactions. Scitovsky (1969, p 89) was one of the first to formulate such a comprehensive definition, saying that *"the perfect integration of asset markets means, ... that the assets must be transferable and the portfolio preferences of individual asset holders are regionally unbiased"*.

According to Obstfeld (1986, pp 55 et seq) there are two categories of measurement concepts based on this definition of financial market integration. The first category draws on the *volume* of transactions and the second category on the *efficiency* of the markets. Methodological flaws are the main reason against the use of quantity-oriented measurement concepts.[9] A smaller degree of international financial transactions does not automatically imply market segmentation. It is possible that simply no incentives for cross-border transactions exist because from the investor's point of view domestic and foreign investment is equivalent. On the other hand, capital flight in connection with monetary and financial crises can hardly be seen as a sign of a high level of integration.[10] Therefore, what is more important than the actual volume of transactions is – according to the theory

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[7] For an overview see, for example Adam et al (2002), Jandura (2000), Shepherd (1994), Goldstein/Mussa (1993), Lemmen (1998) and Obstfeld (1986).

[8] Financial market integration in the *broader* sense is covered by Galati/Tsatsaronis (2001), Adjaouté et al (2000), Santillan/Bayle/Thygesen (2000), European Commission (1999/2001), Quinn (1997) et al.

[9] For quantity-oriented measurement concepts see Feldstein/Horioka (1980), Penati/Dooley (1983), Obstfeld (1986), Murphy (1984), Tesar (1991), Bodman (1994), Otto/Wirjanto (1989), Frankel (1985), Schmidt-Hebbel/Servén/Solimano (1996), Obstfeld (1994), Bayoumi/McDonald (1995), Sorensen/Yosha (1997) et al.

[10] See Deutsche Bundesbank (2001)

of contestable markets – competition on financial markets and the attendant efficiency. Such measurement concepts are based on the "law of one price".

This law says that complete integration results in uniform prices, ie assets bearing the same risk will have the same expected yield regardless of the country in which they are traded. *Any* price discrepancy is therefore an expression of segmentation which reduces the volume of cross-border transactions and thus, in a monetary union, impairs the effectiveness of monetary policy. The causes, however, may be quite different and thus have to be assessed differently. Risk premia, for instance, reflect the preferences of market players and therefore do not contradict the existence of perfect markets. All other reasons for a lack of integration, such as capital controls or the exercising of market power, represent transaction costs which stand in the way of the efficient formation of prices. They prevent the optimum international allocation of capital and are therefore considered to be a particularly serious problem.

The *interest parity theory* applies the law of one price to fixed-interest, homogeneous financial papers.[11] The question of money market integration has to be addressed with *covered interest parity (CIP)*, which says that the yield on a domestic financial paper corresponds to the yield on a foreign paper with a hedged exchange rate risk.[12] The yield spread between two economies is offset by the swap rate of the bilateral exchange rate.

$$(1) \qquad i_t - i_t^* = \frac{E^T_{t,t+k} - E_t}{E_t}$$

Here, i = domestic interest rate; i* = foreign interest rate; E = spot rate; E^T = forward rate.

Equation (1) implies the possibility of complete arbitrage between domestic and foreign financial papers, ie no barriers in the form of transaction costs or default risk exist. For shorter maturities (up to one year) the degree to which covered interest parity is valid represents a measure of the integration of national *money markets* while eliminating

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11 In the capital markets the law of one price is incorporated in the c*apital asset pricing model*. See Bekaert/Campbell (2000), Dumas/Solnik (1995), Ferson/Harvey (1991), Hardouvelis/Malliaropulos/Priestly (1999), Chen/Knez (1995) and Ayuso/Blanco (1999).

12 All variants of interest parity are based on the assumption of completely homogeneous – ie nominally risk-free – financial papers which are perfectly substitutable regarding the maturity, quality of the borrower etc. See Jandura (2000), Lemmen/Eijffinger (1996b), Kearney (1996), Fratzscher (2001), Shepherd (1994) et al. However, this assumption is not completely valid owing to different market conventions in the various economies. Studies in the east European economies, in particular, are confronted with this problem. For that reason, restrictions in the informative value of these studies cannot be ruled out. For a presentation of various market conventions see J P Morgan (1998) and Bruns/Meyer-Bullerdiek (1996).

exchange rate risk.[13] According to Aliber (1973) the factors which lead to a violation of covered interest parity may be summarised as "political risk" or "country risk" wherever they are attributable to actual or looming government intervention in the markets.

Interest parity theory provides not only a definition of completely integrated financial markets but also an instrument for measuring the degree of integration already achieved. As a variant of equation (1), equation (2) shows deviations from covered interest parity (θ) as integration deficits on the right side. The greater the amount of the deviation, the more segmented the observed markets are.[14]

$$(2) \qquad \frac{(1+i_t)}{(1+i_t^*)}\frac{E_t}{E_{t,t+3}^T} - 1 = \theta_t$$

If θ is negative, we may conclude that capital exports are being restricted, denying domestic investors the opportunity to invest their money in higher-yield foreign paper. However, if $\theta > 0$, the home country has a yield advantage over the foreign country, which in some cases might be attributable to a risk premium and/or capital import controls.[15] Moreover, both positive and negative deviations from covered interest parity can be engendered by additional market imperfections, which are caused by an underdeveloped financial sector and are reflected in increased bid-ask-spreads.

4 Does covered interest parity hold in central and eastern Europe?

This chapter will study whether and to what extent central and east European money markets are integrated with EMU markets. Owing to considerable restrictions regarding the availability of data, the following empirical studies are limited exclusively to Poland, the Czech Republic, the Slovak Republic and Hungary. The observation period begins on 31 December 1998, the day before the introduction of the euro (Poland and the Slovak Republic: 31 January 1999), and ends on 30 June 2002. The calculations are based on three-month money market rates and three-month forward rates.[16]

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[13] This is particularly clear if we compare onshore and offshore interest rates as an alternative to directly measuring covered interest parity according to equation (1). See Rogoff (1985).

[14] In the following, the precise formulation of covered interest parity will be used. This is only marginally different from the approximation used in equation (1).

[15] For more on the impact of capital controls and risk premia on covered interest parity see, eg, Aliber (1973), Frenkel/Levich (1975), Marston (1976), Marston (1995), Lemmen (1998) and Jandura (2000).

[16] See Annex for information on the sources of the data.

The econometric test for whether the covered interest parity holds is based on a regression model of the following type.

$$(3) \qquad \frac{1+i_t}{1+i_t^*} = \alpha + \beta \frac{E_{t,t+3}^T}{E_t} + u_t$$

A necessary condition for money market integration is a long-term equilibrium between interest rate ratio and swap rate. This requires that the time series on the left and right sides of equation (3) are either both stationary or both non-stationary and cointegrated. To meet the sufficient conditions for money market efficiency, α has to be 0 and β=1 and the residuals must be serially uncorrelated ("white noise"). If the residuals do not have the characteristics of "white noise", inefficiencies are not corrected immediately and the forward rate does not contain all the relevant information.[17]

The unit root tests were performed on the basis of the Augmented Dickey-Fuller test (ADF), the Phillips-Perron test (PPT) and the Kwiatkowski-Phillips-Schmidt-Shin test (KPSS). They showed that the time series $(1+i_t)/(1+i_t^*)$ is not stationary and I(1) for all countries. The same went for $E_{t,t+3}^T / E_t$. In a first step, equation (3) was estimated using OLS. The unit root tests of the residuals confirm that a cointegration relationship between the two time series exists in all countries.[18] In a second step the parameters α und β are estimated robustly with dynamic OLS (DOLS).[19]

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17 Strictly speaking, if the covered interest parity holds, no residual should appear whatsoever since it, too, is generally an expression of market segmentation. Such a strict application of the "law of one price", however, would lead to the null hypothesis of complete integration being rejected for highly developed industrial countries, too, since such a perfect match cannot be achieved in real life.

18 The cointegration tests used here were the Engle-Granger (EG) and the Augmented Engle-Granger procedure (AEG) and the Cointegrating-Durbin-Watson test (CRDW). It must be noted that the AEG procedure is, generally speaking, an ADF test which is using changed critical values (on this see MacKinnon (1991), Engle/Granger (1987), Engle/Yoo (1987) et al). The CRDW test is a Durbin-Watson test with a different null hypothesis (d=0 instead of d=2). The corresponding critical values were first provided by Sargan/Bhargava (1983). If a cointegration relationship exists, then, according to Stock (1987), the statistical assumptions of OLS are not violated despite the non-stationarity of the individual time series. The OLS estimator is superconsistent – meaning deviations from parity are only temporary – and efficient.

19 This method takes into account the existing endogeneity problem, which leads to distorted t-values of the estimated parameters. The lags and leads of the differentiated swap rates integrated into the regression were restricted to between -2 and +2. At the same time the serial correlation is adjusted; the Newey-West covariance estimator (1987) is consistent in the case of both autocorrelation and heteroscedasticity; for more see Saikkonen (1991). By contrast, Stock/Watson (1993) prefer to adjust the serial correlation using the Cochrane-Orcutt method (see Cochrane/Orcutt, 1949).

The overview in *Table 2* shows clearly that the null hypothesis of covered interest parity being fulfilled is rejected for all four countries.[20] This is confirmed not only by the results of the Wald test of the simultaneous existence of $\alpha=0$ and $\beta=1$, but also by the fact that the t-values of the individual coefficients are highly significant.[21] The point estimates indicate that money markets in the Czech Republic were integrated the most deeply with the euro area throughout the entire observation period, Poland and the Slovak Republic apparently showed the greatest deficits. Whereas differences between the countries were reflected in the estimates, changes over time were not recorded. Because of the brevity of the review period, suitable methods such as rolling time windows or breaking down the time series into segments cannot be used. To that extent, the situation at the current end might be more advantageous than suggested by the results in Table 2, which cover the whole observation period.

Table 2: Covered interest parity in central and east European economies

	Individual series	**α** ***(t-value, α=0)***	**β** ***(t-value, β=1)***	**Wald test F-statistic** ***(Prob.)***
Czech Republic	Cointegrated	-0.08 *(-7.52)***	1.08 *(7.62)***	69.81 *(0.000)*
Hungary	Cointegrated	-0.09 *(-3.76)***	1.09 *(4.13)***	39.47 *(0.000)*
Poland	Cointegrated	-0.15 *(-3.20)***	1.14 *(3.47)***	207.87 *(0.000)*
Slovak Republic	Cointegrated	-0.12 *(-4.42)***	1.12 *(4.62)***	35.51 *(0.000)*

** Rejection of the null hypothesis at the 1% level

With respect to the continuation of the enlargement process, it is of interest to know whether the current level of integration of central and east European money markets has reached the same stage as that of the European Monetary System in the run-up to monetary

[20] These results do not change even if dummies for observed outliers are taken into account for the Slovak Republic and Hungary.

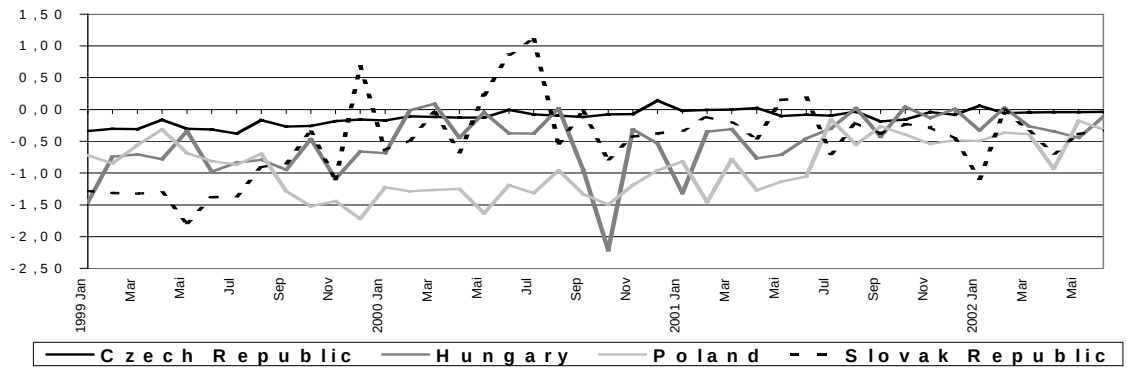
[21] Remarkably, for all countries the deviations of the estimated values to the predicted values for α are nearly identical to the deviations of the estimated values to the predicted values for β in terms of amount but show different signs. This "switch" is caused by the lack of major change in swap rates over time, which makes it difficult to distinguish these from the constant. However, since the deviations are statistically significant, the null hypothesis must still be rejected.

union. It appears advisable to cite the founder members of European monetary union as reference examples. Numerous empirical studies have shown that the networking of money markets among western industrial countries picked up distinctly during the 1980s and that now these markets may be assumed to be completely integrated. Within the EMS and ERM II, covered interest parity is considered to hold since the overcoming of the exchange rate crises in 1992-93 and the removal of the last capital controls in spring 1994.[22] Compared with the present participants in European Economic and Monetary Union, the money markets of the central and east European countries still, consequently, show distinct deficits in integration. Whereas a graphic presentation can be used to provide initial indications of underlying causes, we will use an econometric study to find out more detailed information.

5 Causes for an incomplete integration of money markets in central and eastern Europe

5.1 A graphic presentation

Figure 1: Deviations from covered interest parity (CIP)[a]



a) according to equation (2), annual deviation in percentage points

Figure 1 shows that deviations from covered interest parity in all four countries were mostly negative and were clearly reduced over the course of the observation period, especially since halfway through the year 2001. Ultimately, the reason for the low level of correlation between swap rates and interest rate ratios can only lie in risk premia or

[22] See Popper (1993), Fletcher/Taylor (1994), Marston (1995), Takezawa (1995) and Jandura (2000). However, Holmes/Wu (1997) are unable to prove the stationarity of the CIP deviations for a panel of four EU members between Mai 1990 and January 1996. The authors explain the rejection of covered interest parity particularly by citing the EMS crisis in the first half of the observation period.

transaction costs. The existence of a risk premium may be ruled out from the outset because the deviations in all economies were almost exclusively negative. That means it may be assumed that transaction costs are to blame for the insufficient fulfilment of CIP; transaction costs may be attributed to the influence of capital controls and other inefficiencies related to the underdevelopment of the financial sector. This raises the question of what influences may have contributed to the positive development.

The figure leads one to assume that, at the beginning of the study, cross-border money market transactions were still being hampered by capital export regulations which were dismantled over time. In fact, all four countries actually made considerable efforts during the observation period to liberalise their capital movements. In the Czech Republic a change in the Foreign Exchange Act took effect on 1 January 1999; two years later the last barriers to investment by residents in foreign countries were removed. The Slovak Republic also amended its Foreign Exchange Act with effect from 1 January 2001, whereas Poland still had significant restrictions on foreign exchange transactions in place up to September 2002. Since July 2001 there has been a significant reduction in discrepancies from CIP in Hungary. One possible reason for this may lie in the fact that all remaining restrictions on short-term capital movements were lifted in June.[23]

Yet it is not only the *development* of deviations which permits us to suspect that restrictions on capital movements may have had a certain influence; the absolute *level* may also lead us to believe that such a connection may exist. In the Slovak Republic and Poland – the two countries which had the most comprehensive capital controls in place during the observation period – the deviations, at up to 2 percentage points per annum, seem to be the largest in absolute terms. By contrast, CIP in the Czech Republic, which already in 1999 had the most extensively liberalised capital regime of the four accession countries, is fulfilled the best throughout the entire observation period.

To that extent, the measures for opening these countries' economies externally seem to have had a recognisable impact on money market integration. Restrictions on capital movements, however, do not appear to be the only possible explanation for the discrepancies or for their having been reduced during the observation period. Rather, it may be assumed that, in addition, the underdevelopment of the financial sector is responsible for the CIP not being sufficiently fulfilled. This would also correspond with the recognisable, virtually continuous decline in the deviations over time. This opinion is also supported by the high volatility of the time series or the underlaying pronounced bid-ask

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23 See European Commission (2002 a-d). For details of the restrictions during the observation period see IMF, Exchange Arrangements and Exchange Restrictions.

spreads on national money markets and forex markets, which in turn are a reflection of insufficient competition in the domestic financial sector.[24]

The removal of capital controls tend to be reflected in a structural break in the individual time series and increasingly efficient financial sectors ought to result in a virtually continuous reduction in deviations. In addition, individual outliers may be observed for the Slovak Republic (December 1999 and May-July 2000) and Hungary (October 2000). The positive deviations observed for the Slovak Republic in December 1999 went hand in hand with a short-term increase of money market interest rates, whereas in the summer of 2000 a temporary weakness of the Slovak koruna can be observed but does not have the same impact on forward market quotations. The sharp negative deviation which may be observed for the Hungarian time series in October 2000 is produced by countervailing movements of spot and forward rates compared with the preceding month; where the forint appreciated on the spot market, forward rates were sluggish. At the same time, money market rates were stable compared with the preceding month, whereas in the euro area they reached their highest level throughout the entire observation period. These outliers, however do not provide any further information on potential integration deficits and their causes.

To enable us to make more specific statements on the underlying causes, we need also conduct an econometric analysis. That way we can look at *the extent* to which existing capital controls and financial sector inefficiencies are responsible for the observed segmentation of money markets. It is especially important to search for the root causes because both aspects are associated with increased transaction costs yet have different implications. This way it is assured that after accession to the EU, scheduled for 2004, *no* more capital controls will be possible, with the exception of transitional arrangements.[25] To that extent, accession to the EU and the concomitant adoption of the *acquis communautaire* will lead to the endogenous dismantling of capital controls. If this is identified as the sole cause of deviations from covered interest parity, the full integration of central and east European money markets is only a matter of time. By contrast, financial sector imperfections cannot per se be eradicated by accession to the EU. On the contrary, it is precisely the conditions of the EU's single market which will increasingly bring such imperfections to the surface. Once these countries have joined the Eurosystem, these imperfections may threaten to get in the way of the implementation and conduct of the

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24 In summer 2000 the ask rate on money markets and on foreign exchange forward markets in the Slovak Republic was, in each case, around 0.4% higher than the bid rate. At the end of 2002 the spreads on the forward markets had gone down to just under 0.3%, whereas they had risen to over 0.7% in the case of money market rates (see the website of the National Bank of Slovakia).

25 The negotiated transitional arrangements refer without exception to the purchase of property and are of no importance to short-term capital movements. See European Commission (2002e).

single monetary policy. A detailed analysis of these two components is therefore fundamentally important for the further progress of the integration process.

5.2 An econometric study

The *absolute deviations from covered interest parity* (ABSCIP) are taken here as the variable to be explained. This is because all fluctuations around interest parity, ie positive and negative deviations alike, are a sign of the existence of transaction costs.

Dummies (DUMKV) are used to represent capital controls. The absolute extent of capital controls cannot be directly compared between countries on the basis of descriptive analyses. Rather, it seems advisable to model only *significant* legislative measures on short-term capital movements. In that respect the only fundamental distinction being made here is whether or not important changes in the framework conditions can be detected during the observation period. After a distinct liberalisation the dummy takes on the value of null; if no such move can be detected in the observation period, the dummy retains the value of 1. In line with what has been said in the preceding section, the dummy was 0 in the Czech Republic and Slovak Republic from January 2001, and in Hungary a complete liberalisation may be assumed to have occurred since July of the same year. In Poland, however, this step was only taken after the end of the observation period.

The following variables are used as potential indicators of the state of development and the efficiency of the financial sector.

The *ratio of M_2 to GDP* (M2GDP) is often used as a measure of the size and liquidity of the financial sector. In addition, M2GDP, as the inverse value of the velocity of circulation of money, corresponds to the cash holding coefficient and, as such, indicates the confidence that economic agents have in the domestic currency and the banking system.[26]

The *ratio of private loans to total loans* (CRPCRG) is particularly interesting against the fact that the economies in this study were once part of a socialist economic system. It is generally a measure of progress made in the transition towards a market economy; specifically, it indicates the extent to which loans are made on the basis of free competition among agents and not under the influence of government intervention in economic activity.

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[26] See Buch/Piazolo (2001), p 91 and Levine/Loayza/Beck (2000), pp 37 et seq. However, the variable also has disadvantages as a measure of the development of the financial sector. Lemmen/Eijffinger (1996a, pp 439 et seq) eg see it as a monetary variable which indicates the danger of inflation.

On the whole, it may be expected that the efficiency of domestic markets will increase in line with a rise in CRPCRG.

The *spread between the lending rate and the deposit rate* (ZLZD) gives information on transaction costs, information asymmetries and the intensity of competition in retail banking business. This spread decreases as financial markets become more developed.[27]

Finally, the *growth rate of real lending* (WCRR) is also used as an indicator of the development of the financial sector. It is interpreted as an expression of a growing and highly productive financial sector.

A *trend* (TIME) is additionally used as a collective term for the stepwise implementation of the European Union's *acquis communautaire* during the ongoing accession negotiations and the steady evolution of the financial sector, which are not already captured by the above mentioned variables.

The use of money market-specific data is made more difficult by the fact that for some features only irregular or annual data can be found. The only available variables we could include in this study are the *ratio of interbank assets to total bank assets*. Although they indicate the outstanding amounts, they cannot reflect the actual turnover in interbank business, nor their liquidity. In addition, the variables do not show any signs of significance. Moreover, there is another problem: it is not possible to unambiguously determine the causality. Low money market liquidity may be caused by heavy segmentation, for instance, instead of it being the other way around. To avoid such endogeneity problems, the econometric study shall be confined to purely exogenous determinants.

The regression equation is as follows.

$$\text{(4)} \quad \begin{aligned} ABSCIP_{it} = \delta_i + \gamma_1 M2GDP_{it} + \gamma_2 CRPCRG_{it} + \gamma_3 ZLZD_{it} + \\ \gamma_4 WCRR_{it} + \gamma_5 DUMKV_{it} + \gamma_6 TIME_t + \eta_{it} \end{aligned}$$

where $ABSCIP_{it}$ absolute deviation from covered interest parity

M2GDP ratio of M2 to GDP

CRPCRG ratio of private loans to total loans

ZLZD ratio of the lending rate to the deposit rate

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[27] See Beckmann/Eppendorfer/Neimke (2001), pp 22 et seq.

WCRR	monthly growth rate of lending at constant prices
DUMKV	capital controls dummy
TIME	trend

In line with our explanations above, we expect a negative sign for γ_1, γ_2, γ_4 and γ_6 since the variables are positively correlated with the maturity and efficiency of the financial sector. They are intended to reduce existing market imperfections and the associated monopoly gains and, consequently, to diminish the absolute deviations from covered interest parity. By contrast, ZLZD expresses imperfect competition in the banking sector. Similarly, restrictions on short-term capital movements hamper the harmonisation of domestic and foreign yields. γ_3 and γ_5 are therefore expected to have positive signs.

A variance analysis of the dependent variable makes it clear that the vast majority of the variance is attributable to differences between the individual countries and not to variance within a country.[28] To that extent, it may be assumed that the goodness of the estimate may be increased by incorporating individual effects. The studies based on a fixed-effect estimator confirm their significance. The hypothesis that all fixed effects are equal to null is rejected using the F-test. The Hausman test (Hausman 1978) rejects the null hypothesis that no systematic differences exist between fixed-effect model and random-effect model. Consequently, it may be assumed that a correlation exists between the individual effects and the explanatory variable; the random effect model must be rejected. The Adjusted Bartlett test (Sokal/Rohlf 1995), the Levene test (Levene 1960) and the Brown-Forsythe test (Brown/Forsythe 1974) significantly reject the null hypothesis of equal variances of the individual countries. The modified Bhargava et al. Durbin Watson test (Bhargava et al 1982) and the Baltagi-Wu (LBI) test (Baltagi/Wu 1999) indicate a significant serial correlation of residuals. Taking these results into account, a *Feasible Generalised Least Squares estimate (FGLS)* seems to be the suitable method.[29] The robustness of the standard errors is assured by specifying a heteroscedasticity-consistent covariance matrix according to White (White 1980). Account is taken of the momentum of development by including

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28 A unit root test for panel data run with X-plore 44 according to the method devised by Im/Pesaran/Shin (1997) confirms the stationarity of CIP deviations at the 5% level.

29 True, when calculating the autocorrelation, the so called “Nickell bias” which is due to a correlation between the regressor and the disturbance term occurs. However, the relatively large number of observations with respect to time (T=36) compared to the small number of countries (N=4) substantially diminishes the importance of the bias. Alternatively, models could be used which avoid the “Nickell bias” by explicitly including the dynamics (IV estimator or GMM). Yet these models have the shortcoming that instrumental variables which are only imperfectly correlated with the actual variable have to be used and hence the efficiency of the estimation is reduced. Judson/Owen (1999) show that for T≥30 least square estimators with fixed effects perform just as well or better than these alternative estimators. The estimates were made using Eviews 4.1. and Special Edition Stata 7.

AR terms. The results of the *FGLS estimate* for explaining absolute deviations from covered interest parity using financial market variables are listed in *Table 3*.

Table 3: FGLS estimation of financial market variables to explain absolute deviations from covered interest parity in central and eastern Europe

Explanatory variable	Parameter	Standard error	T-statistic *(prob.)*	Economic significance
M2GDP	-0.047	0.017	-2.74 *(0.007)*	0.0073
CRPCRG	-0.007	0.003	-2.36 *(0.020)*	0.0001
ZLZD	0.064	0.034	1.90 *(0.060)*	0.0147
WCRR	-0.009	0.001	-6.14 *(0.000)*	0.0638
DUMKV	0.050	0.016	3.08 *(0.003)*	0.0632
TIME	-0.004	0.002	-2.90 *(0.004)*	-

All variables have the expected sign. To that extent this seems to confirm that variables which reflect the status of and trends in financial sector influence deviations of CIP. The variable M2GDP contributes to explaining the deviations significantly, as would be expected, ie the more liquid and better developed financial markets are and the more confidence people have in these markets, the less pronounced fluctuations around parity are. CRPCRG and WCRR, too, have a demonstrable effect on money market integration. By contrast, the spread between the lending rate and the deposit rate is only a weakly significant determinant. All the same, this variable's sign, too, is pointing in the expected direction.

Along with the underdevelopment of the financial sector capital controls also play a significant role in the segmentation of central and east European money markets. In that respect the new Foreign Exchange Act in Poland, which entered into effect in autumn 2002 and eliminated all capital controls, is expected to make a further contribution to integration. Besides the variables explicitly included in the study, there are additional factors that appear to be important and which are either linked to the state of the financial sector or attributable to other progress along the road to EU accession. This is what the significant contribution of the trend seems to indicate. Another possibility is that a whole range of additional legislative action not explicitly modelled by dummies but which still contributed

to the continuing process of capital accounts liberalisation is being captured in the significant trend.

Along with the *statistical significance* of the variable, the *economic significance*, which expresses a ratio of the estimated parameter to the variable's average value, is of interest. This normalisation improves comparability between the individual regressors. Measured in terms of this criterion, growth of real lending and the dismantling of capital controls will be the most important factors in the integration of money markets. These results also correspond to the results of the statistical significance. However, the spread between the lending rate and the deposit rate – despite the non-existence of statistical significance – has a much more pronounced economic significance than the remaining variables, whose contribution is much lesser but comparable among one another.[30]

6 Conclusion

In conclusion, it may be said that money markets in the four accession countries in this study already show a large degree of international integration. The remaining deviations from CIP have been continuously reduced over the past four years, yet not eliminated entirely. Moreover, account must be taken of the fact that Poland, Hungary, the Czech Republic and the Slovak Republic are among the leading accession candidates and that we can assume that some central and east European economies have much greater money market segmentation. By comparison, money markets within the EU have been considered completely integrated since the mid-1990s.

The partial segmentation of the four aforementioned accession countries' money markets observed until the end of 2001 is attributable in part to restrictions on short-term capital movements; now these restrictions have been virtually abolished and will play no role in the future. Moreover, other transaction costs which are caused by the low level of liquidity and the remaining underdevelopment of the financial sector lead to at times considerable

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30 In spite of the shortcomings mentioned in footnote 29 an IV-estimator according to Andersen/Hsiao (1982) has also been carried out. A GMM estimator according to Arellano and Bond (1991) which is more efficient than the IV estimator was not feasible, because the number of instruments would exceed the number of statistical units. In such a case it is impossible to calculate the inverse of the instrument matrix. Generally speaking, the results already obtained in the first estimate are confirmed. All parameters have the same sign but as expected lose statistical significance. All the same, the liquidity ratio (M2GDP) maintains a detectable influence on money market integration at the 1% level and the dynamics of lending (WCRR) at the 10% level. Moreover, a χ^2 test of the joint relevance of all variables rejects the null hypothesis that they make no contribution whatsoever to money market integration with an error probability of less than 5%. As already happened in the FGLS estimation, the growth rate of lending and the dummy for capital controls have the greatest economic significance.

spreads in money market rates and thus curtail the possibilities of arbitrage. This could impair the functional ability of payment systems and the implementation and transmission of the single monetary policy within European monetary union. Therefore, before the central and east European economies join the Eurosystem, private sector orientation, liquidity and the institutional efficiency of the national financial sectors should be developed even further.

7 Annex: Sources of data

Three-month money market rates	
CEE-4, EEMU	End-month, Datastream (IR)
Spot exchange rate	
Slovak Republic, Czech Republic, Hungary	End-month, Datastream (WMR)
Poland	Bloomberg
Three-month forward exchange rates	
Slovak Republic, Czech Republic, Hungary	End-month, Datastream (WMR)
Poland	Bloomberg
Inflation rates	
Czech Republic, Hungary, Poland	Cost of living, end of month, Deutsche Bundesbank
Slovak Republic	Consumer price index, monthly average: IMF: International Financial Statistics, line 64
Total outstanding credit	
CEE-4	End-month, IMF: International Financial Statistics, line 32
Total outstanding credit to the private sector	
CEE-4	End-month, IMF: International Financial Statistics, line 32d
Debit interest rates	
CEE-4	End-month, IMF: International Financial Statistics, line 60L
Credit interest rates	
CEE-4	End-month, IMF: International Financial Statistics, line 60P
International foreign reserves	
CEE-4	"all reserves minus gold": end of month, IMF: International Financial Statistics, line 1L.d
Money stock	
CEE-4	"money + quasi-money": end of month, IMF: International Financial Statistics, lines 34 + 35
Exchange rate regime	
CEE-4	Deutsche Bundesbank, Exchange rate statistics, Statistical Supplement to the Monthly Report 5

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