International financial-market integration of central and east European accession countries

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1 Introduction

The Copenhagen criteria for membership of European Union, as well as participation in ERM II at a later date followed ultimately by acceptance into the Eurosystem, require financial sectors in central and eastern Europe to be highly competitive and highly integrated internationally. Furthermore, art. 121 p. 1 EC-Treaty explicitly states that inter alia "[t]he reports of the Commission and the ECB shall also take account of ... the results of the integration of markets..."

Existing studies on this topic mostly deal with the international integration of stock markets (Jochum/Kirchgässner/Platek 1999, Linne 1998, Rockinger/Urga 1998, Gilmore/McManus 2002). However, the pressing need for an internationally competitive banking sector and the increasing similarity between the transmission mechanisms in an enlarged European Monetary Union have pushed not only capital markets but also the money and foreign-exchange markets of central and eastern Europe to the forefront of general interest Buch/Döpke (2000).

This paper describes the extent of integration between the euro area and Poland, the Czech Republic, Hungary and the Slovak Republic in the money and foreign-exchange markets separately. The measures used in this study are *covered interest parity (CIP)* and *uncovered interest parity (UIP),* respectively (section 2). Then we will discuss what exogenous determinants are responsible for the integration deficits on the money markets (section 3). However, we will not study the exchange-rate premia paid on foreign-exchange markets at greater length since it is extremely difficult to identify economic policy influences.[1] Section 4 summarises the results and the corresponding policy recommendations that follow.

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1 For previous attempts to find out the determinants of the exchange-rate premium see, for example, Jiang/Chiang (2000).

2 The extent of international financial market integration in the central and east European accession countries

This section studies whether – and if so, to what extent – the financial markets of Poland, the Czech Republic, the Slovak Republic and Hungary may be regarded as being integrated with euro-area markets. The period under review covers three years (January 1999 to December 2001) on the basis of three-month interest rates. The variables used here are the *covered interest parity (CIP)* and the *uncovered interest parity (UIP)*. By contrasting the two variants, it is possible to follow developments on money and foreign-exchange markets independently of one another and to make a distinction between the underlying risks for each.

Covered interest parity (CIP) is

$$(1)\qquad \frac{(1+i)}{(1+i^*)}\frac{E}{E^T}-1=\theta$$

where θ is a measure of the imperfections of *money market integration*, caused primarily by transaction costs and the existence of country risk. If $\theta > 0$ the home country has a yield advantage over other countries thanks to a risk premium and/or restrictions on capital imports which prevent the complete offsetting of yields. If θ is negative, capital exports are being restricted, thereby denying domestic investors the opportunity to invest their money in higher-yielding foreign securities.[2]

Uncovered interest parity (UIP) is

$$(2)\qquad \frac{(1+i)}{(1+i^*)}\frac{E}{E^E}-1\approx\theta+\rho$$

where ρ is the risk premium on exchange-rate uncertainty.[3] If ρ is positive, it indicates that, since there is uncertainty about the development of the bilateral exchange rate, international investors will tend to prefer foreign currency, whereas a negative value for ρ shows that the domestic currency is a relatively "safe haven".

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2 See Jandura (2000), p 337 f.

3 If precisely written, the right-hand side of equation (10) would have to be $(1+\theta)(1+\rho)-1$ or $\rho+\theta+\rho\theta$. However, the last summand can be neglected as long as the risks are not too pronounced.

Figure 1a: Covered interest parity(CIP)

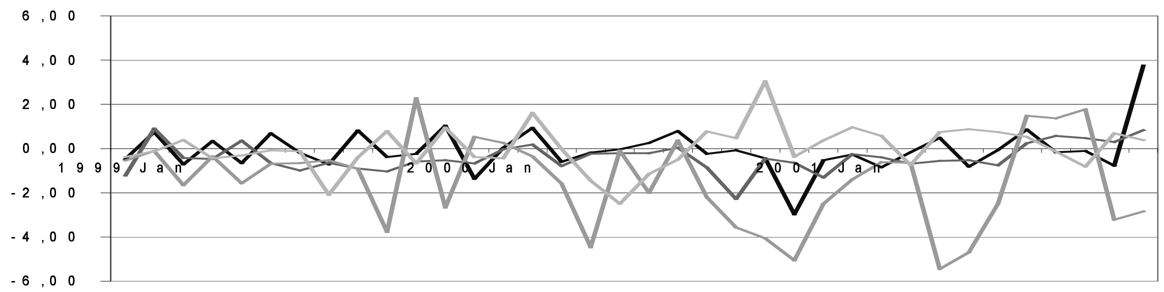
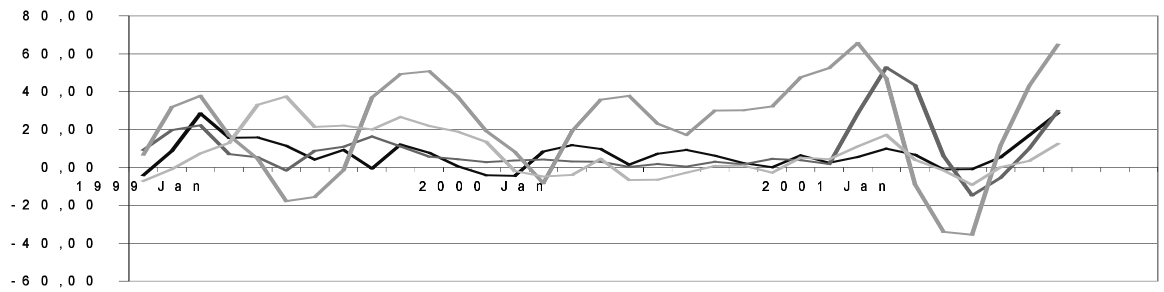


Figure 1b: Uncovered interest parity (UIP)



——Czech Republic ——Hungary ——Poland ——Slovak Republic

Just looking at the graphs will already provide an initial insight into the international integration of central and east European financial markets. In the Slovak Republic, the Czech Republic and Hungary, *covered interest parity (Figure 1a)* shows relatively little deviation from parity throughout the period under review, with this deviation remaining relatively constant. By contrast, developments in Poland, which had a good starting position, tended to be unfavourable. Deviation from *uncovered interest parity (Figure 1b)* in all countries was considerably greater than the deviation from covered interest parity. This picture is consistent with the results of more recent empirical studies, most of which conclude that covered interest parity is nearly fulfilled in highly developed economies while uncovered interest parity is not achieved.[4]

Econometric studies may be used to review the claims made thus far and to, where possible, detail certain aspects of them. The following regression model forms the basis

(3) $Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$

4 See, for example, Ayuso/Restoy (1996), Fletcher/Taylor (1994), Jandura (2000), Lemmen/Eijffinger (1996), Luintel/Paudyal (1998), Popper (1993) and Takezawa (1995). The remaining deviations are primarily attributed to transaction costs.

where Y is the dependent variable, X the explanatory variable, β a partial regression coefficient, ε a stochastic disturbance term and α is the constant. Depending on the examined aspect of financial market integration, Y_t is defined as E_t^T/E_t (CIP) or E_{t+3}/E_t as an approximation for E_t^e/E_t (UIP). In all cases the variable X_t stands for the home country's interest rate advantage over other countries, $X_t = (1+i)/(1+i^*)$. The null hypothesis H_0: $\alpha=0$, $\beta=1$ implies perfectly integrated financial markets and must be rejected if $\alpha\neq0$ and/or $\beta\neq1$.

Table 1 shows the results of a review of *covered interest parity* for the individual countries. The variable $X_t = (1+i)/(1+i^*)$ is non-stationary for all countries and I(1). The same applies to the variable $Y_t = E_t^T/E_t$.[5] The time series were initially studied for an existing cointegration relationship (see the results of the relevant cointegration test in the table).[6] Where it was possible to prove the existence of such a relationship, in a second step, as part of the presented regression model, the hypothesis α=0 and β=1 was tested; both the relevant parameter values and their test results may be taken from the table.

Table 1: Covered interest parity in the central and east European economies

	Cointegration test		**Cointegration relationship**		
	AEG	CRDW	α (t-value, α=0)	β (t-value, β=1)	R^2 (Wald-χ^2)
Czech Republic	-3.96*	1.91**	0.06 *(0.46)*	0.95 *(-0.45)*	0.65 *(0.39)*
Hungary	-3.56*	1.78**	0.05 *(1.03)*	0.96 *(-0.90)*	0.95 *(25.85)*++
Poland	-3.55*	1.59**	-0.18 *(-0.67)*	1.18 *(0.73)*	0.45 *(18.25)*++
Slovak Republic	-3.88*	1.67**	-0.05 *(-1.23)*	1.05 *(1.23)*	0.95 *(1.51)*

* Cointegration relationship significant at the 5% level
** Cointegration relationship significant at the 1% level
++ Null hypothesis rejected at the 1% level of significance

5 In this paper the unit root tests were all conducted on the basis of the Augmented Dickey-Fuller test (ADF), the Phillips-Perron test and the KPSS test. Moreover, the autocorrelation functions (ACF) and the partial autocorrelation functions (PACF) of the time series as well as the corresponding q-statistics according to Ljung/Box (1979) were used for the analysis of the time series.

6 The cointegration tests used were the Engle-Granger (EG) test or the Augmented Engle-Granger test (AEG) as well as the cointegrating regression Durbin-Watson test (CRDW). If the residuals of the regression are stationary, the endogenous and the exogenous variables are cointegrated. It should be noted here that the AEG method is basically an ADF test based on different critical values (see Mac Kinnon 1991, Engle/Granger 1987, Engle/Yoo 1987). The CRDW test is a Durbin-Watson test with a different null hypothesis (d=0 instead of d=2). The relevant critical values were first provided by Sargan/Bhargava (1983).

The results of the unit root tests of OLS residuals show that in all countries a cointegration relationship exists between the two time series studied.[7] The t-statistic of the parameters, the estimates of which are robust,[8] does not reveal any significant deviations from α=0 and β=1. The result of a simultaneous Wald test on the restrictions, though, is that the H_0 hypothesis of CIP in Poland and Hungary must be rejected. In Poland, there are also signs that the residuals are serially correlated.[9] That indicates inefficiencies resulting from the fact that not all relevant information enters into price formation. In Hungary, by contrast, the estimated parameters are close to the H_0 values and it is possible to reject the hypothesis because of the high goodness of the estimate with the estimated parameters having low standard errors.[10]

In the case of *uncovered interest parity* the problem is that the time series $Y_t = E_{t+3}/E_t$ is stationary in all cases, which rules out a long-term equilibrium with the non-stationary time series $X_t = (1+i)/(1+i^*)$. The regressions show extremely low values for R^2 and large variances in the estimated parameters, which means the validity of the uncovered interest parity must be rejected throughout.[11]

All in all, the econometric investigation of the time series confirms the claims already made based on the information shown in the graph on page 3. The international integration of central and east European financial markets is by no means complete, but in the money market sector it has progressed further than in the foreign-exchange markets.

From the surveyed variables it is not possible to firmly determine the extent to which the ascertained integration deficits could make it difficult to be accepted into monetary union. More extensive information can be obtained by comparing the 11 founder members of

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7 In Hungary the time series show a significant structural break in June 2001 which can be explained by the removal of remaining restrictions on short-term capital movements and the introduction of unrestricted convertibility for the Hungarian forint. Without taking the relevant dummy into account, no cointegration relationship would exist between the swap rate and the three-month interest rates.

8 The covariance matrices were adjusted using the Newey-West method.

9 The Durbin-Watson test and the Lagrange multiplier tests have dissimilar results, but for Poland and Hungary they indicate, at times significantly, a serial correlation of residuals.

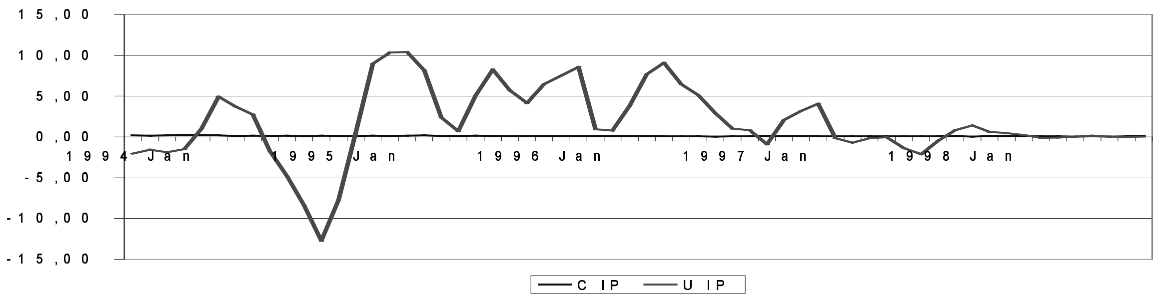
10 Conversely, it cannot be ruled out that the lacking significance of the Wald test in the Czech and Slovak Republics is due to the relatively short length of the time series. The results shown in Table 1 are therefore to be interpreted with caution.

11 The UIP can also be rejected for econometric reasons, however. When using monthly data the three-month exchange-rate changes are not stochastically independent of one another. The OLS estimator could then be inefficient. See Boothe/Longworth (1986) on this problem. Siegel (1972) likewise demonstrates that the UIP can be rejected for purely formal reasons, too. However, the empirical relevance of the Siegel paradox is refuted by McCulloch (1975).

European monetary union to show where they stood in the run-up to Stage Three of EMU, ie their level of integration, what risks they faced and how these factors developed.

Figure 3 shows deviations from interest parities for the 11 founder members of EMU (EMU-11) between January 1994 and December 1998.[12] The euro-area countries' money markets were virtually completely integrated in the run-up stage to monetary union. Thus, as early as five years prior to monetary union, transaction costs and premia for potential country risks no longer posed a significant barrier to the integration of European financial markets. However, during this period under review it is not clear how much the Maastricht Treaty was responsible for a distinct improvement in integration in 1992.

Figure 3: Interest parities in EMU



By contrast, *foreign-exchange markets* were not fully integrated, at least not by the end of 1996. During that stage the mostly positive deviations of the forward rate from the subsequent spot rate indicated that, if Germany is taken as a reference country, the other euro-area countries had a deleterious risk premium; however, this premium is gradually diminishing. The reduction of the exchange-rate premium to nearly nil mainly reflects the fact that accession expectations are being channelled. To that extent, endogenous foreign-exchange-market integration may be observed as accession to monetary union approaches. Remarkably, this did not only happen at the official announcement of participating countries on 2/3 May 1998. Instead, markets changed their expectations much sooner (Bundesbank 1999).

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12 Deviations from the CIP were measured by comparing onshore and offshore interest rates: $(1+i^{on})/(1+i^{off})=\theta$. The assertions on UIP refer to relations between the individual countries and Germany as a reference country. Greece, which did not join the Eurosystem until January 2001, and Luxembourg, which was already in a monetary union with Belgium as early as 1979, were not included. On the whole, the analysis of CIP is based on 600 observations (60 months x 10 countries), that of UIP on 540 observations (60 months x 9 countries – Germany is the reference country). Aggregation consisted of forming simple unweighted averages.

The summary results of econometric tests of the validity of CIP in the countries that were later to form the euro area are contained in Table 3.[13] Although a cointegration relationship between offshore and onshore interest rates can be shown to exist in all countries with a high level of significance, the Wald test always results in a rejection of the hypothesis of perfectly integrated money markets. At the same time the estimated parameters are, however, very close to the tested values (α=0; β=1).[14] As already the case in the central and east European countries, it is shown here that the refutation of covered interest parity does not necessarily mean that the money markets being studied were particularly poorly integrated. Rather, in the case at hand the high goodness of the estimate, with the estimated parameters having low standard errors, permits a significant assessment to be made despite only slight deviation from the tested restrictions.

Table 3: Covered interest parity in the euro-area countries

	Cointegration test		**Cointegration relationship**		
	ADF (AEG)	DW (CRDW)	α (t-value, α=0)	β (t-value, β=1)	R^2 (Wald χ^2)
Belgium/Luxembourg	-6.63**	1.71**	-0.02 (-1.44)	0.99 (-4.10)$^{++}$	1.00 (557.38)$^{++}$
Germany	-6.67**	1.75**	-0.02 (-0.84)	0.97 (-5.13)$^{++}$	1.00 (833.07)$^{++}$
Finland	-4.11**	1.39**	0.14 (1.79)	0.92 (-4.27)$^{++}$	0.99 (109.73)$^{++}$
France	-5.68**	1.97**	-0.12 (-4.49)$^{++}$	1.00 (-0.15)	1.00 (275.33)$^{++}$
Ireland	-5.94**	1.73**	0.01 (0.10)	0.99 (-0.91)	0.99 (50.53)$^{++}$
Italy	-5.26**	1.54**	0.07 (1.49)	-0.97 (-4.68)$^{++}$	1.00 (204.26)$^{++}$
Netherlands	-3.69**	1.52**	-0.06 (-3.33)$^{++}$	0.99 (-2.47)$^{+}$	1.00 (731.53)$^{++}$
Austria	-3.42*	0.81*	-0.13 (-0.96)	1.01 (0.12)	0.98 (359.16)$^{++}$
Portugal	-3.50*	0.92*	0.26 (2.34)$^{+}$	0.95 (-2.87)$^{++}$	1.00 (12.01)$^{++}$
Spain	-5.08**	1.64**	-0.07 (-2.25)$^{+}$	1.00 (0.36)	1.00 (51.31)$^{++}$

* Cointegration relationship is significant at the 5% level
** Cointegration relationship is significant at the 1% level
++ Null hypothesis is rejected at the 1% significance level

[13] The econometric procedure and the parameter tests are the same as in the case of CEE accession countries.

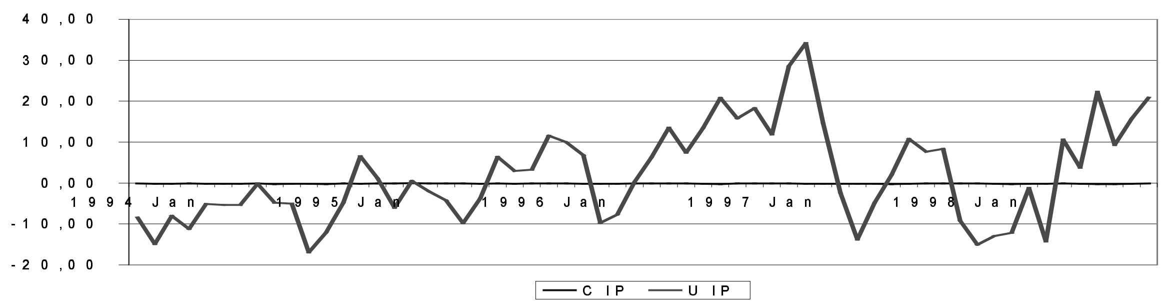
[14] The results thus are largely consistent with the above cited studies, according to which deviations from CIP in the leading industrial countries, albeit small, do admittedly exist. See footnote 4.

On the whole the econometric tests confirm the impression given in figure 3 that the integration of money markets in the future EMU countries was already well advanced prior to the establishment of monetary union and that deficits were only minor.

For *uncovered interest parity* the situation is similar to that in central and eastern Europe. The time series $Y_t = E_{t+3}/E_t$ is stationary in all cases. However, since the pattern of the interest differentials is non-stationary, the assumption of a long-term equilibrium relationship must be rejected from the outset. Bearing in mind the high volatility of deviations already indicated by the figure, the rejection of the UIP cannot come as a surprise.

Of interest to us are not only the EMU founder members' experiences but also a comparison with a control group of advanced non-euro-area industrial countries *(Figure 4)*.[15] For one thing, as in the euro area, money markets are shown to be thoroughly integrated throughout the entire 1994-1999 period. To that extent no direct correlation to euro-area membership is evident. By contrast, during the period under review foreign-exchange-market integration decreased considerably.

Figure 4: Interest parities of the control group



The econometric tests for the validity of the two interest parities put the selected industrial countries in a light similar to that of the euro-area countries.[16] It is true that a cointegration relationship between offshore interest rates and onshore interest rates can be proven for all countries with respect to the *covered interest parity*, yet the Wald test prompts an unequivocal rejection of the hypothesis of perfectly integrated money markets. For *uncovered interest parity* no long-term equilibrium between exchange-rate changes and interest differentials can be proved for the UK and the USA. For Japan and Switzerland a

[15] The study compared interest parities of the USA, the UK, Japan and Switzerland (IC-4). As with the euro-area countries, deviations from CIP were measured by comparing onshore and offshore interest rates. Germany was used as a reference country for reviewing uncovered interest parity.

cointegration relationship exists, but the regression produced a resounding rejection of the imputed parameter values.

With regard to the suitability of the central and east European accession countries for participating in the various integration stages of monetary union, it is, lastly, of interest to compare average deviations from interest parities and their underlying risks. Table 5 shows clearly that average deviations from covered interest parity for 1999-2001 for the EU accession countries in this study were, in terms of amount, in some cases (Czech Republic and Slovak Republic) even a bit lower than the long-run euro-area founder members' average. By contrast, all the CEE economies under examination show a distinctly higher risk premium for exchange-rate fluctuations against the euro.

Table 5: Average deviations from interest parities

	Deviation Money market integration	**Deviation Foreign-exchange market integration**
	Country risk/transaction costs	Exchange-rate risk
Czech Republic	-0.06	8.38
Hungary	-0.40	10.46
Poland	-1.51	22.93
Slovak Republic	-0.02	8.43
EMU-11	0.09	1.61
IC-4	-0.17	1.64

The following section will focus on the extent to which central and east European governments can use economic policy to advance the integration of money markets. The main issue is to prepare domestic financial sectors for the single European market and to ensure their competitiveness within the European Union.

16 The econometric procedure and the conducted tests are the same as above.

3 Determinants of country risk

3.1. Defining the determinants of the risk premium

The currency and financial crises of the 1990s in Mexico (1994/95), Asia (1997/98) and Russia (1998) clearly showed that besides macroeconomic imbalances the state of the domestic financial sector also plays an increasing role in the evolution of balance-of-payments difficulties. Sachs/Tornell/Velasco (1996) integrate both aspects into a simple theoretical model which they use to explain the balance-of-payments crisis in Mexico. They identify three key variables which are responsible for the occurrence of speculative attacks. These are the vulnerability of the financial sector, the current underevaluation of the exchange rate and insufficient foreign reserve assets.

In this section we test the hypothesis that these variables explain the country risk premium paid on the money markets, ie the deviations from covered interest parity (CIP). Since it is impossible to distinct clearly between endogenous capital controls and risk premia, it is important to know whether or not the economies have imposed, or are capable of imposing, capital controls. Consequently, with regard to the *determinants of country risk*, the sample should be composed in such a manner as to ensure that no capital controls were in place in the countries under observation during the entire period under review. As explained in the preceding section, in this case positive deviations from CIP (θ) can be attributed to a premium which is paid for an elevated risk of default (country risk). After 1993, once the last transitional arrangements had expired for Greece, Portugal and Spain, this condition was met for all EU member states. The United States, Canada, Switzerland and Japan do not regulate their capital movements, either. Austria, Denmark, Germany and the Netherlands were excluded owing to a lack of data. Belgium and Luxembourg are treated as a single country. For some euro-area founder members the necessary financial-market data were available only up to and including the second quarter of 1998. On the whole, the study comprises 14 countries and covers a period from the first quarter of 1994 to the second quarter of 1998 (252 observations).

The *state of the domestic financial sector* was measured in terms of the ratio of the lending rate to the deposit rate. This ratio provides information on transaction costs, information asymmetry and the intensity of competition among commercial banks. The spread decreases as financial markets become increasingly more developed.[17]

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[17] See Beckmann/Eppendorfer/Neimke (2001), p 22 f.

The current *misalignment of the exchange rate* cannot be directly observed. The development of the real exchange rate, however, provides an insight into the amount of correction necessary. An even simpler strategy, though, is to use the domestic inflation rate. Although this does not capture external developments such as price increases abroad or nominal changes in the exchange rate, its advantage is that it can be controlled to a large extent by the government or the central bank. Given that the purpose of this paper is to develop policy recommendations to promote financial market integration, the inflation rate seems suitable as the determinant to be tested.

A ratio was created between the *stock of foreign reserve assets* and the money stock M_2. This form of standardisation guarantees comparability between individual countries and also takes into account the fact that not only do foreign investors want to put their money into safety in the event of a balance-of-payments crisis but also that – given that the currencies are convertible – the whole money stock can be converted into foreign currencies. It is not enough only to back central bank money with foreign reserve assets. To prevent the banking sector from collapsing and thereby triggering a financial crisis, the central bank should also be able to cover commercial banks' need for foreign currency in an emergency.[18]

Finally, to distinguish between countries with flexible exchange rates and members of the European Monetary System, a dummy for the *exchange rate system* was included. Countries with a unilaterally pegged currency were not included in the sample.

We use the following regression equation.

(4) $$\theta_{it} = \alpha + \beta_1 ZLZD_{it} + \beta_2 INFL_{it} + \beta_3 RESM2_{it} + \beta_4 WKFLEX_{it} + \varepsilon_{it}$$

where ZLZD is the ratio between the lending rate and the deposit rate

INFL is the (three-month) inflation rate in percent

RESM2 is the ratio of foreign reserve assets to M_2

WKFLEX is a dummy for fully flexible exchange rates.

The hypothesis is tested to see whether a higher spread between the lending rate and the deposit rate, a higher inflation rate, decreased foreign reserve assets and a flexible exchange-rate regime will increase the risk premium demanded on money markets. The latter relationship is attributable to the fact that in our sample flexible rates are presented as

18 See Sachs/Tornell/Velasco (1996), p 162.

an alternative to joining ERM II, a multilateral agreement which generally increases the credibility of participating countries compared with flexible exchange rates. Consequently, positive signs are expected for β_1, β_2 and β_4, and a negative sign for β_3.

The estimates are made with Eviews 4.1 as well as with Intercooled Stata 7. The choice of countries and the observation period ensure that the calculations can be made on the basis of a balanced panel. To rule out spurious regressions, the endogenous variable is tested for stationarity. An ADF test, Phillips-Perron test and KPSS test are run to confirm the stationarity of the time series at the 5% level. A variance analysis shows clearly that the largest share of the dependent variables' variance is due to differences between the individual countries and not to variance within a country. To that extent, it may be assumed that the estimate's coefficient of determination can be increased by incorporating individual effects. The studies are based on a fixed-effect estimator. The t-values of the fixed effects are not shown in the text but nonetheless confirm their significance at the 5% level. The hypothesis that all fixed effects are equal to null is significantly rejected by means of an F test. The Lagrange multiplier test (Breusch/Pagan 1980) produces significant signs that group-specific disturbance terms exist. The Hausmann test (Hausmann 1978) does not reject the null hypothesis, ie there are no systematic differences between the fixed-effect model and the random-effect model. Consequently, it has not to be assumed that a significant correlation exists between individual effects and other explanatory variables.

The modified Bhargava et al Durbin-Watson Test (Bhargava et al 1982) and the Baltagi-Wu (LBI) test (Baltagi /Wu 1999) point to a significant AR(1) process. The autocorellation of the disturbance terms can be eliminated by including an AR(1) term in the fixed-effect model. The adjusted Bartlett test (Sokal/Rohlf 1995), Levene test (Levene 1960) and Brown-Forsythe test (Brown/Forsythe 1974) significantly reject the null hypothesis of equal variance between the individual countries. The White test is likewise highly significant (White 1980). Therefore, heteroscedasticity can be proved to exist both between countries and within individual countries (for the various forms of heteroscedasticity in the panel data, see Kim 1998). Taking the test results into account, the FGLS method was used to estimate the model using cross-section weighting, which factors in heteroscedasticity between countries. The remaining heteroscedasticity within the countries was adjusted using a White estimator with robust standard errors (see also Green

1997 and Beck et al 1993). Lastly, lagging the INFL variable by one period significantly improved the result of the estimate. It is presented in *Table 1.*

Table 1: Determinants of the risk premium on international money markets (1)

Explanatory variable	***Parameter***	***Standard error***	***T statistic***	***Prob***
ZLZD	0.042	0.008	5.59	0.000
INFL (-1)	0.017	0.003	4.76	0.000
RESM2	0.004	0.001	4.48	0.000
WKFLEX	0.082	0.033	2.50	0.013

All parameters turn out to be significant and to have the expected sign. The only exception is the RESM2 variable, which is also significant but does not have the expected sign. At first glance a positive relationship between reserves and the risk premium seems incomprehensible. The composition of the sample might well be responsible for this result. For most of the countries in the study it is largely unnecessary to accumulate foreign reserve assets without fear of losing investor confidence, either because their fundamentals are strong or because they themselves have a key currency (the United States and Japan, for instance).

The unexpected relationship between reserves and the risk premium does not dissolve even if the RESM2 variable is linked to the exchange-rate regime. In other words, if we assume that reserves are only important in connection with fixed-rate systems or quasi-fixed-rate systems, the positive relationship is still confirmed. The empirically determined relationship is even more strongly significant.

The empirical study of the simple basic model, with an R^2 of 0.83 ($R^2_{adj.}$ 0.82), already has a high goodness of fit. To that extent, a large portion of the country risk can be explained using only a small number of variables. The inclusion of additional variables increases the explanatory power of the regression only minutely. Still, a balance-of-payment surplus (LBBIP) and a dummy for EU membership (EU) – as expected – make a significant contribution to reducing the risk premium on money markets, as is shown in *Table 2*. The addition of both variables increases R^2 to 0.85 ($R^2_{adj.}$ 0.83).

Table 2: Determinants of the risk premium on international money markets (2)

Explanatory variable	***Parameter***	***Standard error***	***T statistic***	***Prob***
ZLZD	0.037	0.007	5.02	0.000
INFL (-1)	0.014	0.004	3.89	0.000
RESM2	0.002	0.001	3.01	0.003
WKFLEX	0.074	0.031	2.34	0.020
LBBIP	-0.004	0.002	-2.01	0.046
EU	-0.050	0.012	-4.04	0.000

3.2. Defining the determinants of capital controls

The model for explaining deviations from CIP when capital controls are in place incorporate the same variables as the basic model with free movement of capital, except that the signs are reversed. The economic explanation for this hypothesis of reversed signs, which intuitively appears to be surprising, is that capital controls imposed in reaction to an existing country risk have been made endogenous. The consequence is that foreign countries have a yield advantage, ie any risk premia having the opposite effect are overcompensated.[19]

The following regression is used to explain capital controls in the central and east European accession countries.

$$(5) \qquad \theta_{it} = \alpha + \gamma_1 \mathrm{ZLZD}_{it} + \gamma_2 \mathrm{INFL}_{it} + \gamma_3 \mathrm{RESM2}_{it} + \gamma_4 \mathrm{WKFLEX}_{it} + \varepsilon_{it}$$

In contrast to the preceding regression equation, a negative sign is now expected for γ_1, γ_2 and γ_4 and a positive sign for γ_3. That is to say, if the financial sector is increasingly being weakened, inflation is higher and reserves are insufficient, a tightening of capital controls may be expected. The significance of the exchange-rate regime cannot be determined ex ante since the individual systems have various advantages and disadvantages for the stability of the financial sector.

The study covers the relatively short period from the first quarter of 1999 to the fourth quarter of 2001 owing to a lack of available data. The results of the regression are shown in *Table 3*. However, due to the extremely small number of samples (only 44 observations in all), they are to be interpreted with caution.

Table 3: Determinants of capital controls in central and eastern Europe (1)

Explanatory variable	***Parameter***	***Standard error***	***T statistic***	***Prob.***
ZLZD	0.128	0.192	0.67	0.508
INFL	-0.163	0.065	-2.50	0.017
RESM2	-0.043	0.020	-2.19	0.035
WKFLEX	-1.814	0.690	-2.63	0.013

These estimates are likewise performed using Eviews 4.1 and Intercooled Stata 7. The conducted tests (see section 3.2.1) lead to the same results as those using the preceding sample. The only difference is that the Hausmann test rejects the null hypothesis which states that there are no systematic differences between the fixed-effect model and the random-effect model. Consequently, there must be a correlation between individual effects and other explanatory variables. The INFL was not lagged by one period because the sample was already very small.

With the exception of ZLZD all model parameters are significantly different from null and, in addition, have different signs – as expected – than the results for euro-area and industrial countries. To that extent, the presumed endogeneity of capital controls and the dominance of the primary effect of capital controls over the secondary effect are empirically confirmed. However, the spread between the lending rate and the deposit rate does not seem to be a significant determinant of capital controls although it was highly significant as an influencing factor in country risk.

RESM2 has the wrong sign as in the basic model with free movement of capital. That leads once again to the surprising relationship between higher reserves and an increase in capital controls. We receive the same results if we link RESM2 to the exchange-rate regime. That means the reserves have a positive and significant relationship to capital controls even in connection with a fixed-rate system or a mixed system. It does not appear very helpful to cite good fundamentals and the existence of key currencies as an explanation.

However, the transition phase these countries went through just before joining the EU, which entails more frequent changes in the exchange-rate regime, may serve to explain this phenomenon. A trend among accession countries towards taking on flexible exchange rates is being observed. The progress being made in the transformation process is undoubtedly

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[19] See Lemmen/Eijffinger (1996).

one factor. Another is that this trend might be promoted by the desire to join the EU and the attendant abolition of any remaining restrictions on capital movements. The higher-than-average stocks of foreign reserve assets held by countries which extensively regulated capital movements could then date back to periods where the currency was pegged, with no adjustment having been made to the new exchange-rate regime thus far. However, the relationship ultimately remains unclear.

As opposed to the empirical testing of the model for euro-area and further advanced industrial countries, the estimated results in this case can be improved considerably by replacing or adding variables. The goodness of the estimate increases substantially if, instead of ZLZD, the ratio of broad money (M_2) to GDP (M2BIP) is used as a status variable for the financial sector. This figure is often used as a measure of the size of the financial sector but says less about the efficiency of the banking sector.[20] However, as the reverse value of the velocity of the circulation of money, M2BIP corresponds to the cash holding coefficient and, as such, is a measure of economic agents' confidence in the domestic currency and the banking system. By including the debt ratio (DEBTBIP) as an additional determinant the explanatory value of the regression can be further increased (*see Table 4*). On the whole, an R^2 of 0.58 ($R^2_{adj.}$ 0.47) is achieved, in comparison with an R^2 of 0.43 ($R^2_{adj.}$ 0.30) for the underlying model.

Table 4: Determinants of capital controls in central and eastern Europe (2)

Explanatory variable	***Parameter***	***Standard error***	***T statistic***	***Prob***
M2BIP	3.469	0.768	4.52	0.000
DEBTBIP	-0.026	0.0090	-2.89	0.007
INFL	-0.130	0.027	-4.79	0.000
RESM2	-0.063	0.014	-4.55	0.000
WKFLEX	-2.338	0.677	-3.45	0.002

20 See Buch/Piazolo (2001), p 91 and Levine/Loayza/Beck (2000), p 37 f. However, the use of this variable as a measure of the development of the financial sector has its disadvantages, too. Lemmen/Eijffinger (1996, p 439 f), for instance, tend to think of it as a monetary variable which indicates potential inflation hazards.

Conclusion

We can sum up by saying that the money markets in the euro area and other advanced industrial countries are largely integrated internationally. In central and eastern Europe the remaining deficits do not pose a significant barrier to EU accession. Moreover, the exchange-rate premium for investments in central and eastern Europe seems to be much higher than within the EMU-11 prior to the establishment of monetary union or in the four industrial countries additionally included in the survey. That means immediate participation in ERM II could harbour the threat of speculative attacks against the new member countries' currencies. However, the development of accession expectations seems to go hand in hand with a stabilising influence on exchange-rate expectations.

The adjustment burden imposed on the financial sector by EU membership and the attendant complete liberalisation of capital movements could be reduced significantly by further developing the strength of the financial sector and by continuing to promote price stability. Moreover, econometric studies indicate that the reduction of current-account deficits and government debt can accelerate the integration of the money markets.

Annex: Data Sources

money market rates, 3 months	
EMU-11, IC-4,	end of period, BIS, code HEEA
CEE-4	end of period, Datastream
euro-currency market rates, 3 months	
EMU-11, IC-4	end of period, BIS, Code JFBA
spot exchange rates	
EMU-11, IC-4	exchange rates against US-$, end of period, BIS, code QBCA
MOE-4	exchange rates against Euro, end of period, Datastream
forward exchange rates, 3 months	
MOE-4	exchange rates against Euro, end of period, Datastream
inflation rates	
EMU, IC-4, Czech Republic, Hungary, Poland	costs of living, end of period, Deutsche Bundesbank
Slovak Republic	consumer price index, period average, IMF: International Financial Statistics, line 64
lending rates	
all countries	end of period, IMF: International Financial Statistics, line 60L
deposit rates	
all countries	end of period, IMF: International Financial Statistics, line 60L
international reserve	
all countries	all reserves minus gold, end of period, IMF: International Financial Statistics, Line 1L.d
money	
Austria, Belgium/Luxembourg, France, Ireland, Italy, Netherlands, Portugal, Spain	M3 - harmonised index, end of period, BIS, code ACKA
IC-4, Finland	M2 – national index, end of period, BIS, code ABUA
MOE-4	money + quasi-money, end of period, IMF: International Financial Statistics, lines 34+35
exchange rate regime	
all countries	Deutsche Bundesbank, Exchange Rate Statistics, Statistical Supplement to the Monthly Report 5

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