Deutsche Bank Research

The CEE-4 heading towards the euro

Are the CEE-4 currencies fundamentally undervalued?

September 6, 2005

In the race towards the euro, the four large Central and Eastern European new EU members (CEE-4) – Poland, Hungary, Slovakia and the Czech Republic – will soon enter the home stretch. The potential parities of the zloty, the forint and the koruna versus the euro are of decisive importance not only for economic policy but also for companies and financial markets.

Despite the rising importance of this issue, there continues to be uncertainty as to the real over- or undervaluation of the CEE-4 currencies. Our paper presents an exchange-rate model that examines the competitiveness of these economies in the EU's single market on the basis of euro wage levels in manufacturing.

We initially estimate the correlation between productivity and the euro wage level for the EU-15 countries. In a second step we enter the CEE-4 data in the equation and calculate the equilibrium wage level. In doing so, we arrive at the euro wage level these countries could afford in light of their factor endowment if they wish to remain competitive in the single market.

Our estimates suggest continuous undervaluation of the CEE-4 currencies. Even though the productivity gap between the EU-15 and the new members is large, it is apparently not as large as implied by the current exchange rates. Poland, Slovakia and the Czech Republic exhibit in this sense an undervalued real exchange rate versus the euro. Only the Hungarian forint has reached its equilibrium level over the last few years in the course of substantial wage increases.

Our main finding of a real undervaluation is compatible with the CEE-4's ongoing attractiveness for foreign investors. The competitive positions of Poland, Hungary, Slovakia and the Czech Republic in the single market remain strong at the current real exchange rate levels.

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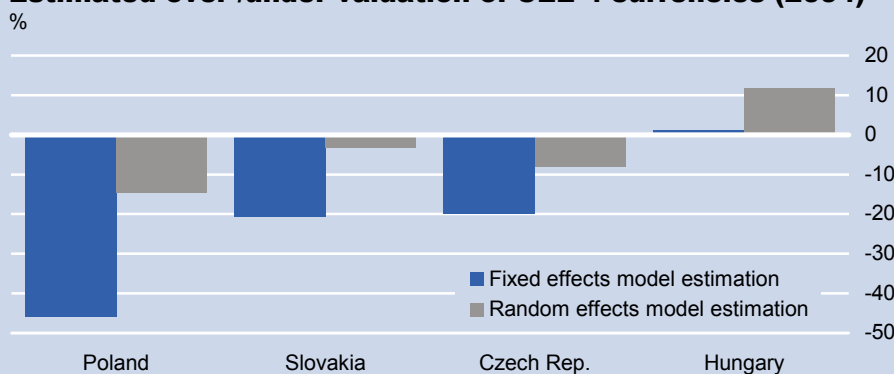+49 69 910-31815
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Estimated over-/under-valuation of CEE-4 currencies (2004)*
%

■ Fixed effects model estimation
■ Random effects model estimation

Poland Slovakia Czech Rep. Hungary
* Negative readings suggest undervaluation

Source: Deutsche Bank Research

**Poland:
Nominal exchange rate**

PLN/EUR

Source: ECB **1**

**Hungary:
Nominal exchange rate**

HUF/EUR

Source: ECB **2**

**Slovakia & Czech Republic:
Nominal exchange rates**

SKK/EUR

CZK/EUR

Source: ECB **3**

Real effective exchange rate*
1995=100

Czech Republic
Hungary
Poland
Slovakia

* A rising real effective exchange rate
corresponds to an appreciation of the currency

Source: OECD Main Economic Indicators **4**
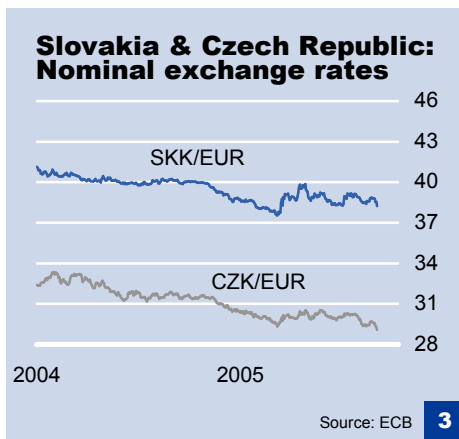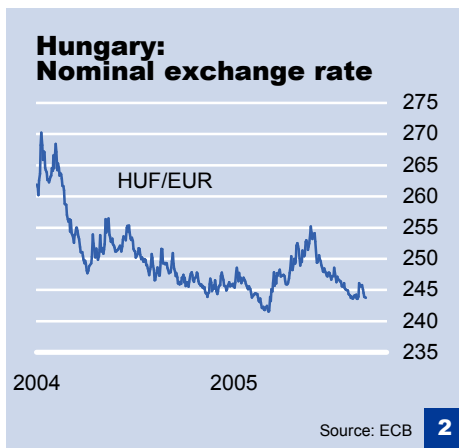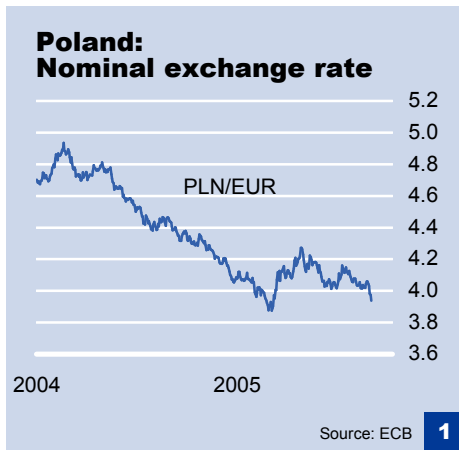
Heading towards the euro, the four large new Central and Eastern European EU members – the Czech Republic, Hungary, Poland and Slovakia – will soon enter the home stretch. They will follow the lead of the smaller accession countries from Central and Eastern Europe (CEE) – Slovenia and the Baltic states (as well as Cyprus and Malta) – which have already joined the European Exchange Rate Mechanism (ERM II) and pegged their currencies to the euro.

The potential parities of the zloty, the forint and the koruna versus the euro are of decisive importance not only for economic policy but also for companies and financial markets. As a result of the peg to the EUR, the exchange rate can no longer be used as a macro-economic adjustment tool. An overvalued real exchange rate would strongly restrict the CEE countries' competitiveness in the single market. Moreover, on signs of untenable overvaluation there would be considerably higher risk to exchange-rate stability in the ERM II. Neither, however, would a real undervaluation of a currency vis-à-vis the euro be free of risks – over the medium term regarding fulfilment of the inflation criterion by the accession countries, and over the long term regarding the convergence of inflation rates in the euro area.

Despite the rising importance of this issue, there continues to be uncertainty as to the real over- or undervaluation of the CEE-4 currencies. Some of the key indicators send conflicting signals: export growth in the region is basically robust but massive current account deficits could point to an overvaluation of the currencies. The development of (inflation-adjusted) real effective exchange rates also sheds little light on the absolute degree of over- or under-valuation as it is difficult to identify a suitable base year.

This paper presents an exchange-rate model which focuses on the price competitiveness of exporters from the CEE-4. We estimate a real equilibrium exchange rate versus the euro on the basis of the euro wage level in manufacturing. The results suggest that the currencies are and will continue to be undervalued for some time, which puts the CEE-4 in an excellent competitive position.

## Exchange-rate models send conflicting signals

In the case of the CEE currencies, standard exchange-rate models are of limited use. Both fundamental equilibrium exchange rate (FEER) models and behavioural equilibrium exchange rate (BEER) models define the real effective equilibrium exchange rate as the exchange rate yielding internal and external equilibrium simultane-ously. In these models, internal equilibrium is conceived to be non-inflationary growth at full employment in line with the growth potential. External equilibrium is achieved if the exchange rate brings the current account balance in line with the long-term capital account. Such equilibrium models[1] depend on three critical assumptions:

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[1] In econometric terms this means that the critical measures for potential growth and external equilibrium are to be assumed given or to be identified in separate estimations. So a typical FEER model takes the following form: $CA = b_0 + b_1 q + b_2 y_d + b_3 y_f = -KA$. Behavioural models (BEER) resemble the FEER models but add short- to medium-term factors, first of all interest rate differentials and cyclical factors: $Q_t = b_1 Z1_t + b_2 Z2_t + T_t + e_t$. Here, vectors Z1 and Z2 refer to long-term (Z1) and medium-term (Z2) economic variables which influence the real effective equilibrium exchange rate, while T stands for transition factors whose impact on the exchange rate is only of a temporary nature (e_t is an error term). In such a model the real exchange rate can be compared with the current (i.e. reflecting both long-term and cyclical factors) equilibrium exchange rate.

Export growth (2004)
% yoy
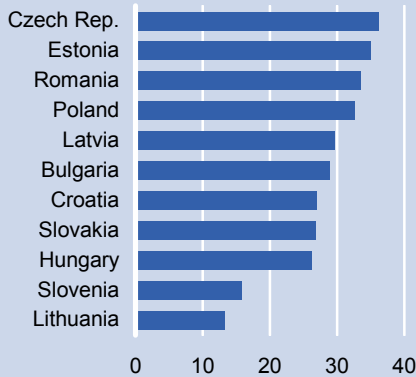
Sources: IMF, Deutsche Bank Research **5**

— A current account model with the corresponding exchange rate elasticities can be specified.

— Potential growth can be estimated with sufficient accuracy.

— The optimal capital account position over the medium- and long term can be identified.

In reality, however, transition countries such as the CEE-4 do not meet these preconditions. There are only short time series available and they exhibit structural breaks. Estimating the real exchange rate elasticity of individual current account positions, though, is only possible on the basis of long time series. What's more, such an estimate requires key variables, such as potential growth and the sustainable level of the current account deficit, to be derived exogenously. So it comes as no surprise that the results derived using such models depend strongly on the underlying assumptions and that studies frequently arrive at contradictory results. Table 6 shows the high divergence of results which is difficult to interpret.

Studies show high divergence of results

Currency	Authors	Period	Over-/undervaluation of currencies*
Zloty	Égert und Lahrèche-Révil (2003)	2001: Q2	Eff.**: +11%
	Rubaszek (2003)	2001: Q2	Eff.**: +16%
	Rawdanowicz (2003)	2002	Eff.**: +/-0%
	Smídková et al. (2003)	2002	Eff.**: +10% - +12%
	Alberola (2003)	2002: Q4	Eff.**: -10%
	Rubaszek (2003)	2002: Q4	Eff.**: +4.3%
Forint	Smídková et al. (2003)	2002	Eff.**: +6%
	Csajbók (2003)	2002	Eff.**: +3% - +10%
	Rahn (2003)	2002: Q1	Eff.**: -3% - +5%
Czech koruna	Lommatzsch und Tober (2002)	2001	Eff.**: +/-0% - +15%
	Égert und Lahrèche-Révil (2003)	2001: Q1	Eff.**: +15%
Slovak koruna	Égert und Lahrèche-Révil (2003)	2001	EUR***: +10%
	Égert und Lommatzsch (2003)	2002: Q4	EUR***: +10 - +15%

*　Positive readings suggest overvaluation, negative readings undervaluation versus the estimated equilibrium exchange rate.
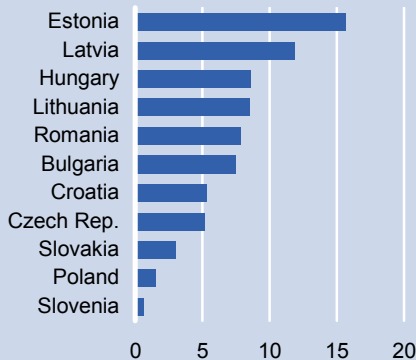**　Over-/undervaluation versus real effective exchange rate.
***　Real over-/undervaluation versus EUR.

Source: Deutsche Bank Research **6**

Current account deficit (2004)
% of GDP

Sources: IMF, Deutsche Bank Research **7**

Euro wages and competitiveness in the Single Market

In this study, we have chosen a different approach: we examine the competitive position of the CEE-4 economies in the EU Single Market on the basis of euro wage levels in manufacturing. Professionals and market participants often base their statements about the international competitiveness of economies and/or the over- or undervaluation of their currencies on the wage level in these countries. We use the euro wage level in manufacturing as proxy for the real equilibrium exchange rate versus the euro. If wage costs (in EUR) are higher than permitted by the level of productivity in the CEE economies, this suggests an overvaluation of the currency. Currency devaluation – or politically untenable wage cuts – would be required to return to competitiveness.

We start by estimating the correlation between productivity and the euro wage level for the EU-15 countries. The EU-15 is a suitable control group, as they are direct competitors of the CEE-4 in the

Methodology

Estimating medium-sized panel data set models, heterogeneity of the sample generally poses a problem. We aim to solve this problem by only including countries from the same common economic area, i.e. the EU-15. Moreover, individual observations in panel estimations are not independent of one another, so a central assumption in standard OLS-estimations (ordinary least squares) is violated. Also, there is serial and spacial correlation of error terms and hetero-skedasticity. These problems are taken care of by using the PCSE-estimator (panel corrected standard errors). The model would still be problematic if the variables were non-stationary, i.e. followed a trend with merely random deviations – not an unrealistic assumption in observing wage levels over a period of twelve years. The unit root test (ADF test), however, proves the absence of non-stationarity. Nonetheless, this model exhibits serially correlated errors – a problem we seek to counter by means of a Prais-Winstem transformation.

$$w_{it} - \rho w_{it-1} = a + \beta_1(\ln \mathrm{gdp}_{it} - \rho \ln \mathrm{gdp}_{it-1})$$
$$+ \beta_2(\ln \mathrm{sch}_{it} - \rho \ln \mathrm{sch}_{it-1}) + \beta_3(\ln \mathrm{agr}_{it} - \rho \ln \mathrm{agr}_{it-1})$$
$$+ \beta_4(\ln \mathrm{pom}_{it} - \rho \ln \mathrm{pom}_{it-1}) + \beta_5(\mathrm{rol}_{it} - \rho \mathrm{rol}_{it-1})$$
$$+ \beta_6(\exp_{it} - \rho \exp_{it-1}) + \beta_7(\mathrm{fdi}_{it} - \rho \mathrm{fdi}_{it-1})$$
$$+ \beta_8(\ln \mathrm{ope}_{it} - \rho \ln \mathrm{ope}_{it-1}) + \beta_9(\mathrm{oec}_{it} - \rho \mathrm{oec}_{it-1})$$
$$+ \beta_{10}m_i + u_{it} - \rho u_{i-1}$$

ρ represents the estimated auto-correlation coefficient. On the basis of this estimation for the EU-15, the CEE wage level is forecast out of sample.

Estimation results*

Dependent var.: monthly wages in EUR

	Coefficient	P-value
GDP per capita in PPP	0.63	0.00
Human capital	0.11	0.27
Agriculture (% of GDP)	-0.10	0.14
Telephone lines (per 1000 inhabitants)	0.09	0.56
Rule of law	0.41	0.18
Government expenditure (% of GDP)	0.05	0.88
Direct investment (stock)	0.00	0.61
Degree of openness	-0.23	0.00
OECD dummy	0.90	0.44
R&D spending (% of GDP)	0.10	0.01

* random effects estimation
RE GLS regression with AR(1) term, R² = 0.60
Observations = 183, Groups = 15

Source: Deutsche Bank Research **8**

Single Market. Economic structures in these countries are relatively similar, so heterogeneity in the sample is low.

In a second step we enter the accession countries' data in the equation and calculate their equilibrium wage levels. We then compare the estimated values with the actual wage levels in the CEE and interpret the deviations as over- or undervaluation of the currencies.[2] Euro wages in manufacturing are thus considered to be a measure of the real exchange rate vis-à-vis the euro.

Our estimates therefore show the euro wages that the CEE-4 can "afford" in light of their level of productivity if they want to remain competitive in the Single Market. This approach has the advantage that wages – as opposed to prices – can directly be measured and compared in monetary terms. Moreover, the correlation between wage levels and an economy's competitive position – as opposed to theoretical exchange-rate concepts such as the internal and external equilibrium – can easily be explained to politicians, market partici-pants and the general public.[3]

First of all, we must identify the economic determinants of wage levels. International wage differences are attributable to the econo-mies' differing physical and human capital endowment as well as their technological potential – and to how effectively these factors are combined. As a rule, factor availability is hard to measure directly. But some robust standard proxies have been established that we use in our estimate: gross domestic product per capita or per employee (in purchasing power parities) is the most compre-hensive measure of productivity. Human capital endowment is approximated by means of average length of school enrolment. The share of agriculture in GDP acts as indicator of economic development, while the share of R&D spending in GDP and the accumulated stock of foreign investment in relation to GDP reveals differences in technological potential. In order to cover the quality of the institutional environment we use the "rule of law" indicator from the World Bank governance indicators. By including the number of telephone lines per inhabitant, we also take differences in infra-structure into consideration. Finally, we look at the degree of open-ness of the economy and the government spending ratio as potentially important factors determining the wage level.

We integrate these variables into two different panel models – a random and a fixed-effects model. Both models have specific advantages and disadvantages. As a result, the parallel estimation of both models allows us to examine the robustness of our results: the random-effects model is based on the assumption that there is no correlation between included and excluded variables but considers potential heteroskedasticity. We include in this estimation

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[2] This is not a new approach. It was already applied by Halpern and Wyplosz (1997) as well as Krajnyák and Zettelmeyer (1998). The findings included one of the most important and most well-known "stylised facts" of the transition process: an initially pronounced undervaluation in real terms of the Eastern European currencies.

[3] A disadvantage, though, is the fact that problems of differentiation and conversion render it more difficult to compare international wage data. In a monthly com-parison of national wages the first thing that catches the eye is strongly diverging working hours in the individual countries. One must also differentiate between paid and unpaid overtime and take account of obligatory or voluntary special pay components such as Christmas and holiday bonuses. We have used data from the US Bureau of Labor Statistics, the International Labour Organisation (ILO), national sources and the WIIW. With the help of data from Universiteit Groningen, hourly wages were converted into monthly wages on the basis of hours worked per month.

Estimation results*

Dependent var.: monthly wages in EUR

	Coefficient	P-value
GDP per capita in PPP	0.65	0.00
Human capital	0.10	0.17
Agriculture (% of GDP)	-0.09	0.29
Telephone lines (per 1000 inhabitants)	0.13	0.34
Rule of law	0.15	0.58
Government expenditure (% of GDP)	-0.39	0.25
Direct investment (stock)	0.00	0.57
Degree of openness	-0.34	0.00
OECD dummy	0.97	0.40
R&D spending (% of GDP)	0.04	0.44

* fixed-effects estimation, country constants not shown
PCSE regression with AR(1) term, R^2 = 0.99
Observations = 183, Groups = 15

Source: Deutsche Bank Research **9**

Wages between 1993 and 2004

EUR/month
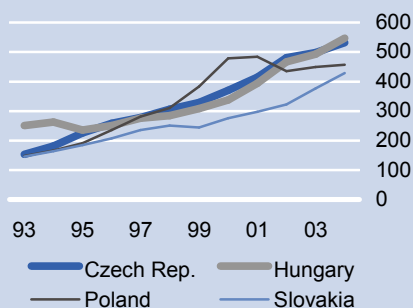
Source: Deutsche Bank Research **10**

Wage estimates Poland 1993-2004

EUR/month
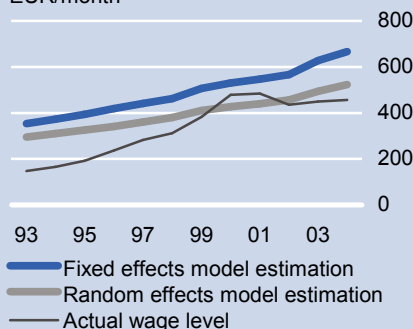
Source: Deutsche Bank Research **11**

a dummy variable for the EU-15 countries, which is to capture potential structural differences between old and new EU members. In the fixed-effects model, we estimate a separate y-intercept for each country in order to exclude potential omitted variable bias. This, however, gives rise to the question which of the 15 separate country-specific constants should be used to predict the adequate wage level in the accession countries. We use the lowest country-specific constant out of the estimate for the EU-15 (i.e. that for Portugal) and thus implicitly assume that an overvaluation of the CEE currencies would create a greater problem than an under-valuation.

The estimates show a robust economic relationship between the wage level and the explanatory variables. Wage levels rise in line with the level of productivity and human capital, technological potential, the stock of foreign direct investment (FDI) as well as the quality of infrastructure and the institutional environment. On the contrary, a high degree of openness and a large share of agriculture in GDP lead – ceteris paribus – to lower wages. On the basis of this equation we can now determine the suitable euro wage level in the CEE-4.

Extrapolation of a suitable euro wage level

In the course of increases in real wages, euro wages in Central and Eastern Europe have risen continuously over the last ten years. Our estimates reveal, however, that these wage increases lag behind the massive increases in productivity, so the CEE-4's favourable com-petitive position remains unchanged. Both model estimates show that the initial undervaluation is still in place. We therefore confirm the stylised fact of an initial strong undervaluation of the CEE currencies already discussed by Halpern and Wyplosz (1997).

Our estimates suggest that the CEE-4 currencies continued to be undervalued in 2004. Poland and Slovakia, in particular, exhibit a markedly undervalued real exchange rate versus the euro. The Czech koruna also seems undervalued – albeit to a smaller degree. Only the Hungarian forint has reached its equilibrium level (accor-ding to the fixed-effects estimate) over the last few years in the course of substantial wage increases or even markedly exceeded it (according to the random-effects estimate).

— Poland: Following the zloty's extraordinary strength in 2001 which led to a slight overvaluation, the currency has weakened again. This is also evident in our estimates. Our random-effects estimate shows the zloty to be undervalued by roughly 15%, while the undervaluation is as high as 40% in the fixed-effects estimate.

— Slovakia: On a euro basis, monthly wages in Slovakia have doubled over the past eight years. The undervaluation versus the euro has been reduced step-by-step but is still substantial at 20% according to the fixed-effects estimate. According to the random-effects estimate, however, the equilibrium exchange rate was reached in 2004.

— Czech Republic: Even though the koruna came considerably closer to its equilibrium exchange rate during the last ten years, both models still show an undervaluation of 8% and 20%, respectively, for the year 2004.
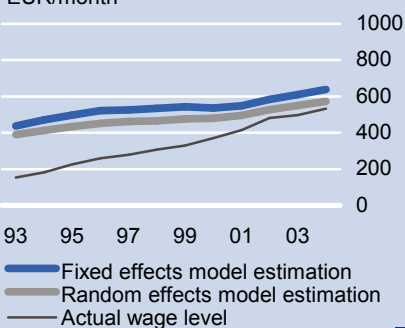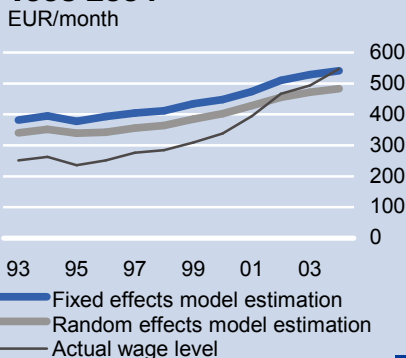
Wage estimates Slovakia 1993-2004
EUR/month

Fixed effects model estimation
Random effects model estimation
Actual wage level
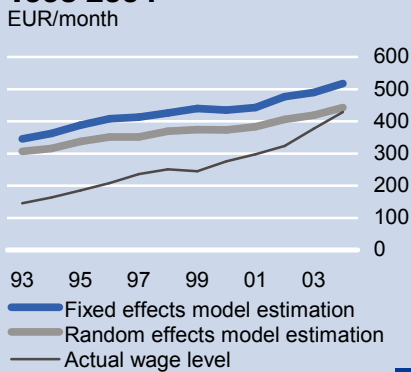
Source: Deutsche Bank Research **12**

Wage estimates Czech Republic 1993-2004
EUR/month

Fixed effects model estimation
Random effects model estimation
Actual wage level

Source: Deutsche Bank Research **13**

Wage estimates Hungary 1993-2004
EUR/month

Fixed effects model estimation
Random effects model estimation
Actual wage level

Source: Deutsche Bank Research **14**

Estimated over-/under- valuation of CEE-4 currencies (2004)*
%

Fixed effects model estimation
Random effects model estimation
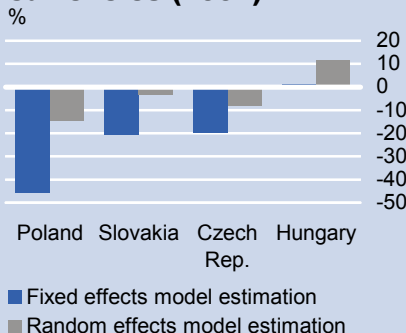
* Negative readings suggest undervaluation

Source: Deutsche Bank Research **15**

— Hungary: The pronounced wage increases since 2001 have left their mark on Hungary's competitiveness. Starting in 2002, our random-effects estimates point to an overvaluation of the forint, which rose to 12% up to 2004. The fixed-effects model, too, shows that Hungary's competitiveness has suffered markedly over the past few years and that the forint was already slightly overvalued on a 2004 annual average.

Based on this calculated under-/overvaluation in 2004, "fair" euro parities can be determined. In doing so, we assume that actual exchange rates will approach the calculated equilibrium exchange rate in the remaining two to three years before ERM II entry. Our random-effects model arrives at the following equilibrium exchange rates versus the euro: the zloty at 3.86/EUR, the forint at 280/EUR, the Czech koruna at 29.4/EUR and the Slovak koruna at 38.8/EUR. So the main result is that – with the exception of Hungary – the CEE-4 currencies are in a good competitive position at their present levels, particularly as the fixed-effects model suggests an even stronger undervaluation. Also, this extrapolation is based on the assumption that the productivity differential between the EU-15 and the new members will remain constant during the above mentioned period. Especially in the case of Slovakia, however, the large-scale foreign direct investment attracted over the last few years could still lead to massive productivity increases and thus to a higher equilibrium exchange rate.

The simulations are subject to several imponderables, though, and should not be regarded as spot-on forecasts. The confidence intervals in the out-of-sample projections are relatively large. More-over, it is important to note that the chosen variables can only be inadequate approximations of the true situation. So it is possible that the relatively high level of human capital in the accession countries – measured by the average length of school enrolment – takes only insufficient consideration of the quality of education. "Soft" factors – such as the power of trade unions or differences in work ethic – are not considered at all in the model. For all these reasons, too much should not be read into the simulations.

Conclusions

A large majority of factors suggest continued undervaluation of the CEE-4 currencies. This was confirmed by numerous sensitivity tests. Even though the productivity gap between the EU-15 and the new members is large, it is apparently not as large as implied by the current exchange rates. The CEE currencies' initial undervaluation is more persistent than assumed by many people.

Our main finding of a real undervaluation is compatible with the CEE-4's ongoing attractiveness for foreign investors. In light of the empirical results regarding the CEE-4's competitiveness, not only policy-makers and companies operating in these countries but also financial market participants can be relaxed about future prospects such as membership in ERM II and European Monetary Union.

At the current exchange-rate levels, the CEE-4's competitive position in the single market seems safe. There is reason for concern, however, for producers in the EU-15 as they will have to wrestle with the advantage enjoyed by the new member states for the foreseeable future.

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