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How Far Has Trade Integration Advanced?: An Analysis of the Actual and Potential Trade of Three Central and Eastern European Countries[1]

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We examine the development of potential and actual trade in the Czech Republic, Hungary, and Poland, using the gravity model for trade as an analytical device. However, recent literature indicates that the point estimates of the gravity equation for estimating trade potential are highly uncertain. Hence we base our conclusions on the concept of speed of convergence to potential trade. Examining only the dynamics of actual and potential trade is less dependent on the estimation methodology. Using panel error-correction models we find significant convergence to the estimated potential trade. We also give an explanation for the differences in the speed of convergence among the three countries based on the product-structure of exports and the effects of foreign direct investment. The conclusions drawn from our measure of the speed of convergence are robust across diverse estimation methodologies. *J. Comp. Econ.*, June 2001, **29**(2), pp. 276–292. Economics and Research Department, National Bank of Hungary, H-1850, Budapest, Szabadság tér 8/9, Hungary. © 2001 Academic Press

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1. INTRODUCTION

This paper investigates the equilibrium level of trade of three Central and Eastern European (CEE) countries, the Czech Republic, Hungary, and Poland, by taking the gravity approach to model trade relations. Foreign trade data from 1990 to 1997 for 53 developed and nondeveloped economies are used to assess the trade performance of these countries. Employing different pooled and panel techniques, we examine the robustness of the equation for different estimation methodologies. We compare our results to more recent estimates by Gros and Gonciarz (1996) and Breuss and Egger (1999), who base their conclusions for trade potential on data from the early 1990's. In order to obtain more robust conclusions, we define a measure of convergence that is quite robust across different estimation methodologies, and we prove that there is significant convergence to the estimated equilibrium relationship using a panel error correction method. We analyze trade relations not just between the EU and the CEE countries, but also among the CEE countries and several different regions to get a more accurate picture of trade reorientation in the 1990's.

Our measure of convergence indicates that there has been a clear reorientation of trade from east to the west after 1993 in the Czech Republic and Hungary, which contradicts earlier studies projecting constant EU trade shares after 1992, as in Gros and Gonciarz (1996), or after 1994, as in Brenton and Gros (1997). With respect to Poland, however, trade reorientation is not so obvious. This is explained by changes in the product structure of exports and also by the different intensity and structure of FDI undertaken in these countries. The paper is organized as follows. Section 2 discusses the theory of, and the theoretical debate surrounding, the gravity equation and gives a brief summary of earlier empirical works. Section 3 presents and interprets our results. Section 4 offers conclusions.

2. THEORETICAL BACKGROUND AND EARLIER EMPIRICAL WORK

To analyze potential trade flows, we use the gravity equation. In its simplest form, this equation expresses bilateral trade flows across pairs of countries and has, as explanatory variables, the income and population of both trading partners and the distance of their economic centers. Additional explanatory variables are included depending on the assumptions that are made concerning various market structures.

The gravity equation performed quite well in analyzing international trade flows as early as the 1960's. However, strong theoretical foundations were not produced until the 1980's, in the work of Bergstrand (1985), Helpman and Krugman (1985), and Bergstrand (1989), from which it became obvious that the gravity equation is an appropriate representation irrespective of the structure of product markets. There is still an ongoing debate in the theoretical literature concerning whether or not the gravity equation can distinguish between different models of trade, e.g., models of monopolistic competition with differentiated goods and Hecksher–Ohlin (H–O) models. We show that the gravity equation is consistent with several assumptions regarding the structure of both product and factor markets, i.e., neither increasing returns nor monopolistic competition is a necessary condition for its use.

The original justification for the gravity equation is based on a partial equilibrium model of export supply and import demand by Linnemann (1966). The gravity equation turns out to be a reduced form of this model under some simplifying assumptions. However, many authors, e.g., Bergstrand (1985), argue that this partial equilibrium model could not explain the multiplicative form of the equation and also left some of its parameters unidentified. Linnemann's justification excludes prices, which is consistent with the simplest form of the equation, and Bergstrand (1985) claims that this is the main reason for the unidentified nature of some parameters. Bergstrand's attempt at a theoretical justification for the gravity equation is a model with products differentiated nationally by monopolistic competition. He develops a general equilibrium model of world trade with N countries, one aggregate tradable good, one domestic good, and one internationally immobile factor of production in each country. Examining the resulting N^2 equilibrium conditions leads to a reduced form expression for the bilateral flow of goods across pairs of countries. Assuming that these flows are small relative to the sum of all bilateral trade flows and that preferences and technology are identical for all countries, the resulting reduced form of the model can be interpreted as the generalized gravity equation, containing price variables.

Bergstrand (1989) extended this model by adding production with monopolistic competition among firms that use labor and capital as factors of production. Thus, firms produce differentiated products under increasing returns-to-scale. After some simplifying assumptions, Bergstrand again derives the general form of the gravity equation. Among the explanatory variables are now the importing country's tariff rates on its partner's exports, the bilateral exchange rate, and the appropriate price variables. The price and exchange rate variables can be omitted only when products are perfect substitutes for one another in consumer preferences and when they can be transported costlessly between markets. However, this structure takes us to the standard H–O setting.

Deardorff (1995) also argues that the H–O model is consistent with the gravity equations. If trade is frictionless and producers and consumers are indifferent, and if markets are settled randomly among all possibilities, gross trade flows will follow a gravity equation with distance and prices playing no role. He proves that, if trade is impeded and each good is produced by only one country, the H–O framework will result in the same bilateral trade pattern as the model with differentiated products. It can be shown that, if there are transaction costs of trade, distance should also be included in the gravity equation. Evenett and Keller (1998) also show that the standard gravity equation can be obtained from the H–O model with both perfect and imperfect product specialization. Hence, some assumption different from increasing returns-to-scale is responsible for the empirical success of the model.

Feenstra et al. (1998) develop a model that incorporates both homogenous and differentiated goods. The markets for homogenous goods are described by a reciprocal dumping model with Cournot–Nash competition. The common feature of differentiated and homogenous goods is that a home-market effect can be observed in both markets. Larger countries tend to be exporters of certain products, since the larger market attracts firms to locate there. Their theoretical model suggests that the home-market effect should be larger for differentiated goods. This implication can be tested empirically and the results support the conjecture.

Hummels and Levinsohn (1993) test for the relevance of monopolistic competition in international trade, using intraindustry trade data. Their results suggest that much of intraindustry trade is specific to country-pairings; they conclude that actual factor data are not able to explain the volume of intraindustry trade. Hence, their work supports a model of trade with monopolistic competition.

Therefore the empirical success of the gravity equation in explaining the country structure of trade is the result of neither monopolistic competition nor the new trade theory. It can be derived by assuming either perfectly competitive or monopolistic market structures. As regards the latter, relative prices and the exchange rate should be included among the variables in the equation.

As an analytical device for economic policy in the CEE countries, the gravity equation attracted attention in the early 1990's. With the collapse of the former trade bloc of CEE economies, the Council for Mutual Economic Assistance (CMEA) naturally raised the question of where and to what extent trade should be redirected. Wang and Winters (1991) and Baldwin (1993)[2] use the gravity model to address these questions.

Both studies estimate a barter-type gravity equation, i.e., an equation without price and exchange rate variables. Wang and Winters (1991) argue that the inclusion of price terms is inconsistent with the long-term nature of the model and that there is a measurement problem with prices, because price indices are only very crude proxies for price levels. Their first claim is not justified in the light of the theoretical considerations presented above. Price and exchange rate variables can be excluded only if the different elasticities of substitution and transformation are infinite. However, this should be tested. Wang and Winters (1991) estimate the gravity equation on data from 1985 for 76 countries. Baldwin (1993) updates the sample with 12 countries and estimates the equation for 1989. Both studies find high integration potentials for the three CEE countries vis-à-vis Western European economies. At the same time, Baldwin's estimates are somewhat lower than those of Wang and Winters (1991), which may be partly due to the different GDP data used.

[2] A third study dealing with the estimation of potential trade between Eastern Europe and the west is Collins and Rodrick (1991). Instead of a gravity model, these authors employ a special estimation technique (Baldwin, 1993). Despite using a different technique, their results are consistent with those of Wang and Winters (1991).

A more recent study by Gros and Gonciarz (1996) comes to substantially different conclusions. Based on estimates of data from the early 1990's, they find that the CEE countries have nearly exhausted, or even out-performed, the trade potential implied by the gravity equation. This is usually explained by the fact that Baldwin's earlier estimates are based on purchasing power parity GDP data, which overestimates the trade potential by a factor of three or four. Furthermore, the earlier studies do not take into account the effect of rapid trade liberalization, which made the adjustment toward equilibrium much faster than expected. Breuss and Egger (1999) compute the prediction error of the gravity equation. Their conclusion is that the 95% forecasting intervals around the point estimate are about ±350%, which makes any conclusion about the level of potential trade irrelevant.

3. ESTIMATION

Similarly to earlier studies mentioned above, our study is an analysis of bilateral trade flows across pairs of countries, so the gravity equation takes the form

$$X_{ij} = \alpha Y_i^{\beta_1} L_i^{\beta_2} Y_j^{\beta_3} L_j^{\beta_4} D_{ij}^{\beta_5} A_{ij}^{\beta_6}, \tag{1}$$

where X_{ij} is the dollar value of the flow of goods from country i to country j; Y_k and L_k ($k = i, j$) are nominal GDP in current U.S. dollars and population in k, respectively; D_{ij} is the distance between the capital cities of i and j, and A_{ij} contains any other factors that promote or hinder trade between i and j. With this specification, typical parameter estimates for β_1 and β_3 are positive, while those for β_2, β_4, and β_5 are negative. The sign of β_6 depends on whether the factors in A_{ij} promote or hinder trade.

We estimate Eq. (1) using trade flows for 53 countries (28 of which are OECD countries) from 1990 to 1997. In A_{ij}, we include the bilateral exchange rate, export and import prices, and dummies representing other trade-promoting and trade-impeding factors, e.g., common border and language and participation in trade integration. The detailed description of data and their sources can be found in Appendix A. We apply three different estimation methodologies, pooled estimation, random effects estimation, and fixed effects estimation proposed by Mátyás (1997). Results appear in Table 1. The first two columns contain parameter estimates from generalized least-squares regression on pooled data, with both nominal and purchasing power parity (PPP) GDP taken into consideration. In the same manner, the third and fourth columns contain parameter estimates from random effects estimation, while the last two columns are the ordinary least-squares estimates using Mátyás's fixed effects estimation method.

In general, the parameters are signed correctly and are in the range expected from previous studies. The only exceptions are the EFTAEU and NAFTA dummies in the pooled estimation, and the CEFTA variable in the fixed effect estimation.

Although expected to be positive, these are negative and significant.[3] Nevertheless, from these six regressions, we choose the pooled estimation with current U.S. dollar GDP as a basis for further analysis, for the following reasons. Gros and Gonciarz (1996) argue that, while PPP GDP is a good measure to compare the wealth or the economic potential of a country, the amount of goods and services that it can purchase or supply through international trade depends on GDP based on the actual nominal exchange rate, hence, the choice of nominal GDP. Concerning the choice between estimation methods, the Hausman test rejected the null-hypothesis of no correlation between the regressors and individual effects at a 1% significance level in the case of the random effects estimation. Therefore, we applied instrumental variable estimation using the first differences of the explanatory variables as instruments. Unfortunately, these instruments proved to be very poor and resulted in unreasonable and largely insignificant coefficients. Thus, we do not think that the random effect estimates are reliable enough. The fixed effect estimation based on Mátyás (1997) was also ruled out. The parameters were substantially different from those produced with the other two methods, because a large component of the variance in the dependent variable could be explained by local and target country dummies. The coefficients of the other two estimation results were quite similar to each other and to the findings of other empirical researchers, e.g., Wang and Winters (1991), Baldwin (1993), Baldwin (1994), and Breuss and Egger (1999). However, the Mátyás (1997) type estimates differed considerably. This explains our choice of using the pooled estimation with nominal GDP.

Before proceeding, we make a few comments on the reliability of our estimates. As mentioned earlier, Breuss and Egger (1999) show that the point estimates of the gravity model are highly unstable. However, we argue that our estimation results are reliable and stable, if we use the dynamics characterizing potential trade rather than the point estimates for our analysis. Decomposing the total variance of the prediction error of the equation to the contribution of the residual uncertainty and the effect of parameter instability results in the formula (Greene, 1997, p. 369)

$$\mathrm{Var}(e^0) = \sigma^2 + x^{0\prime}(\sigma^2(X'X)^{-1})x^0, \tag{2}$$

where σ^2 is the residual uncertainty, i.e., the theoretical uncertainty of the model, which can not be decreased by increasing the sample size, and $x^{0\prime}(\sigma^2(X'X)^{-1})x^0$ is the parameter instability component, which is the estimation uncertainty of the parameters. The latter converges to zero as the sample size increases.

[3] We tried different formulations and found that the EFTAEU variable was negative in most of them. When we restrict our sample to OECD countries only, the parameter of the EFTAEU variable is positive. This implies that non-OECD, presumably Asian, countries shift trade potential to a higher level through the whole equation, as they trade more intensively than other countries. The NAFTA variable was insignificant in most cases and seemed to be unstable. We made no further efforts to correct the sign of the CEFTA parameter in the fixed effects estimation, since that method produced controversial parameters.

TABLE 1
Estimation Results, Dependent Variable: $TRADE_{ij}$ (Standard Errors in Parentheses)[a]

	Model estimated					
	GLS (cross-section weights), common constant		GLS, random effects		OLS, fixed effects based on Mátyás (1997)[b]	
Estimation method	With GDP	With GDP PPP	With GDP	With GDP PPP	With GDP	With GDP PPP
Constant	−23.947***	−35.097***	−23.136***	−35.695***	11.858	3.030
	(0.143)	(0.173)	(0.512)	(0.657)	(7.884)	(7.728)
GDP in	0.971***	—	0.755***	—	0.274***	—
country i	(0.003)	—	(0.017)	—	(0.074)	—
GDP in	0.837***	—	0.862***	—	0.401***	—
country j	(0.003)	—	(0.017)	—	(0.079)	—
GDP PPP in	—	1.610***	—	1.475***	—	0.933***
country i	—	(0.006)	—	(0.031)	—	(0.110)
GDP PPP in	—	1.389***	—	1.522**	—	0.892***
country j	—	(0.006)	—	(0.031)	—	(0.112)
Population in	−0.099**	−0.756***	0.093***	−0.625***	−1.168***	−1.994***
country i	(0.003)	(0.006)	(0.022)	(0.032)	(0.389)	(0.417)
Population in	0.003	−0.555***	0.008	−0.670***	0.505	0.048
country j	(0.004)	(0.006)	(0.021)	(0.032)	(0.391)	(0.413)
GDP–deflator in	−0.967***	−0.604***	−0.324***	−0.142***	−3.84***	−0.332***
country i	(0.033)	(0.038)	(0.026)	(0.026)	(0.106)	(0.093)
GDP–deflator in	−0.000	0.323***	0.011	0.249***	0.464***	0.639***
country j	(0.025)	(0.027)	(0.027)	(0.027)	(0.096)	(0.078)
Exchange rate	−0.287***	−0.202***	−0.111***	−0.092***	−0.314***	−0.321***
	(0.022)	(0.023)	(0.018)	(0.018)	(0.050)	(0.049)
Export price of	0.678***	0.416***	0.231***	0.086***	0.075	0.033
country i	(0.036)	(0.041)	(0.027)	(0.027)	(0.105)	(0.098)
Import price of	0.361***	−0.019	0.161***	−0.068*	−0.078	−0.227***
country j	(0.026)	(0.027)	(0.029)	(0.028)	(0.093)	(0.081)
DISTANCE	−0.934***	−0.976***	−0.958***	−1.010***	−0.893***	−0.894***
	(0.004)	(0.004)	(0.024)	(0.024)	(0.012)	(0.0121)
BORDER	0.719***	0.712***	—	—	0.621***	0.619
	(0.012)	(0.012)	—	—	(0.039)	(0.0391)***
EFTAEU	−0.306***	−0.183***	—	—	—	—
	(0.011)	(0.012)	—	—	—	—
CEFTA	0.679***	0.400***	—	—	−0.341***	−0.338***
	(0.026)	(0.028)	—	—	(0.093)	(0.0931)
NAFTA	−0.207**	−0.508***	—	—	0.692***	0.691***
	(0.101)	(0.095)	—	—	(0.144)	(0.1441)
ENGLISH	1.027***	0.869***	—	—	0.685***	0.686***
	(0.015)	(0.016)	—	—	(0.059)	(0.0591)
SPANISH	0.144***	−0.149***	—	—	1.163***	1.307***
	(0.023)	(0.021)	—	—	(0.053)	(0.2181)

TABLE 1—*Continued*

Estimation method	Model estimated: GLS (cross-section weights), common constant — With GDP	With GDP PPP	GLS, random effects — With GDP	With GDP PPP	OLS, fixed effects based on Mátyás (1997)[b] — With GDP	With GDP PPP
ASEAN	1.120***	1.018***	—	—	−0.226***	−0.225***
	(0.056)	(0.057)	—	—	(0.096)	(0.0961)
MERCOSUR	0.329***	0.640***	—	—	0.477***	0.476***
	(0.040)	(0.053)	—	—	(0.091)	(0.0911)
CEE	−0.820***	−0.772***	—	—	−2.013***	−2.027***
	(0.011)	(0.011)	—	—	(0.055)	(0.0551)
R-squared	0.775	0.778	0.389	0.402	0.994	0.861
Adjusted *R*-squared	0.775	0.778	0.389	0.402	0.860	0.860
Durbin–Watson	0.220	0.228	1.460	1.487	0.670	0.670
Normality (Jarque–Bera)	4812.0***	4332.6***	188779.9***	193478.9***	20309.8***	20229.3***
Hausman-test	—	—	597.3***	280.3***	—	—
S.E. of regression	1.175	1.174	1.249	1.241	0.994	0.932
Breusch–Pagan test for random effects	32878.2***	33090.1***	—	—	—	—
Total panel observations	17,334	17,314	17,334	17,314	17,334	17,314
Sample	1990–1997					
Number of countries	53					

[a] In addition, the specifications contain time effect dummies. These are available from the authors upon request.

[b] In addition, the model contains 53 exporter and 53 importer time-specific effects.

*** Significant at 1% level.

** Significant at 5% level.

* Significant at 10% level.

Our estimation sample is so large that only 1% of the variance in the prediction error comes from parameter uncertainty, while residual uncertainty is unaffected by the bigger sample size. Therefore, while the prediction error is large in itself, the equilibrium relationship, dependent only on parameter uncertainty and following from the model, exists and is properly estimated. Hence, the gravity equation can be considered as a cointegrating relationship, having a significant and stable long-run equilibrium. However, the short-term dynamics, largely reflecting residual uncertainty, around the long-run relationship are very large. Thus, the analysis of dynamics offers more reliable conclusions than the analysis of point estimates.

To determine whether there is convergence to the estimated relationship, we estimate an error-correction model (Appendix B) and find significant convergence in the data across different estimation methodologies. Therefore, we define a new measure, the average speed of convergence, as the average growth rate of potential trade divided by the average growth rate of actual trade between 1993 and 1997. We use this measure to assess the convergence speed of the three CEE countries relative to different regions. This is not a convergence measure in the strict sense because, to indicate convergence, a true measure should be negative, if potential trade is higher than actual, and it should be positive if the opposite is true. For our analysis, we posit convergence if the growth rate of potential trade is lower than that of actual trade, and we posit divergence in the opposite case. We proceed this way because the point estimates for the level of potential trade are highly uncertain. Furthermore, scaling potential trade by actual trade provides an insight into how successful these three countries were in exploiting their trade opportunities. In doing so, we assume implicitly that they were below their estimated level of trade potential up to the period considered. This assumption seems reasonable for trade with developed economies as per capita GDP growth rates can not explain the double-digit growth rate of trade up to the most recent periods. Regarding their trade with the countries of the former Soviet Union, we expect the opposite to hold; i.e., potential trade is below actual trade due to the former political relationship between these countries. Hence, we expect to find negative values (convergence) relative to developed economies and positive values (divergence) relative to the countries of the former Soviet Union.

In Table 2, we present the average speeds of convergence for the three CEE countries across the different estimation methods. Our measures of convergence

TABLE 2
Average Speed of Convergence across Different Estimation Methods[a]

	Pooled		Fixed effects		Random effects	
	With GDP	With GDP PPP	With GDP	With GDP PPP	With GDP	With GDP PPP
			Exports			
Czech Republic	−4.4	−7.8	−1.9	−3.0	−0.2	−2.7
Hungary	−9.5	−8.7	−3.6	−3.7	−8.4	−6.7
Poland	0.0	0.7	1.6	3.4	0.4	2.2
			Imports			
Czech Republic	−0.2	−3.1	3.5	2.3	1.8	−1.7
Hungary	−5.1	−3.6	−0.2	0.1	−2.6	−1.2
Poland	−5.9	−4.5	−4.1	−4.4	−4.8	−3.4

[a] Average growth rate of potential/average growth rate of actual $\times$ 100 $-$ 100.

are quite stable across the different estimation methodologies so that results based on our measure of the average speed of convergence are quite robust.

4. RESULTS

In this section, we present the main results of our pooled estimation using current GDP. To analyze the trade reorientation of the different countries, we grouped them into the following main regions, EU, EFTA, other developed countries (ODEV), other Central and Eastern European countries (OCE), and Southeast Asian countries (SEA).[4]

In contrast to the previously mentioned studies, which concluded that the CEE countries had already achieved their trade potential with respect to the EU on the basis of data from the early 1990's we find substantial potential remaining for the Czech Republic and Poland, in terms of both exports and imports. However, this is not the case for Hungary, which achieved its potential by 1997, according to our results. The difference between our findings and those of the other studies lies in different estimation methodologies. First, we use eight years of data instead of a cross section for one year, so that we exploit the dynamic structure of the data during the estimation. Second, instead of using data just for the developed economies, we employ a large sample of emerging and former centrally planned economies, and we use a dummy variable (CEE) in the estimation if one of the trading partners is a CEE country, to capture the special status of these countries during the sample period. This dummy was negative and significant (Table 1), which means that the level of trade was repressed in these countries compared to other economies in the estimation period. When predicting potential trade we assume that this dummy is zero because we consider potential trade in a market economy context.

Tables 3 and 4 contain results for potential, relative to actual, exports and imports for these three countries with respect to other regions. Inspecting the last columns of these tables, it is clear that the gap between potential and actual exports decreased significantly from 1993 to 1997 for the Czech Republic and Hungary but did not change for Poland, while the gap between potential and actual imports in the same period decreased for Hungary and Poland, but remained virtually unchanged for the Czech Republic. There are marked differences with respect to different regions that would be worth analyzing further. However, since the point estimates are very uncertain, we base our conclusions about actual and potential trade on our convergence measure (Table 5).

From Table 5, we conclude that total exports and exports relative to the EU have converged more quickly than imports in the case of the Czech Republic and

[4] The countries considered in the analysis apart from the EU (EU-15) and EFTA countries (Iceland, Norway, and Switzerland) were the following. The ODEV countries are Australia, Canada, Iceland, Japan, New Zealand, and the United States. The OCE country group consists of Bulgaria, Estonia, Latvia, Lithuania, Russia, and Ukraine. The SEA countries are China, Hong Kong, Korea, Malaysia, Philippines, Singapore, and Thailand.

TABLE 3
Actual and Potential Exports (Potential/Actual Percentage Deviation)[a] (Pooled Estimates with Current GDP in USD)

	EU	EFTA	ODEV	CEFTA	OCE	SEA	Total
			Czech Republic				
1993	182.7	321.5	187.2	−45.3	−48.1	−66.6	102.7
1997	111.6	171.1	127.1	−33.7	−13.3	125.9	69.0
			Hungary				
1993	60.2	195.6	136.0	91.7	−56.9	67.9	63.5
1997	−11.8	116.0	25.3	91.9	−5.1	60.4	9.8
			Poland				
1993	117.8	351.4	310.7	197.3	122.8	−21.1	125.7
1997	114.2	249.0	304.4	135.0	67.2	270.7	125.8

[a] Positive (negative) entry means that potential trade is higher (lower) than actual by this percentage.

Hungary. This finding differs from our preliminary expectation that import competition was more pronounced in these countries at the start of the transition because their own products were not competitive in international markets. The export success of the Czech Republic and Hungary can be attributed to successful changes in product structure.[5] However, for Poland, we find strong import-convergence while no export convergence is discernible at the aggregate level. Aggregate export convergence was faster in Hungary than in the Czech Republic. Import convergence was fastest in Poland, followed by Hungary and finally the Czech Republic.

Hungarian and Czech export convergence was fastest relative to the EU, EFTA, and ODEV economies, while significant divergence is detected with the OCE countries, and in the case of the Czech Republic, also with the CEFTA and SEA countries. Concerning imports for these two economies, there is quick convergence relative to the ODEV and SEA countries, and in the case of Hungary also with the EU countries. There is no convergence with EFTA countries, and in the case of the Czech Republic, there is especially rapid divergence with CEFTA economies. Polish export convergence is not pronounced with the EU and the ODEV economies. It seems to be strongest with the OCE countries; however, there is quick divergence relative to the SEA economies. Polish import convergence, on the other hand, is strong with every region except the EFTA group.

These results suggest that there has been a clear reorientation of both exports and imports from east to west after 1993 for the Czech Republic and Hungary. This

[5] The asymmetric approach of trade liberalization in the Associate Agreements between the EU and these three countries may also be responsible for faster export convergence. This seems to be straightforward in the case of the Czech Republic and Hungary. However, for Poland, imports converged more rapidly than exports. Hence, changes in the product structure of Polish exports failed to enable that country to exploit its export opportunities.

TABLE 4
Actual and Potential Imports (Potential/Actual Percentage Deviation)[a] (Pooled Estimates with Current GDP in USD)

	EU	EFTA	ODEV	CEFTA	OCE	SEA	Total
				Czech Republic			
1993	221.6	119.5	142.8	−45.9	−70.8	−27.9	116.1
1997	194.3	142.9	95.5	−11.7	−68.7	−42.4	114.5
				Hungary			
1993	76.3	74.7	120.5	126.8	−76.3	−6.8	47.2
1997	18.2	127.5	77.9	93.7	−69.3	−52.4	19.3
				Poland			
1993	150.7	75.6	185.5	182.4	76.4	−22.4	139.7
1997	102.9	106.5	159.3	59.9	24.6	−56.9	87.7

[a] Positive (negative) entry means that potential trade is higher (lower) than acutal by this percentage.

finding contradicts Gros and Gonciarz (1996) and Brenton and Gros (1997), who predicted that not much trade reorientation should be expected after 1992 to 1994. However, for Poland, trade reorientation is not so obvious. There is practically no convergence in terms of exports relative to the EU, but there is strong convergence with the OCE in terms of both exports and imports. Our results indicate that Poland may not have been very successful in exploiting trade opportunities in the export markets of developed economies. While import convergence with the EU is broadly similar for the three CEE countries in that the average speed of convergence is negative in all cases, the speed of export convergence varies considerably between the three countries. Hungary clearly takes first place with the Czech Republic in second, and Poland hardly converges at all.

These tendencies may be strongly correlated with the product structure of exports and also with inflows of foreign direct investment (FDI). Until 1997, the ranking

TABLE 5
Average Speed of Convergence between 1993 and 1997[a]

	EU	EFTA	ODEV	CEFTA	OCE	SEA	Total
			Exports				
Czech Republic	−7.0	−10.4	−5.7	4.9	13.7	61.2	−4.4
Hungary	−13.9	−7.5	−14.6	0.0	21.8	−1.1	−9.5
Poland	−0.4	−6.2	−0.4	−5.7	6.9	47.2	0.0
			Imports				
Czech Republic	−2.2	2.6	−5.3	13.0	1.7	−5.5	−0.2
Hungary	−9.5	6.8	−5.2	−3.9	6.7	−15.5	−5.1
Poland	−5.2	4.1	−2.4	−13.3	−8.3	−13.7	−5.9

[a] Average growth rate of potential/average growth rate of actual $\times$ 100 − 100.

of the countries according to the stocks of per capita inward FDI matches that of the estimated export convergence, with Hungary having the largest amount of per capita FDI and the Czech Republic having the second largest (Oszlay, 1999). Jakab et al. (2000) estimate a gravity model with FDI variables and show that bilateral FDI inflows provide a significant stimulus to bilateral trade. The question is whether the stock of FDI also enhances the speed of trade convergence. As capital inflows help reduce differences in capital intensities and technological levels between countries of different levels of development, they can also contribute to faster convergence.

However, large differences in terms of productivity and trade orientation exist between FDI flows, requiring a deeper examination than simply looking at per capita FDI stocks. Recent studies using more disaggregated data find the same order between the three countries in terms of the development of export product structures and export convergence. According to the OECD ITCS database, the share of machinery and machinery equipment in total exports had increased by 21, 11, and 1 percentage points in Hungary, the Czech Republic, and Poland, respectively, between 1993 and 1997. The same ordering holds for the shares of machinery and equipment in 1997. As the import demands of developed economies are growing at the fastest pace in industries characterized by differentiated products, countries capable of specializing in such technology-intensive products will be able to take better advantage of their trade potential.

Zielinska-Glebocka (2000) emphasizes that FDI flows into Poland were concentrated in traditional labor-intensive industries, which contribute to a conservation of the center–periphery relationship in EU–Polish trade, with Poland specializing in peripheral activities, exporting less skill-intensive, low value-added products and importing skill-intensive, high value-added ones. Ulff-Moller Nielsen (2000) suggests that the quality of Polish exports lags considerably behind that of the EU. Using 1998 data, Éltető (2000) shows that the share of products of high technological intensity in Hungarian manufacturing exports to the EU is almost three times as high as that in Poland and is comparable to a highly developed EU country, such as The Netherlands. Furthermore, Inotay (1999) compares the product structure of CEFTA countries regarding the imports of Germany and finds that the share of technology-intensive products in the total industrial exports of Hungary, the Czech Republic, and Poland was 58.5, 39.6, and 20.4%, respectively, in 1997. He also states that technology-intensive products played the most important role in Hungarian and Czech export growth. At the same time, the role of technology-intensive products was less pronounced in Polish export growth. These results alter the conclusions of Brenton and Gros (1997), who argue that the trade expansion of these countries was not accompanied by product upgrading. Nevertheless, we emphasize that these new results are derived from data from the second half of the 1990's, in contrast to the previous studies, which used earlier data. Thus, differences in the export product structures and FDI inflows seem to support our results regarding the discrepancies of trade convergence between the three countries.

5. CONCLUSION

In this paper, we analyze the trade performance of three CEE countries, the Czech Republic, Hungary, and Poland, using the gravity approach covering the period up to the second half of the 1990's. Our data set includes 53 developed and emerging economies including these three countries. Using different pooled and panel techniques, we check for the robustness of the equation across different estimation methodologies. Comparing our results with the estimates of Gros and Gonciarz (1996) and Breuss and Egger (1999), we arrive at different conclusions. According to our point estimates, there is still substantial trading potential left for the Czech Republic and Poland in 1997. However, as the point estimates of the gravity equations are highly uncertain, we define a measure of convergence that is quite robust across different estimation methodologies. In support of this measure, we find significant convergence to the estimated equilibrium relationship in an error-correction framework. We analyze these CEE countries' trade relations not only with the EU but also with several different regions to get a more accurate picture of trade reorientation in the 1990's. From our measure of convergence, there is a clear reorientation of trade from east to west after 1993 in the Czech Republic and Hungary, contradicting earlier studies that project constant EU trade shares after 1992 to 1994, e.g., Gros and Gonciarz (1996) and Brenton and Gros (1997). However, trade reorientation was not so obvious for Poland. We explain our results by differences in the product structure of exports and by the amount and structure of FDI in these countries.

APPENDIX A: DATA SOURCES AND DEFINITIONS

For the basic version of the estimations, an annual panel data set of 53 countries is used for the period between 1990 and 1997. As the gravity model is originally formulated in multiplicative form, we linearize the model by taking the natural logarithm of all variables. The source of bilateral trade-flow data is the International Trade by Commodities Statistics (ITCS) database of the OECD for the 28 OECD countries and the Direction of Trade Statistics Yearbooks, published by the IMF, for non-OECD countries. The import data for bilateral trade flows are in current US dollars. The variable $\mathrm{TRADE}_{ij,t}$ denotes the trade flow from country i to country j at time t (i.e., imports of country j from country i at time t). Two measures of income are used, GDP at market prices, in current US-dollars (GDP), and GDP at PPP, in current international US-dollars (PPP GDP). The source of GDP and PPP GDP data is the World Development Indicators (WDI) database of the World Bank. Population data are collected from the International Financial Statistics (IFS). Bilateral exchange rate index data are calculated from the national currency/US-dollar exchange rate data of the International Financial Statistics (IFS) and are recomputed for a fixed base ($1994 = 100$). We use four types of price level data, the GDP deflator of the exporter, the GDP deflator of the importer, the export prices of the exporter, and the import prices of the importer.

GDP deflator data are calculated from WDI database data and are rebased for the base year of 1994. We use three sources for export and import price data, IFS for non-OECD countries, the export and import prices of goods on the diskette called International Trade and Competitiveness Indicators of OECD, and data from the National Bank of Hungary. Unfortunately, we encountered a serious problem of missing values in connection with the non-OECD countries. All export and import price data refer to fix-based price levels ($1994 = 100$) in national currency units.

The transportation costs are proxied by the geographical distances between the capital cities.[6] Distance data were obtained from the software PcGlobe 3.0.

The variable BORDER is a dummy-variable, which equals one if the two countries have a common border. The dummy called EFTAEU takes the value of one if both countries i and j are members of the European Union or EFTA in 1997 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom). The variable CEFTA takes the value of one if both countries i and j are members of CEFTA (Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia). The dummy called NAFTA equals one if both countries i and j are NAFTA countries (Canada, Mexico, the United States). The ASEAN dummy is one if both countries i and j are ASEAN members (Indonesia, Malaysia, Philippines, Singapore, Thailand). The variable called MERCOSUR is one if both countries i and j are members of MERCOSUR[7] (Argentina, Brazil, Chile,[8] Paraguay, Uruguay). In order to capture the effects of common languages, we create variables called ENGLISH and SPANISH, which take the value of one provided both countries i and j have the same official language. The dummy called CEE takes the value one provided that country i or country j is a former planned economy (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Russian Federation, Slovakia, Slovenia, Ukraine).

APPENDIX B: IS ACTUAL TRADE CONVERGING TOWARD EQUILIBRIUM?

In order to be able to use the estimated level of trade as some kind of equilibrium level, we ascertain that there is a tendency for actual trade to converge toward the estimated levels. For this purpose, we estimate a simple error correction model by regressing the change in actual trade values on the difference between actual and potential data in the previous period. For convergence to occur, the estimated coefficient should be negative and significant. The estimation results can be found

[6] However, in large countries such as the United States or Russia, the geographical distance between the capital cities may be different from economic distance. The transportation distance between Japan and the United States is probably better measured by the distance between Los Angeles and Tokyo than that between Washington, DC and Tokyo.

[7] Mercado Comun del Sur.

[8] In fact, Chile is an associate member of MERCOSUR.

TABLE 6
Convergence of Actual Trade toward Potential Trade[a]

	With GDP	With GDP PPP
	Exports	
Pooled	−0.024**	−0.013
Fixed effects	−0.260***	−0.277***
Random effects	−0.038**	−0.029*
	Imports	
Pooled	−0.062***	−0.056***
Fixed effects	−0.563***	−0.591***
Random effects	−0.080***	−0.084***

[a] The β coefficient of $\text{TRADE}_{ij,t} = \alpha + \beta(\text{TRADE}_{ij,t-1} - \text{POTENTIAL}_{ij,t-1})$ regression (standard errors in parentheses).
*** Significant at 1% level.
** Significant at 5% level.
* Significant at 10% level.

in Table 6. Regardless of the estimation technique used, i.e., pooled, fixed, or random effects, the coefficients for the explanatory variable are negative and highly significant for current GDP. Hence, there is convergence of actual trade toward the estimated level in our sample.

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