

SFB 649 Discussion Paper 2005-014

Are Eastern European Countries Catching Up? Time Series Evidence for Czech Republic, Hungary, and Poland

Ralf Brüggemann*
Carsten Trenkler*



* Department of Economics, Humboldt-Universität zu Berlin,
Germany

This research was supported by the Deutsche
Forschungsgemeinschaft through the SFB 649 "Economic Risk".

<http://sfb649.wiwi.hu-berlin.de>
ISSN 1860-5664

SFB 649, Humboldt-Universität zu Berlin
Spandauer Straße 1, D-10178 Berlin



SFB 649 ECONOMIC RISK BERLIN

Are Eastern European Countries Catching Up? Time Series Evidence for Czech Republic, Hungary, and Poland*

Ralf Brüggemann
Humboldt-Universität zu Berlin

Carsten Trenkler
Humboldt-Universität zu Berlin

March 4, 2005

Abstract

The catching up process in Czech Republic, Hungary, and Poland is analyzed by investigating the integration properties of log-differences in per-capita GDP versus the EU15 and a Mediterranean country group. We account for structural changes by using unit root tests that allow for two endogenous breaks in the level and the trend. We find that Czech Republic and Hungary are stochastically converging towards the Mediterranean group, while only Czech Republic is stochastically converging towards EU15. Remaining per capita GDP differences are only reduced by deterministic trends. Extrapolating these trends we find that catching up will take about 20 years.

Keywords: Stochastic convergence, Catching up, Unit root tests, EU accession

JEL classification: C32, E24

1 Introduction

Czech Republic, Hungary, and Poland are the three largest economies among the group of eight Central and Eastern European (CEE) countries that have entered the EU on May 1, 2004. The CEE countries underwent major changes in their economic and political system during their transition to market economies in the 1990s. Although, there was some catch-up of the transition countries in comparison to the old member states, economic differences, e.g. in per capita GDP, still exists (see e.g. European Commission (2003)). However, economic integration of the acceding countries is an integral part for the functioning of the EU. Furthermore, comparable levels of economic activity are necessary for successfully enlarging the Euro currency area. Empirical evidence regarding the state of convergence and the catching up progress will be helpful for political decision makers. In this paper we therefore analyze the relative growth dynamics of Czech Republic, Hungary, and Poland with respect to the former EU15 countries.

*This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 'Economic Risk'. Corresponding author: Ralf Brüggemann, Humboldt-Universität zu Berlin, Department of Economics, Spandauer Str. 1, 10178 Berlin, Germany. E-mail: brueggem@wiwi.hu-berlin.de

Specific evidence on the catching up progress of EU acceding countries is scarce. The few existing studies include Kočenda (2001), Boreiko (2003), and Holtemöller (2005). The lack of econometric studies may be explained by the difficulties involved modeling acceding country data: only relatively few time series observations are available and structural changes have occurred frequently. We account for structural breaks in our analysis by following Strazicich, Lee & Day (2004) who have studied convergence among OECD countries. As Strazicich et al. (2004) we analyze log-differences of real per capita GDP using LM unit root tests that allow for two breaks in the trend and the level of a series at unknown time.

A stationary log-difference of two per capita GDP series implies stochastic convergence in the sense that stochastic shocks have only temporary effects. Output in the two countries is then driven by a common stochastic long-run trend. In this case the catching up progress of the poorer country is only determined by the deterministic components after the last break. Referring to a Solow model, Strazicich et al. (2004) interpret breaks in the deterministic components as permanent changes in country-specific compensating differentials that have their origin in e.g. different relative levels of technology. As we cover a much shorter time period, we interpret the broken deterministic terms differently. In particular, we think of them as representing e.g. changes in the political and economic environment in the CEE countries due to structural reforms in the political and legal system, changes in the competition policy, and specific economic policy programs. In this sense the broken deterministic terms refer to exogenous events.

In our empirical analysis for the acceding countries we use EU15 and a group of Mediterranean countries (Spain, Portugal and Greece) as reference countries. If the log-difference of per capita GDP (relative to the reference group) is stationary, we extrapolate the deterministic trends and make rough projections for the timing of the catching up process. For comparison, we also give results for the Mediterranean countries taking EU15 as a reference group.

The remainder of the paper is structured as follows: In Section 2 we briefly describe the econometric methods and our data before our main results are given in Section 3.

2 Methods and Data

We apply the LM unit root test of Lee & Strazicich (2003) that allows for two breaks in the trend and the level of a time series at unknown time. We use this procedure for two main reasons. First, it is the most flexible unit root test in terms of the number of breaks at unknown time. This is important because we do not have information on specific break points. Second, the test also allows for structural changes under the unit root null hypothesis. Ignoring possible breaks in connection with stochastic nonstationarity may lead to size distortions (see e.g. Strazicich et al. (2004)).

The test works as follows. We define $Z_t = [1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]'$, where the dummy variable $D_{jt} = 1$ for $t \geq T_j + 1$ ($j = 1, 2$) and zero otherwise, $DT_{jt} = t$ for $t \geq T_j + 1$ ($j = 1, 2$) and zero otherwise. T_j denotes the break point. Then, we have $\Delta Z_t = [1, B_{1t}, B_{2t}, D_{1t}, D_{2t}]'$ with $B_{jt} = \Delta D_{jt}$ and D_{jt} as above. The first difference of the time series of interest, say Δy_t , is regressed on ΔZ_t to obtain the estimated coefficient vector $\tilde{\delta}$. Then we compute $\tilde{S}_t = y_t - (y_1 - Z_1 \tilde{\delta}) - Z_t \tilde{\delta}$ ($t = 2, \dots, T$) and perform the unit root regression

$$\Delta y_t = \phi \tilde{S}_{t-1} + d' \Delta Z_t + \sum_{j=1}^k \gamma_j \Delta \tilde{S}_{t-j} + \varepsilon_t \quad (2.1)$$

to obtain the estimator $\tilde{\phi}$. Hence, the statistic for testing the unit root null hypothesis $\phi = 0$ is

$$\tau = \tilde{\phi} / \tilde{\sigma}_\phi, \quad (2.2)$$

where $\tilde{\sigma}_\phi$ is the estimated standard deviation of $\tilde{\phi}$. To endogenously determine the relative break points $\lambda_j = T_j/T$ ($j = 1, 2$), a minimum LM unit root test is performed using a grid search over $\lambda = (\lambda_1, \lambda_2)$ in the time interval $[0.1T, 0.9T]$. Hence, we apply the test statistic

$$LM_\tau = \inf_{\lambda} \tau(\lambda). \quad (2.3)$$

The critical values depend moderately on the break dates. We use the ones given in Lee & Strazicich (2003) for certain combinations of T_1 and T_2 . The number of lags of $\Delta\tilde{S}_t$ in (2.1) is determined by a general to specific procedure as suggested by Lee & Strazicich (2003) and Strazicich et al. (2004). Thus, k is chosen according to the highest significant number of lags of a maximum of 8 lags. We employ the 10% critical value of 1.645 of the normal distribution for the respective t -tests.¹

For the empirical analysis we use monthly data of per capita real GDP of Czech Republic, Poland, Hungary, EU15 average, Spain, Greece, and Portugal in Euro purchasing power standards (PPS), i.e. the GDP figures are adjusted for the purchasing power of the national currencies. The sample covers the period 1991:01 - 2003:12 and the data are compiled from databases of Eurostat, the IMF, the OECD, and the Czech Central Statistic Office.²

Spain, Greece, and Portugal have been identified as a low income group among the EU countries by Carvalho & Harvey (2005). Therefore, we consider the average per capita GDP of these three Mediterranean countries as a second reference for the evaluation of the CEE countries' catching up progress.

3 Results

The LM unit root test is applied to relative income with respect to the EU15 and the Mediterranean group. Thus, we consider $y_{it} = \log(Y_{rt}) - \log(Y_{it})$, where Y_{it} is the real per capita GDP of country i under consideration and Y_{rt} denotes the average real per capita GDP of the EU15 or the Mediterranean countries, respectively. Note that the two breaks allowed for are significant in all test situations at least at the 10% level. The analysis of Czech Republic indicates the presence of three structural breaks. Consequently, we only use data after the first break in 1992:05. In all other cases, we use data from 1991:01 onwards. Our results are summarized in Table 1 and Figure 1.

For Czech Republic and Hungary we find that relative income is stationary with respect to the Mediterranean countries. Moreover, we find relative income of Czech Republic to be stationary with respect to EU15. In contrast, non-stationarity of per capita log-difference cannot be rejected for Poland. In this case only the first difference of relative incomes, i.e. the growth rate differentials, are stationary (results not shown here). Thus, Czech Republic and Hungarian

¹The statistic LM_τ has been computed by using a Gauss program provided by Junsoo Lee via the web page <http://www.cba.ua.edu/~jlee/gauss>.

²All data are available from the authors upon request. The raw per capita real GDP series are of yearly frequency. Therefore, we have interpolated the yearly series for each country into a monthly series using the respective monthly index of industrial production. This interpolation has been done with the help of the program ECOTRIM, which is used by Eurostat to compute e.g. quarterly national accounts.

real per capita GDP are stochastically converging towards the incomes of the Mediterranean countries in the spirit of Strazicich et al. (2004). Moreover, Czech Republic is stochastically converging towards EU15. Therefore, as pointed out in the introduction, only the exogenous trend after the last break determines the catching up process.

Figure 1 shows the broken deterministic components obtained by regressing y_{it} for each country on segmented linear trends and constants for the corresponding subperiods together with the relative income and the residuals after adjusting for the deterministic terms.³ Clearly, the exogenous trend reduces the income differentials between Czech Republic and EU15 average. If that trend continues it will take about 21 years until Czech Republic finishes the catching up process. However, regarding the Mediterranean countries the relative growth trend is practically zero. Hence, Czech Republic and the Mediterranean countries reduce income differentials with respect to EU15 with the same speed. In contrast, the relative growth trends for Hungary are much higher. Projecting the trends into future results in a 17 to 19 year catching up period for Hungary with respect to former EU15 and the Mediterranean group.⁴ Note that the relative growth in Poland has stopped since the end of the 1990s. Since, in addition, the Polish growth rate differentials regarding the former EU15 are stationary, one may not expect important progress in reducing the income gap over the next decades. It will probably take much longer for Poland to catch up than for Czech Republic or Hungary, not only because it is the poorest of three countries.

Although we observe differences among the CEE countries, a further analysis has shown that they all stochastically converge to their group mean in per capita GDP. Moreover, Czech Republic and Poland are approaching the group mean deterministically from above and below, respectively. In contrast, Hungary seems to diverge deterministically due to high growth rates in the recent past.

As a benchmark for comparison, we also include some results for the Mediterranean countries (see Panel A in Table 1 and last row of Figure 1). We find that the link to average EU15 GDP is much stronger than for the CEE countries. They all stochastically converge to EU15-GDP and, with the exception of Portugal, the exogenous trends continue to reduce the income differences. If these trends do not break, Spain will achieve average EU15-GDP in approximately 4 years and Greece in 8 years. These results suggest a much more optimistic view on the economic development of these countries than presented in Carvalho & Harvey (2005).⁵

Overall, our results indicate that unless further exogenous breaks occur the catching up process in Czech Republic and Hungary will take about 20 years, while it will take much longer in Poland.

References

Boreiko, D. (2003). EMU and accession countries: Fuzzy cluster analysis of membership, *International Journal of Finance and Economics* **8**: 309–325.

³Formulating an ARMA model for the stationary series gives very similar estimates of the deterministic terms.

⁴One has to be careful in interpreting the trend with respect to the EU15, since Hungarian relative income vs. EU15 is not stationary. However, the first difference of the relative income series is stationary. Hence, the trend slope after the last break approximately equals the growth rate differential between Hungary and EU15.

⁵The difference could be explained by the different sample periods covered. Carvalho & Harvey (2005) stop their analysis in 1997, after which the Mediterranean countries have experienced a large relative growth (compare Figure 1).

- Carvalho, V. M. & Harvey, A. C. (2005). Convergence in the trends and cycles of euro-zone income, *Journal of Applied Econometrics*, **forthcoming**.
- European Commission (2003). Towards an enlarged European Union: Key indicators on member states and candidate countries, Booklet, Brussels.
- Holtemöller, O. (2005). Uncovered interest rate parity and monetary convergence of potential EMU accession countries, *International Economics and Economic Policy*, **forthcoming**.
- Kočenda, E. (2001). Macroeconomic convergence in transition countries, *Journal of Comparative Economics* **29**: 1–23.
- Lee, J. & Strazicich, M. C. (2003). Minimum lagrange multiplier unit root test with two structural breaks, *The Review of Economics and Statistics* **85**: 1082–1089.
- Strazicich, M. C., Lee, J. & Day, E. (2004). Are incomes converging among OECD countries? Time series evidence with two structural breaks, *Journal of Macroeconomics* **26**: 131–145.

Table 1: Unit Root Test Results

Panel A: EU15 Average				
Country	\tilde{k}	\tilde{T}_1, \tilde{T}_2	Test statistic LM_τ	Critical value relative break points λ
Czech Republic	0	1995:10, 2000:04	-8.25**	0.2, 0.6
Hungary	3	1993:01, 1995:12	-4.42	0.2, 0.4
Poland	7	1992:05, 1997:06	-4.25	0.2, 0.4
Greece	6	1998:08, 2001:09	-9.65**	0.6, 0.8
Portugal	0	1994:11, 2002:06	-12.24**	0.2, 0.8
Spain	6	1997:03, 2001:09	-6.00*	0.4, 0.8
Panel B: Mediterranean Group Mean				
Country	\tilde{k}	\tilde{T}_1, \tilde{T}_2	Test statistic LM_τ	Critical value relative break points λ
Czech Republic	3	1995:08, 1998:11	-7.04**	0.2, 0.6
Hungary	4	1992:07, 1995:11	-6.56**	0.2, 0.4
Poland	7	1992:05, 1996:10	-4.68	0.2, 0.4

Note: Panel A: The LM unit root test is applied to the log-difference between real per capita GDP of the respective country and the real per capita GDP of EU15 average. Panel B: Results for unit root test for the log-difference between real per capita GDP of the respective country and the average real per capita GDP of the Mediterranean countries Spain, Greece, and Portugal. The data period is 1991:01-2003:12 except for Czech Republic, for which the sample 1992:05-2003:12 is considered. Critical values can be found in Table 2 of Lee & Strazicich (2003). * and ** refer to the 5% and 10% significance levels, respectively.

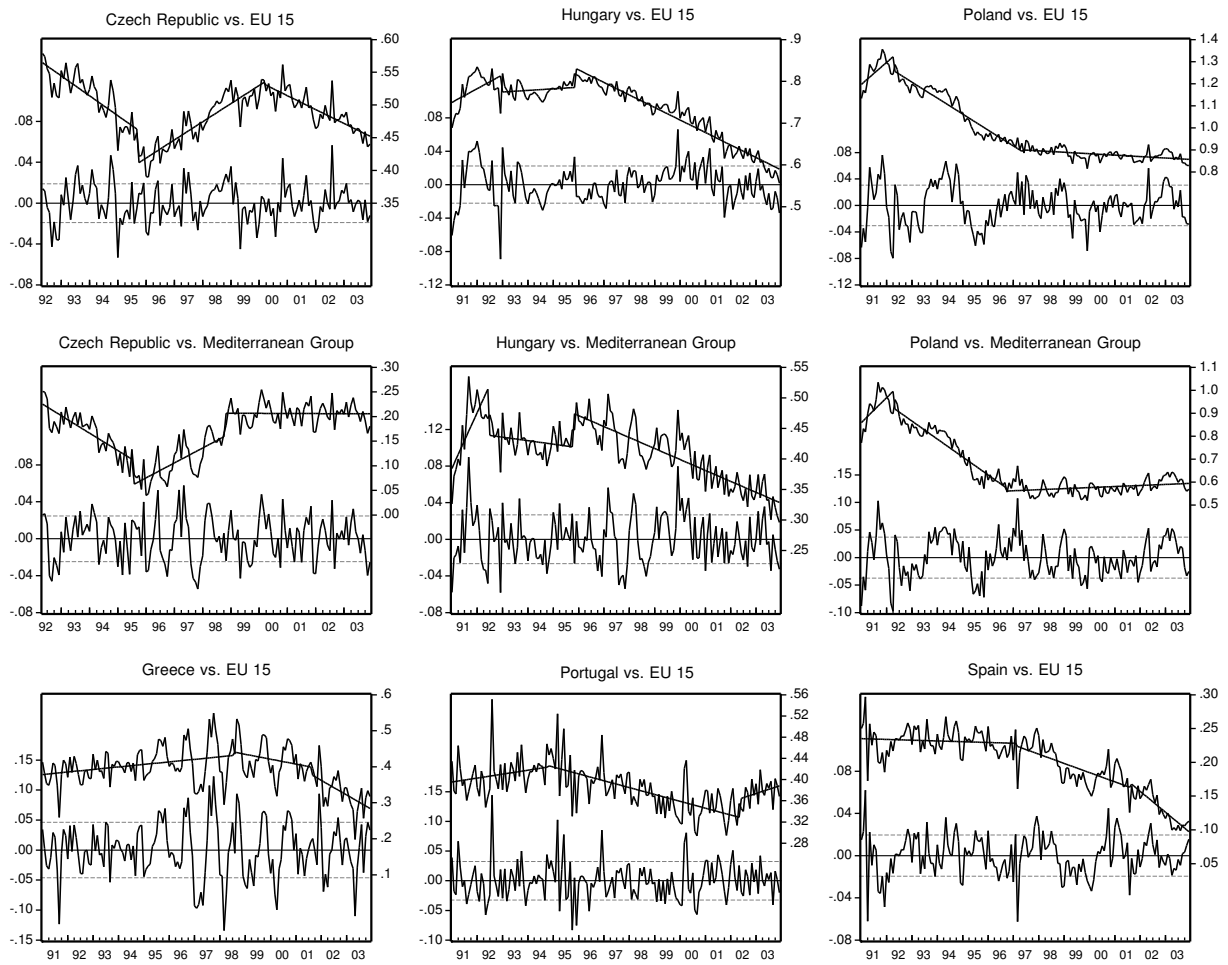


Figure 1: Log-differences in real per-capita GDP (measured in Euro PPS) together with broken deterministic trends and corresponding residuals. Sample: January 1991 to December 2003. (May 1992 to Dec. 2003 for Czech Republic.)

SFB 649 Discussion Paper Series

For a complete list of Discussion Papers published by the SFB 649, please visit <http://sfb649.wiwi.hu-berlin.de>.

- 001 "Nonparametric Risk Management with Generalized Hyperbolic Distributions" by Ying Chen, Wolfgang Härdle and Seok-Oh Jeong, January 2005.
- 002 "Selecting Comparables for the Valuation of the European Firms" by Ingolf Dittmann and Christian Weiner, February 2005.
- 003 "Competitive Risk Sharing Contracts with One-sided Commitment" by Dirk Krueger and Harald Uhlig, February 2005.
- 004 "Value-at-Risk Calculations with Time Varying Copulae" by Enzo Giacomini and Wolfgang Härdle, February 2005.
- 005 "An Optimal Stopping Problem in a Diffusion-type Model with Delay" by Pavel V. Gapeev and Markus Reiß, February 2005.
- 006 "Conditional and Dynamic Convex Risk Measures" by Kai Detlefsen and Giacomo Scandolo, February 2005.
- 007 "Implied Trinomial Trees" by Pavel Čížek and Karel Komorád, February 2005.
- 008 "Stable Distributions" by Szymon Borak, Wolfgang Härdle and Rafal Weron, February 2005.
- 009 "Predicting Bankruptcy with Support Vector Machines" by Wolfgang Härdle, Rouslan A. Moro and Dorothea Schäfer, February 2005.
- 010 "Working with the XQC" by Wolfgang Härdle and Heiko Lehmann, February 2005.
- 011 "FFT Based Option Pricing" by Szymon Borak, Kai Detlefsen and Wolfgang Härdle, February 2005.
- 012 "Common Functional Implied Volatility Analysis" by Michal Benko and Wolfgang Härdle, February 2005.
- 013 "Nonparametric Productivity Analysis" by Wolfgang Härdle and Seok-Oh Jeong, March 2005.
- 014 "Are Eastern European Countries Catching Up? Time Series Evidence for Czech Republic, Hungary, and Poland" by Ralf Brüggemann and Carsten Trenkler, March 2005.

SFB 649, Spandauer Straße 1, D-10178 Berlin
<http://sfb649.wiwi.hu-berlin.de>

This research was supported by the Deutsche
Forschungsgemeinschaft through the SFB 649 "Economic Risk".

