Determinants of Economic Growth in Central and Eastern Europe: A panel analysis

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Abstract. This paper provides an analysis of the determinants of economic growth in Central and Eastern Europe on the basis of a comparison with developments in the region that have undergone a process of transition economy . Are analyzed 18 countries in central and eastern : Armenia , Azerbaijan , Belarus , Bosnia & Herzegovina, Bulgaria, Georgia , Hungary, Kyrgyzstan , Croatia , Latvia , Lithuania , Macedonia , Moldova , Poland , Romania, Slovakia Slovenia and Albania for the period 1998-2011. The data on GDP, number of employees and physical capital stock are taken from the database of the International Monetary Fund to 18 countries. While the total productivity of factors of production is taken from the database of the "Total Economy Database". The data were obtained for the period 1998-2011 for 18 CEE countries, which means that we are dealing with 18 individual units and 14 time periods, thus forming 252 observations in total. Panel analysis will be used to construct the model of economic growth.

Keywords : Cointegration , stacionarity , increasing, effects .

1 Introduction

The experience of Central and Eastern Europe countries in transition situations (CEE) and in the countries of ex-Soviet Union (CIS) has been very different. Financial and economic crisis has attacked all countries of CEE causing damage in the flow of development and fast economic growth. So, the first years of raising for these countries has been and continue to be very problematic. This makes you think about the development model before crisis situations in the region, which is a unique model that resulted in a fast economic growth. With the fall of Berlin Wall (1989), the South-Eastern Central and Eastern European countries, where are located Baltic countries, Balkans countries as Albania, Bosnia, Bulgaria, Croatia, Serbia, Armenia, Azerbaijan, Estonia etc came out of Eastern Block and communist centralized system. By going toward trade economic system, each country would get through "transition periods", which is characterized of similar trends but with their specific features according to each country. This phenomenon made possible that centralized state economies as non-efficient had to close by force or make as private different sections of economy. This approach resulted together with social and political tensions in a drastic reduction of the domestic production for each person in the first years of after 90-s.In this period of time unemployment goes to the top in many countries as result of privatizations, reduction of administrate, closing of industries and exposing of agricultural section, where the majority of people were employed toward to high productivity of trade economy. With the establishing of the situation the employer force began to be postponed from non-profit sector to private sector, growing its productivity ; raw materials which began to be used ,led in a fast economic growth for a certain period of time. But this was not a consistent growth **because** these countries were not supported in the aggregate production growth. During the period 1990-2011 countries have evolved in terms of income per capita . In year 1990 Albania estimated GDP per capita level of $ 2,854 (PPP) in 2011shows a level of $ 8,944 (PPP) showing a tripling of them . In 2011 Albania ranks last compared with all other countries and also its GDP per capita results in less than one third of the EU average . These figures may make

optimistic retrospect but not too optimistic perspective if trying to compare countries EU member states and the organic part of this potential merger . Comparing countries between them in 2011 , Slovenia ranks first with $ 27.412 while coming in second place Czech Republic with $ 26.046 . Larger differences observed in 1994 and in 2003. The first period of divergence (1990-1994) is understandable because countries were approached to a new economic system without having the experience needed heterogeneity showing their individual behavior.

The second period of divergence (period 1998-2003) can be interpreted in commitments group of EU member states such as Estonia, Hungary, Lithuania, Latvia, Poland, the Republic Czech, Slovak Republic and Slovenia, took before joining them in 2004 by accelerate the pace.
The economic growth of South-Eastern Europe countries was not reflected in the reduce of unemployment .However, the unemployment was stopped somehow from the growth of private sector, it remained high which led to the massive emigration of the employers toward developed countries which resulted in a stabilization of the unemployment levels.

2. LITERATURE REVIEW

The economic growth and development have a positive influence in labor market but "the unemployment growth", seems to be a big barrier for the poor people to benefit from the positive flow of the growth of a country. The amount of the poor growth is seen depending on the rates in which the growth generates employment and better possibilities for profits. On the other hand competition and the wellbeing level of a country are related in a clear way with the performance of the economic growth. There is no long-term reduction of poorness, without economic growth. For this reason, the economic performance of regions, states and world has given clear form to the studies during last decades. The main determinants of economic growth, find their explanation in the empiric studies which suggest two approaches (Khan, 2004): The first ,neoclassic model (Solow, of the economic growth who suggest dissolution of the economic growth level according to the contribution of the fundamental resources of the economic growth such as: human capital, physical stock of capital and the growth of Total Productivity of the Production Factors (TFP).

Secondly, during the building of the comparative analysis of the economic growth among different countries, are identified the structure resources of the economic growth such as: investment rates, registration rates in school, the integration in the international trade, macroeconomic stability, infrastructure and quality of institutions. It is understandable that these structure variables contribute in the development of one or some fundamental resources of the economic growth which were used in the first approach.

Papyracis and Gerlagh (2007), analyze empiric determinants of the economic growth in the United States, using facts cross-section in 49 countries. Their depending variable is the rates of growth of GDP, independent variable of regress are initial income, natural resources, investments, education, sincerity and corruption. They found that the empiric facts supported the absolute hypothesis of the convergence for the United States, and they indicate that the richness of the natural resources is a important negative determinant of the growth. The studies of the regression of economic growth are used to explain the differences in the economic performance between nations and regions. Mankiw, Romer and Weil (1992), supposing the reduction of capital return, they agree that neoclassic theory of growth predict a growing tendency of the convergence of nations or regions in development, so poor countries or regions have tendency to grow faster than the rich countries.

3.ECONOMETRIC ANALYSIS

3.1 The data

The evidence on GDP, the number of employees and the physical capital stock are taken from the base of International Monetary Fund for 18 countries, but the total of productivity of factors of production is taken from the base of evidence of "Total Economy Database". The evidence is taken for the period 1998-2011 for 18 countries of CEE, which means that there are 18 individual fractions and 14 time periods, creating in this way 252 observations in total.

There are given facts for all the variables for this studied period for each country and for all time period, this evidence forms a balanced panel.

3.2 Growth model

The model which will be estimated to identify the determinants of economic growth for 18 countries of Eastern Europe and Central Asia as: Albania, Armenia, Azerbaijan, Belarus, Bosnia & Herzegovina, Bulgarian, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kirgiziane Republic, Latvi, Lithuania, Macedonia, Moldova, Slovak Republic and Slovenia is as follows:

$$\mathbf{Lny_{it} = \beta_{0it} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + u_t}$$

where:

Yit- represents GDP which is measured according to parity of the purchasing power divided for the number of employees in a respective place.

PTF – represents the growth of total productivity of the production which is expressed in a difference.

lnk – represents logarithm of physical capital stock per worker in a respective place

u_t – represents remains of regression

3.3 The study of Stacionarity

The first step of analysis which is formed on the evidence which has their part the time series is stationarity. For its study is used the unit root test for the panel evidence based on the test Levin-Lin-Chou and Breitung to find out if they have common unit roots for all the variables of the panel[1]. The test of stationarity :

$$\Delta y_{it} = \delta_i y_{i,t-1} + z'_{it}\gamma i + \varepsilon_{it}$$

H0 : $\delta i = 0$ for each i

Ha : $\delta i < 0$ - are stationer

[1] Other tests of unit roots for the panel evidence as Im-Pesaran-Shin;Fisher-Adf,Fisher-PP test for existence of the unit roots,individual for each variable of panel.

If all the variables have unit roots, then the series are not stationer and in this case is used the rule of differentiation to indicate that the variables are stationer or positioned of the first place. When variables are stationer of the first place than Johansen test of co-integration for the panel evidence is applied to see if the short-term estimated relationship stand even for long-term periods. To discover the direction of the relationship in short-term periods is used Engel-Granger test. Tests results Levin, Lin, Chu and Breitung of the unit roots showed that the panel evidence studied have common unit roots in the same level of GDP per worker, in the same way the physical capital stock for worker .For this reason that the variable of total productivity of factors is taken divided from the unit root test, it proves to be stationer in level[2].

Im-Pesaran-Shin, Fisher-Adf, Fisher-PP tests show that exist individual unit roots as for Lny and Lnk. Making the difference of order 1 is seen that the series of physical capital stock per worker becomes stationer, which means is I(1).On the other hand the series of GDP for Im-Pesaran-Shin and Breitung tests shows a presence of unit roots and difference of the first order and second order. Despite this it s interesting that the series of GDP is differentiated according to I(1), in order not to lose more information and not to attenuate more than it is necessary its change, which affects negatively in the evaluation of panel model.

Because of the series is stationer of first place, I(1) than to determine if the series co-integration which each-other Johansen Fischer test should be done (table 1) for co-integration of the panel evidence. The co-integration results depend importantly on the number of logarithm used for the remnants. In our case only remnants in lag (1) are considered. Because of the probability for each of tests is smaller than 0,05 then we can say that series co-integrate with each-other.

3.4 Econometric Model

Firstly we estimate the regression on combined data, using OSL, from which we get a common constant for all the countries in the survey. In this case OLS provides efficient estimates but with heteroscedasticity, autocorrelation or correlation problems, of observations within a country. In this case the individual effects are included in the error term.

$$Lny_{it} = \beta_{0it} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + u_t$$

where:

i - Stands for individual units, in this case for each of the CEE countries analyzed, and
t - for the relevant period.

Variable	Coefficient	Standard error	t statistics	p value
β_{0it}	0.045	0.002	17.776	0.000

[2] So, we say that the series of total productivity of factors is I(1).

Δlnk_{it}	0.113	0.013	8.253	0.000
PTF	0.006	0.0005	10.073	0.000
R^2adj	***AIC***	***HQ***	***DW***	***Prob***
0.581	-3.780	-3.762	1.246	0.000

Table 2: Evaluation of the model Δlny with united data

Secondly, it is estimated the fixed effects model (FEC) according to cross-section to determine if different CEE countries have different initial levels of economic growth (so they have different values of intercept. If unobserved individual effects are correlated with the explanatory variables, OLS produces displaced and inefficient estimators. In order to get the individual effects, dummy variables for each country are included in the model, thus avoiding also the internal correlation. To avoid the dummy variable trap, we use 17 dummy variables for the 18 observed countries.

$$Lny_{it} = \alpha_0 + \alpha_1 D_{1i} + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \ldots\ldots + \alpha_{17} D_{17i} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + u_{it}$$

To determine if all countries, during different periods, have different levels of economic growth, we estimate the model of fixed effects (FEP) by period. In order to do this, we incorporate in the model dummy variables, for the 14 observed years. However, the addition of a large number of variables in the model, results in a loss of degrees of freedom and the estimations achieved will be displaced.

$$Lny_{it} = c_0 + c_1 D_{1i} + c_2 D_{2i} + c_3 D_{3i} + \ldots + c_{13} D_{13i} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + u_{it}$$

Moreover, it is also estimated the model of fixed effects for cross-sectional data and for time series (FEPC). (Table3)

$$Lny_{it} = \alpha_0 + \alpha_1 D_{1i} + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \ldots + \alpha_{17} D_{17i} + c_1 D_{1i} + c_2 D_{2i} + c_3 D_{3i} + \ldots + c_{13} D_{13i} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + u_{it}$$

Finally, we estimate the equation with random effects by cross-section and time series, which estimates the expected value of intercept and avoids potential correlation between individual observations and the error term, using the composite error term.

$$Lny_{it} = \beta_{0it} + \beta_1 lnk_{it} + \beta_2 PTF_{it} + w_{it}$$

where:

wit = uit + μit represents the composite error term, consisting in the regression error term and stochastic differences. (Table 4)

Among the models of random effects, the model of random effects by cross-section and period, is assessed to be the most suitable, taking into consideration R^2, statistical significance of variables and DW. Therefore, it is applied Hausman test, in order to select the best model, between the one with fixed effects by cross-section and the one by period. (Table 5)

Given that the Chi statistics is 0.000, for both cross-section and period, the appropriate model to use when estimating is the model of random effects by cross-section and period. After evaluating the random effects model, for both individual and period records, it results that an increase of one percentage point of the physical capital stock leads to an economic growth of 0.086 percentage points, when all other variables kept constant.
Also, for an increase of one percentage point of the total labor productivity, leads to an economic growth of 0.006 percentage points, for all countries in our research and when all other variables are held constant.

Regarding the normal distribution test, statistics J-B =594.95 p=0.000, so the basic hypothesis is rejected, residuals do not result in normal distribution.

Referring to the results of effects of countries and time series (table 6) we can say that: From the intercept estimates, it is noted that Moldova and Slovenia have parted from the worst position of economic growth compared to all the other countries. Meanwhile, Bosnia & Herzegovina is in a better initial economic position. Based on the estimation of effects of the period, presented in the intercept, it is noted that for all countries, growth has been at its lowest in 1999 and has had an upward trend until 2008.

4. Results and Conclusions

Levin, Lin, Chu and Breitung tests of unitary roots, indicate that panel data have common unitary root level for GDP per worker as well as for the stock of physical capital per worker. Being that the factors total productivity variable is taken differentiated, from the test of unitary roots it results in stationary level, which means that the series of this variable is I(1).

Im-Pesaran-Shin, Fisher-ADF, Fisher-PP tests indicate that there are individual unitary roots for LNY and Lnk. After integrating in the first order, it is noted that the series of the stock of physical capital per worker turns stationary of order I(1). While GDP series for Im-Pesaran-Shin, and Breitung tests appears a presence of unitary roots even in the first and second order difference. Despite this, it is of interest that the GDP series be differentiated according to I (1), in order to prevent loosing more information and to not soften too much its variability, which would adversely affect our assessment of the panel model.

5. Literature

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Appendix

Hypothes No. of C	**Model 1**				**Model 2**			
	Trace Test	**Prob**	**Max-Eigen test**	**Prob.**	**Trace Test**	**Prob.**	**Max-Eigen test**	**Prob.**
None	196	0.000	167.6	0.000	243.8	0.000	205.7	0.000
At mos	73.74	0.000	71.97	0.000	81.15	0.000	77.84	0.000
At mos	34.21	0.553	34.21	0.553	34.21	0.553	34.21	0.553
	No trend & no Intercept In CE or test VAR				No trend & Whith Intercept In CE or test VAR			

Table 1. The results of co-integrim test Johansen Fischer for panel data.
**MacKinnon-Haug-Michelis (1999) p-values

	Fixed Effects by cross-section				**Fixed Effects by time**				**Fixed Effects by cross-section and time**			
	coeff.	**Std error**	**t. Stat**	**Prob**	**coeff.**	**Std error**	**t. Stat**	**Prob**	**coeff.**	**Std error**	**t. Stat**	**Prob**
β_{0it}	0.044	0.002	18.763	0.000	0.0473	0.002	20.685	0.000	0.046	0.002	22.731	0.000

Δlnk_{it}	0.106	0.013	8.003	0.000	0.0857	0.013	6.286	0.000	0.080	0.012	6.547	0.000
PTF	0.006	0.0006	10.19	0.000	0.0056	0.000	10.391	0.000	0.006	0.000	10.620	0.000
	R^2adj	**AIC**	**SC**	**DW**	**R^2adj**	**AIC**	**SC**	**DW**	**R^2adj**	**AIC**	**SC**	**DW**
	0.640	-3.864	-3.569	1.554	0.688	-4.027	-3.806	1.299	0.760	-4.223	-3.750	1.80

Table 1: Estimated models with fixed effects by cross-section, according to the period and according to both of them together

Note: Δlny dependent variable; The models are all statistically significant (p = 0.000)

	Random Effects by cross-section				**Random Effects by time**				**Random Effects by cross-section and time**			
	coeff.	**Std error**	**t. Stat**	**Prob**	**coeff.**	**Std error**	**t. Stat**	**Prob**	**coeff.**	**Std error**	**t. Stat**	**Prob**
β_{0it}	0.044	0.004	10.749	0.000	0.046	0.005	8.883	0.000	0.046	0.006	7.221	0.000
Δlnk_{it}	0.109	0.013	8.30	0.000	0.092	0.013	6.965	0.000	0.086	0.011	7.200	0.000
PTF	0.006	0.000	10.385	0.000	0.005	0.000	10.73	0.000	0.006	0.000	11.173	0.000
	R^2adj	**DW**	**Prob**		**R^2adj**	**DW**	**Prob**		**R^2adj**	**DW**	**Prob**	
	0.606	1.448	0.000		0.491	1.283	0.000		0.516	1.632	0.000	

Table 2: Estimates of the model with random effects for both cross-section and time period.

	Statistics Chi	**Prob.**
Period random	0.000	1.000
Cross-section Random	0.000	1.000
Period and Cross random	6.716	0.034

Table 3: Hausman test results

Dummy Variable	**Country**	Free term value	**Year**	Free term value
1	Albania	-0.005089	1999	-0.018428
2	Armenia	0.005515	2000	-0.000850
3	Azerbajxhani	0.025029	2001	-0.001549
4	Bjellorusia	-0.008842	2002	-0.004088
5	Bosnjë & Herzegovina	0.026140	2003	-0.003000
6	Bullgaria	0.019602	2004	0.004467
7	Croatia	-0.000808	2005	0.011730
8	Czech Republic	-0.008143	2006	0.025633
9	Estonia	-0.001823	2007	0.016977
10	Georgia	0.008184	2008	0.031385
11	Hungaria	0.002157		
12	Republic Kirgiziane	-0.007101		
13	Latvia	0.003949		
14	Lituania	-0.004847		
15	Macedonia	-0.009429		
16	Moldavia	-0.027966		
17	Slovak Republic	-0.002835		
18	Sllovenia	-0.013692		

Table 4: Free term values for each country and each year according to the random effects for the cross-section for the period.