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Competitiveness Factors at National and Regional Level. A Panel Analysis for Romania¹

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Abstract

The paper attempts to identify with the help of a panel model the presence of common or divergent development patterns and some significant factors of competitiveness at national and regional level (mainly regarding investment and employment, overall and by main economic sectors). The results for Romania and its development regions reveal specific ways of GDP formation for each region (the presence of „regional economies”), based on different mixes of factors, augmented or not by certain economic policies, and also some differences in the sectoral development patterns of the regions.

Keywords: competitiveness, panel data models, regional development, regional policy

JEL Classification: C23, O18, R12, R15

Introduction

The paper attempts to identify with the help of *panel models*² the presence of common or divergent development patterns and some significant drivers of competitiveness at national and regional level. For such a purpose, real data in logarithm regarding the GDP and production factors (capital and labor) for the eight regions and 42 counties of Romania were used over the interval 2000-2005³. Labor was introduced in the model as annual change in employed population, while the data availability restrictions made us to consider the gross investments as proxy for capital.

The Model

Denoting by $Y_{i,t}$ – the logarithm of real GDP, by $X1_{i,t}$ – the logarithm of stock of gross investments and by $X2_{i,t}$ – the logarithm of annual change in employed population and considering a common Cobb-Dougllass production function the general form of the model may be written as:

$$\forall i \in [1, N], \forall t \in [1, T]: \quad Y_{i,t} = \alpha_i + \beta_i X1_{i,t} + \gamma_i X2_{i,t} + \varepsilon_{i,t}. \quad (1)$$

The innovations (shocks), $\varepsilon_{i,t}$, are presumed as independent and identically distributed, of zero average and constant dispersion σ_ε^2 , $\forall i \in [1, N]$ ⁴.

In the case of a *pooled model* (identical production function for all the regions/counties), the GDP elasticities in relation to labor and investments are identical for all considered

¹ Partial first results of research supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number SOP HRD/89/1.5/S/62988.

² See C. Scutaru-Ungureanu, I. Florescu, C. Stănică, Modele de dezvoltare sectorială, in *Analiza interdependențelor dintre dezvoltarea durabilă a României și a țărilor membre UE în perioada postaderare*, coord. Lucian Liviu Albu, Academia Română, Institutul Național de Cercetări Economice, Institutul de Prognoză Economică, Editura Expert, București, ISBN 973-159-014-5, 973-618-162-6, 2007.

³ Sectoral data aggregation according to NACE Rev.1.

⁴ D. Jula, *Econometrie*, Editura Bren, București, 2005.

regions/counties ($\beta_i = \beta$, $\gamma_i = \gamma$, $\forall i \in [1, N]$), and the average total factor productivity, α_i , is also identical for all considered spatial units (and/or sectoral units, in case of additional sectoral analysis). The model is then written as:

$$Y_{i,t} = \alpha + \beta X1_{i,t} + \gamma X2_{i,t} + \varepsilon_{i,t}. \quad (2)$$

However, when working with aggregated series, it is very likely that the macroeconomic production functions are not identical for all the analyzed spatial units. If the total homogeneity assumption is rejected, it should be analyzed whether the elasticities of different factors are identical, and in case the latter assumption is also rejected then one may say that there is no common production structure among the analyzed units. In such a case, the panel data analysis is not recommended and biased estimators may result, so that the production functions have to be estimated separately for each spatial or sectoral unit.

If an identical relationship may be found for all the spatial units between output and considered factors, then the heterogeneity source may be given by α_i . In this case, such constants reflect the total average productivity of production factors (Solow residual). Since nobody may say that the analyzed spatial units have the same level of structural productivity, it is likely that the structural or atemporal factors lead to structural differences of productivity among these units. In such cases, we have to test the assumption of a common constant for all the regions/counties and/or sectors. If such an assumption is rejected, then an individual effects model is obtained, written as:

$$Y_{i,t} = \alpha_i + \beta X1_{i,t} + \gamma X2_{i,t} + \varepsilon_{i,t} \quad (3)$$

In this case, the average total factor productivity, $E(\alpha_i + \varepsilon_{i,t}) = \alpha_i$, varies from one region to another, despite possible identical production structures (given by the elasticities in relation to labor and capital).

Another problem of panel data modeling is the correlation of error term with any of the independent variables, which leads to inconsistent OLS estimates. The use of a fixed effects estimator eliminates variations in relation to time, and the resulting error term is not correlated with the independent variables. However, although being consistent, the fixed effects estimators may be of limited use, since they do not provide estimates of the dummy variables. In such a case, a random effects estimator is used, which directly models heteroskedasticity⁵. Nevertheless, such an estimator may be also inconsistent if the error term is correlated with any of the independent variables. To solve such a problem, an AR(1) variable or a lagged effect were introduced in the model.

The Results

The results of the model at national level for the current eight regions and 42 counties of Romania⁶ reveal a common GDP development pattern both for the eight regions and the 42 countries. In both cases, a lagged variable was also used⁷.

In the case of eight regions model, the development pattern is described by equation:

$$Y = 0.121346166411 + 0.0258841438899 * X1 + 0.102458019895 * X2 + 0.953638613593 * Y(-1) \quad (4)$$

(12.79392)

(19.57204)

(5.269324)

(337.6104)

$R^2 = 0.978571$

DW = 2.049555

⁵ Emla Fitzsimons, Vincent Hogan, J. Peter Neary, Explaining the Volume of North-South Trade in Ireland: A Gravity Model Approach, *The Economic and Social Review*, Vol. 30, No. 4, October, 1999, pp. 381-401.

⁶ Detailed results were not presented due to space restrictions.

⁷ Estimation with OLS that allows for heteroskedasticity in panel. Introduction of an AR(1) variable leads to acceptable results only if also using a dummy variable for the București-Ifov region, its impact being significant.

In the case of 42 counties model, introduction of an AR(1) variable does not lead to acceptable results, while by using a lagged variable of the overall economic conditions in the previous period (described by the variable $y(-1)$)⁸ the plausibility of estimates increases, the development pattern being described by the equation:

$$Y = 0.111386019586 + 0.0259392101545 * X1 + 0.372092954785 * X2 + 0.952416366455 * Y(-1) \quad (5)$$

(655.4159) (377.7734) (933.8602) (9212.039)

$$R^2 = 0.999980$$

$$DW = 2.305264$$

Given the use of a simple panel model and the small time series, *the investments impact on GDP was lower than that of employed population* (the latter with a downward trend during the analyzed period, due to significant sectoral restructuring); however, the coefficients of both variables were statistically significant. The lagged effect of previous period overall conditions was very high in the case of both models. One may also notice a lagged effect of the variables that describe investments and employed population dynamics, but the development pattern was different for the eight regions model (low impact, and negative coefficient and heteroskedasticity within panel) and for the 42 counties model (low impact, but positive coefficient and heteroskedasticity within period)⁹. The impact of București-Ilfov region on the development pattern was significant during the analyzed interval, but the attempt to remove it from the model did not provide conclusive results – the Capital City region evolved together with the other regions/counties and not differently.

Since in the basic equations¹⁰ the α_i coefficients had high values, signalling the likely impact of other factors that were not considered by the model, in a next stage we attempted to introduce other variables able to quantify such impacts. We were especially interested in finding whether the *government policies* had a sizeable influence, besides the analyzed factors, to the GDP formation at territorial level (and, in a general meaning, to the overall competitiveness of the territorial units)¹¹. In this respect, two new variables were added to the model¹², namely the state budget subsidies to the county budgets and the county budgets expenditures on economic actions, the model being written as:

$$Y_{i,t} = \alpha_i + \beta X1_{i,t} + \gamma X2_{i,t} + \delta X3 + \sigma X4 + \varepsilon_{i,t} \quad (6)$$

The results also reveal a common development pattern over the interval 2000-2005, both new variables having *positive and statistically significant impacts, albeit of very low magnitude*:

$$Y = 0.132534196262 + 0.0269966483216 * X1 + 0.20418148994 * X2 + 0.0043691554163 * X3 +$$

(789.5819) (787.0770) (348.1445) (303.9376)

$$0.00756738000382 * X4 + 0.940926285091 * Y(-1) \quad (7)$$

(315.9672) (15377.81)

$$R^2 = 0.999913$$

$$DW = 2.325402$$

The magnitude of investments impact, albeit low, was highly exceeding that of expenditures on economic actions, but the lagged impact was also high. When considering the lagged impact of the other variables, one may notice lower magnitudes, positive in the case of investments and employed population and negative in that of subsidies and expenditures on economic actions¹³. Such results are somewhat similar

⁸ Estimation with the method that allows for heteroskedasticity within period..

⁹ Idem.

¹⁰ Without error-correction terms.

¹¹ Data for 41 counties, the Capital and Ilfov County being considered a single entity.

¹² Real data, in logarithm.

¹³ When considering a model with lagged effects for all the variables, together, then the sign of coefficient for the variable describing subsidies becomes negative even in the case of direct effect.

to other studies; for instance, analyzing the issue of compatibility between two possibly separate goals, namely national economic efficiency and inter-regional equity, Fratesi (2008) showed that despite the fact that income transfers towards less productive areas played a significant part for many years, there were other factors at play, e.g. even such a strategy is efficient in the short run it may hamper development in a longer run. Moreover, the income transfers may hamper factor mobility or induce unemployment¹⁴. The next step was to analyze if within the regions common GDP formation patterns may be identified¹⁵, by using the same model. The results are shown in Table 1.

Table 1

Region	Model coefficients					
	C	X1	X2	AR(1)	Y(-1)	Dummy variables
Nord-Est (R ² = 0.999315) (DW = 2.540277)	0.061457 (43.16341)	0.001179 (3.680190)	0.190718 (31.04588)	-	0.987311 (1856.454)	-
Sud-Est (R ² = 0.998677) (DW = 2.179740)	0.362911 (213.0670)	0.091341 (178.7270)	0.042805 (5.013678)	-	0.820551 (1024.900)	-
Sud Muntenia (R ² = 0.999744) (DW = 2.501900)	0.280108 (220.4731)	0.086112 (194.8104)	0.650099 (59.76925)	-	0.853415 (1185.661)	-
Sud-Vest Oltenia (R ² = 0.997542) (DW = 2.363791)	0.282379 (64.02771)	0.008756 (7.775124)	0.700494 (30.58598)	-	0.910231 (709.8930)	-
Vest (R ² = 0.998275) (DW = 2.087225)	1.822006 (350.1905)	0.561477 (295.4743)	0.729359 (21.23361)	-	-	-
(R ² = 0.988888) (DW = 2.340802)	0.242491 (13.58221)	0.040202 (7.923061)	0.262977 (6.193449)	-	0.900923 (115.8497)	0.021296 ¹ (11.18615)
Nord-Vest (R ² = 0.991194) (DW = 2.295798)	6.238992 (11.90585)	0.004117 (4.776363)	0.183416 (10.64216)	0.991560 (685.7003)	-	-
Centru	2.383664	0.329720	-1.526617	-	-	-

¹⁴ See U. Fratesi, Regional policy from a supra-regional perspective, *Annals of Regional Science* 42, Springer Verlag, 2008, pp. 681-703.

¹⁵ Only seven regions were considered, because the București-Ilfov region has only two counties, with very different economic power.

0.996742) (DW = 1.818854)	(235.4808)	(109.5800)	(-32.34691)			
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1. For Timiș County.

Source: Author's computation.

One may also notice a common GDP development pattern in the analyzed regions, described by the model's equations, but also regional peculiarities. In all the regions, one should notice the *somewhat lower impact of investments as compared to employed population* (except for the **Sud-Est** Region); however, with high discrepancies among the regions – from a very low impact in the **Nord-Est** Region, to a higher one in the **Sud-Est**, **Sud Muntenia** and **Vest** regions. The higher impact of employed population dynamics – also positive – may be noticed in the **Sud-Vest Oltenia** and **Sud Muntenia** regions, while the single negative impact in the **Centru** Region¹⁶. Similar to the national analysis, the GDP lagged effect was significant, but also significant and positive in the case of investments (in the **Sud-Est**, **Sud Muntenia**, **Vest** and **Centru** regions) and of employed population dynamics (in the **Nord-Est**, **Sud-Est**, **Sud Muntenia** and **Centru** regions)¹⁷. We also introduced in the regional model the same variables describing government policies, namely subsidies and expenditures on economic activities, in an attempt to identify peculiar or general features of GDP formation pattern. The results are shown in Table 2.

Table 2

Region	Model coefficients									
	C	X1	X2	X3	X4	AR(1)	Y(-1)	X1(-1)	X3(-1)	X4(-1)
Nord-Est (R ² = 0.983766) (DW = 2.586248)	5.260819 (14.43745)	-0.003133 (- 0.762063)	-0.094822 (- 4.097173)	0.003097 (4.921677)	0.003403 (1.096674)	0.989152 (507.5861)	-	-	-	-
Sud-Est (R ² = 0.998718) (DW = 2.300934)	0.417817 (129.0226)	0.099603 (134.4977)	-0.019386 (- 2.086088)	-0.000853 (- 6.121160)	0.016896 (19.81863)	-	0.793165 (507.3198)	-	-	-
Sud Muntenia (R ² = 0.997560) (DW = 2.041918)	1.987394 (1538.136)	0.433164 (638.9153)	1.045223 (24.12948)	0.006544 (17.54191)	0.152591 (178.2056)	-	-	-	-	-
Sud-Vest Oltenia (R ² = 0.985950) (DW = 2.112022)	0.211995 (24.93012)	0.017688 (12.83912)	-0.053727 (- 2.445241)	0.022530 (44.46348)	-0.030747 (- 19.92092)	-	0.923961 (335.8324)	-	-	-
Vest (R ² = 0.988623) (DW = 2.076266)	0.294225 (10.79843)	0.075679 (14.80957)	0.176468 (3.895762)	0.005260 (5.234382)	0.011468 (4.469463)	-	0.826910 (57.61670)	0.031573 (6.789118)	-	-
Nord-Vest (R ² = 0.999620) (DW = 2.190300)	0.089501 (26.88598)	0.025570 (34.55703)	0.278680 (19.95035)	0.001508 (4.340657)	0.039737 (36.23314)	-	0.959931 (599.0692)	-	-	-0.045901 (- 39.57653)
Centru (R ² = 0.999637) (DW =	0.137535 (53.48938)	0.024477 (34.3574)	-0.333913 (- 22.64822)	-0.014497 (- 60.28965)	0.038416 (47.51916)	-	0.938258 (703.9931)	-	-0.003680 (- 14.58631)	-

¹⁶ Total employed population registered over the analyzed interval beside oscillating dynamics also dramatic drops, especially in the Brașov County, due to the impact of industrial restructuring, much delayed in some sectors.

¹⁷ In the Sud-Vest Oltenia Region the lagged effect of employed population was negative and significant (together with the significant lagged impact of GDP).

2.293190)									
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Source: Author's computation.

One may notice first a common GDP formation pattern as according to the model, but also increased regional peculiarities (practically each region had a specific pattern, although based on the common effects model, which suggests *specific response patterns to the general and regional policies*). The investments impact was also positive and statistically significant (except for the **Nord-Est** Region), with a similar gap among the **Sud-Est, Sud Muntenia** and **Vest** regions and the other regions. Except for the **Sud Muntenia, Vest** and **Nord-Vest** regions, the sign of coefficient of employed population turned negative, which for the analyzed interval suggests opportunities missed due to delayed restructuring. The sign of coefficient of subsidies from state budget was positive and statistically significant, but of low magnitude, except for the **Centru** and **Sud-Est** regions, while the coefficient of expenditures on economic activities was positive (except for the **Sud-Vest Oltenia** Region) and of a magnitude somewhat higher than in the case of subsidies. Where identifiable, the lagged effect was high for the overall economic conditions, but of lower magnitude than in the case of the simpler, two-equations model. Also, one may notice in the **Nord-Vest** Region a small negative lagged effect in the case of expenditures on economic activities, and in the **Centru** Region a small lagged effect of subsidies from the state budget.

Conclusions

Using panel modeling, we attempted to identify whether there were specific patterns of GDP formation given by the contribution of the regions/counties of Romania, as well as the impact of investments and employment dynamics (as competitiveness drivers) and of government policies. Although the analyzed time interval was short, our analysis found specific models of GDP formation within each region („regional economies”), either based on a higher impact of investments (in the *Sud-Est, Sud Muntenia* and *Vest* regions), or of employed population dynamics. Such impacts were augmented (or not) by the effects of certain economic policies, so that one may say that *particular regional responses to the general and regional policies* were identifiable. This calls both for the need of true decentralization of the regional development policies and for a higher policy customization to meet the real needs of people living in certain territories.

The lagged effects were high for almost all variables, but the development pattern was different in relation to the degree of aggregation. The impact of the *București-Ilfov* Region on GDP formation pattern was significant, but the region evolved together with the other regions towards the same direction and not in a different manner.

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