

**ECONOMIC SPACE TRAJECTORY THROUGH DIFFERENT REGIONAL GROWTH MODELS.**  
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JEL: O47, R11, C21, C23

**Abstract**

Regional economic growth processes assumed a key role in the EU policy agenda since the early 1990s, in order to enhance social and economic convergence within the EU spatial landscape.

Literature on regional economic growth and convergence has provided some evidence on most relevant factors affecting economic processes, mainly assuming homogeneity of production functions and steady state conditions in cross-section and panel regressions.

In this framework, assuming a minimal definition of *transitional* steady state, a quantitative analysis has been carried out centred on:

- LSDV (Least Square Dummy Variables) estimates to cluster EU 11 regions (EU 13 excluding UK and Ireland due to lack of statistical data) with homogeneous latent structures affecting different *transitional* growth patterns;
- coupled with multinomial conditional logit models to qualify the spatial distribution of expected vs actual regional gaps.

Even conscious of the shortcomings of the neoclassical production function convergence and divergence mechanisms, a sort of metaphor of substantive economic behaviour, three main findings for an explorative analysis are proposed:

- i) the role of enlarged neoclassical production function and, at same time, its limited weight in the average with respect to social and political factors or other stock fundamental determinants;
- ii) the deep differences of above defined weight between European regions;
- iii) the need for an adaptive governance of EU finance effort, within the same strategic objective of convergence.

**Introduction: a snapshot of regional growth in Europe**

As in the Article 130A of the Treaty of Maastricht, convergence processes between regions at economic and social levels are strongly pursued and they represent the hard core of the European cohesion policy directed to reduce observed inequality in development dynamics. Although the phenomenon seems to be particularly evident by analyzing socioeconomic characteristics of enlarged EU, it is still relevant in the sub area constituted by the first participants to the EU.

By ranking GDP per capita levels as share of average standards in the EU-11 sample of countries (EU-13 less UK and Ireland), it is possible to find out that the 10 most developed regions record a GDP ratio of around 158% during the period 2000 – 2004, in contrast to the 55% of the 10 poorest regions. In this framework, it is important to highlight the lack of significant dynamics in terms of movements in or out the 2 defined groups. Furthermore, the exam of GDP distribution across all sample during the same time span indicates as more of the 66% regions are characterized by a GDP per capita below the average level and as more than 25% of the sample shows GDP standards below the 75% of total average value.

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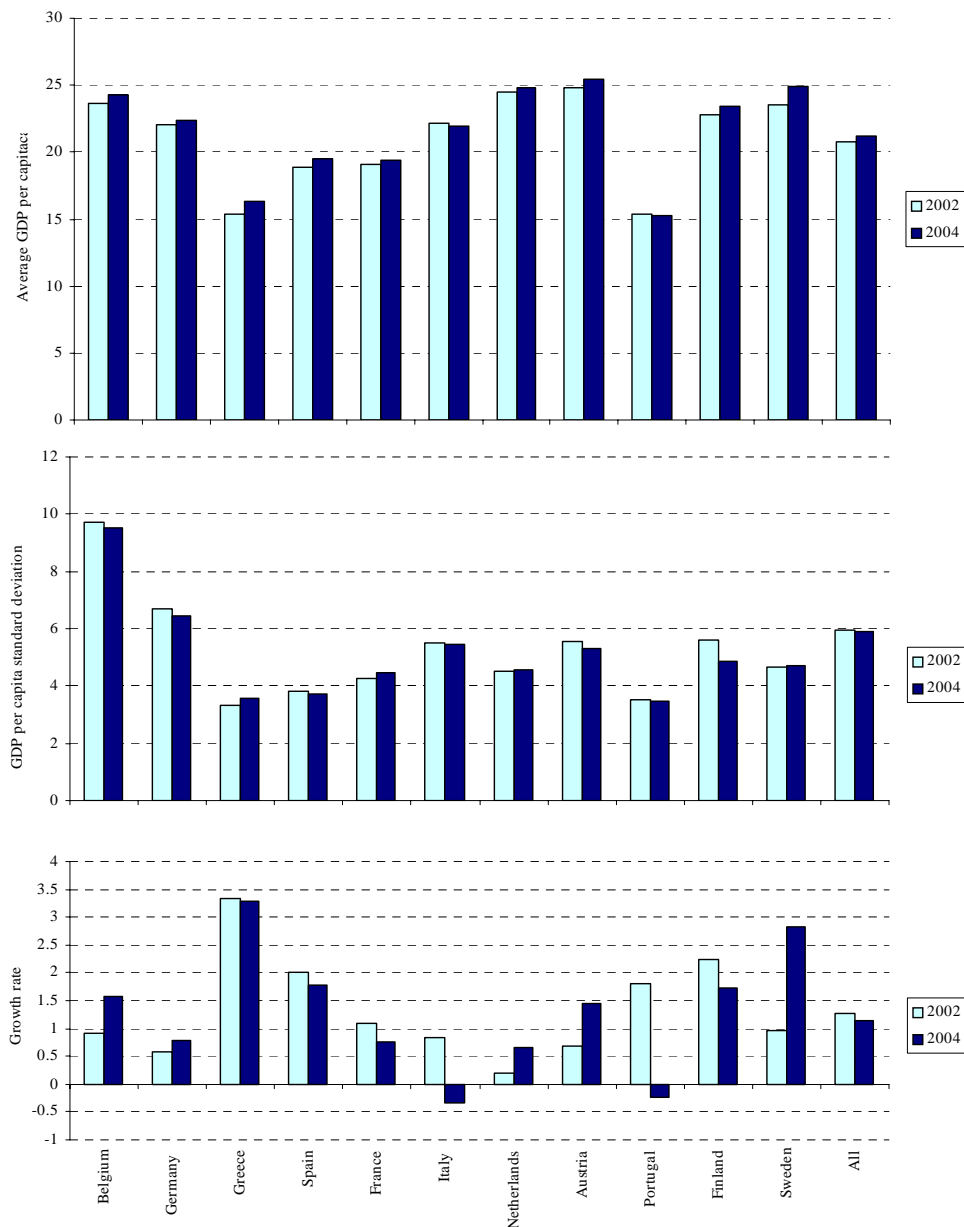
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In general, among EU-11 low income regions are geographically concentrated in the southern parts of Spain, Italy, Greece and Portugal (and some German areas) confirming common conclusions on development delay in the South.

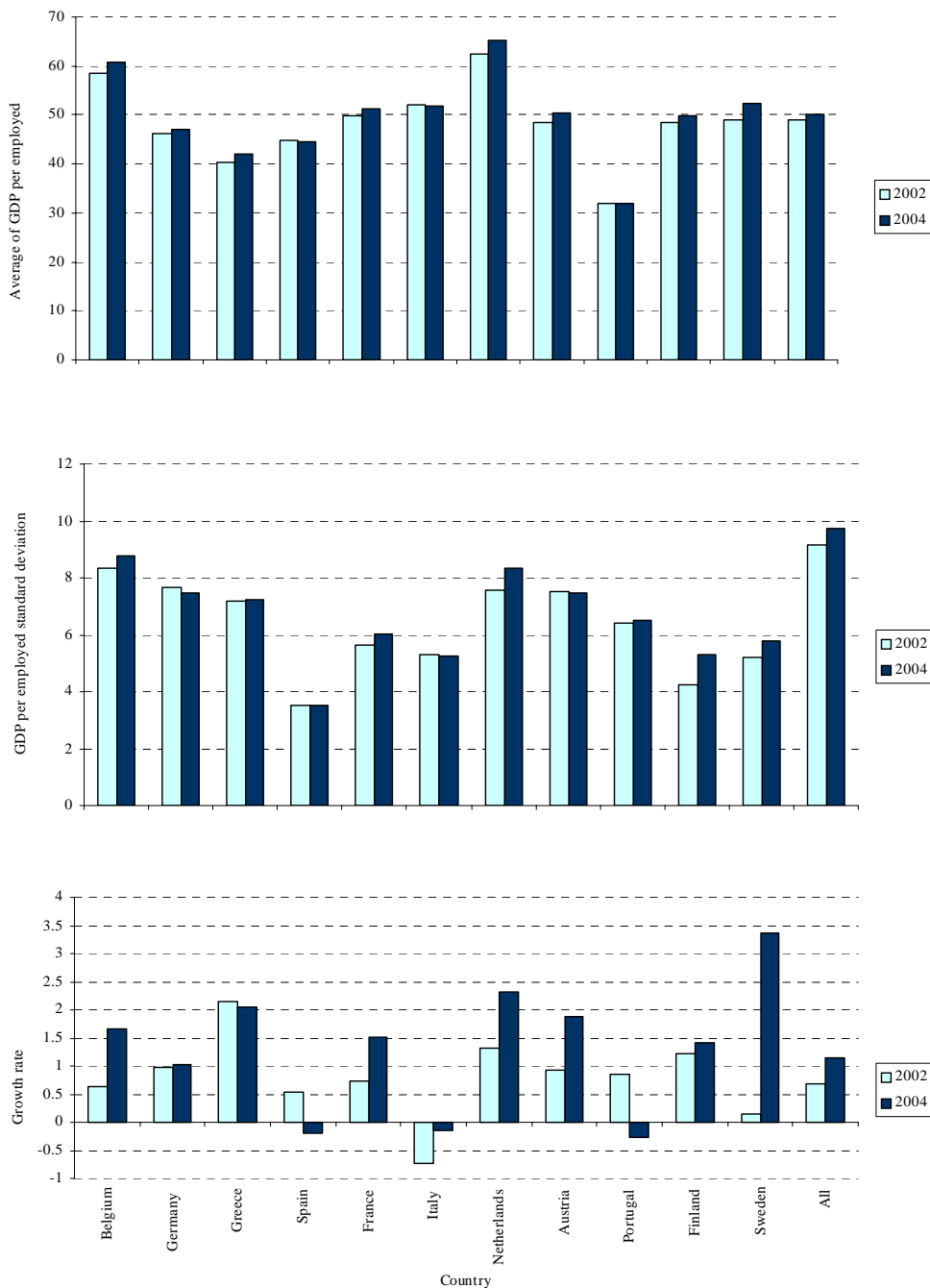
As it is reasonable to be expected, productivity dynamics are strongly related to income distributions across regions and they show the existence of important regional disparities as GDP per capita levels. In particular, during the period 2000 – 2004, it is found out that productivity level range from on average 141% of the EU-11 sample average level in the first 10 richest regions to 61% in the last 10 less developed regions, mainly concentrated in the southern part of Portugal, Greece, Spain and some German areas.

Finally, as presented in Figures 1 and 2, GDP and productivity disparities are also clear if national GDP and productivity dynamics are examined. In particular, during the 2002-2004 period, processes of economic growth are evident in all 11 countries but Italy, Portugal and Spain (even if the last one shows positive temporal variations in GDP levels) though trends present strong differences between different countries.

**Figure 1: Growth of GDP per capita in Europe by countries and regions, 2002-2004**



**Figure 2: Productivity in Europe by countries and regions, 2002-2004**



High variability both between and within countries together with high variability characterizing the whole sample at regional level (bar named “All” in the Figures) indicates the possibility of different development patterns. May partitions of European economic space other than country level be more useful on theoretical and policy grounds?

The mentioned strategic EU effort toward regional cohesion coupled with the above quantitative framework suggests a deeper analysis of convergence/divergence mechanisms within the overall European area, overwhelming to some extent, the country level.

## ***Literature review***

Neoclassical growth theory stresses the existence of convergence processes in the long run as suggested by convergent dynamics of economic growth rates between different areas, countries as well as regions. Starting from the mid-1980s, further theoretical developments and in particular the endogenous growth theory highlight as convergence mechanisms seem to be weaker than it was expected, by showing longer times and not stable patterns of realization than it was suggested in the Solow-Swan model. The new theory addresses economic growth problem by identifying increasing returns and technical change as main factors of development (Romer, 1986; Lucas, 1988; Mankiw, Romer and Weil, 1992; Barro and Sala-i-Martin, 1997). In this general framework, it is possible to define at least three main model variants, *i.e.* “conditional” convergence, “club” convergence and explosive growth patterns. In the first category are included theoretical studies proposing the existence of different long-run steady state solutions constrained by structural and institutional differences between areas. The second groups of theories highlights phenomena of economic convergence between countries characterized by similar economic and social backgrounds. Finally, the third category stresses the possibility of high concentration of technological knowledge and, as a consequence, addresses the hypothesis that differences in economic development trends may be divergent between areas, technological advance being characterized by difficulty in diffusion mechanisms. As in de la Fuente (2002) the findings of “practically all existing studies ... allow us to reject with a fair degree of confidence a series of recent models in which the assumption of increasing returns generates an explosive behaviour of distribution of income across economies that cannot be found in the data”.

## ***Methodological issues***

Literature on regional economic growth and convergence has provided some evidence on several relevant factors affecting economic processes, mainly assuming various extensions of neoclassical production function in cross-section and panel regressions. Theoretical conclusions and policy suggestions have not reached a *consensus*, even if some relevance of human capital, structural change, reallocation of productive factors across sectors and heterogeneity of narrow defined steady state regional condition is recognized.

A minimal definition of transitional steady state for EU spatial units could be the equalization of regional growth rates of productivity, so that regional shares of GDP are stable over time.

Furthermore, a generic specification of the model we are referring to is:

$$[1] \quad \ln Y_{i,t}^* = \alpha_i + \sum_j \gamma_j \ln X_{j,i,t-\tau}$$

$$[2] \quad \ln Y_{i,t} - \ln Y_{i,t-\tau} = \beta(Y_{i,t}^* - Y_{i,t-\tau})$$

$$[3] \quad \ln Y_{i,t} = \beta\alpha_i + \beta\sum_j \gamma_j \ln X_{j,i,t-\tau} + (1-\beta)\ln Y_{i,t-\tau}$$

where

$\beta$  = adaptive coefficient to the above defined steady state, with  $0 \leq \beta \leq 1$

$Y_{i,t}$  = gross productivity in region  $i$  relative to EU regions average

$Y_{i,t}^*$  = expected transitional steady state productivity in region  $i$ , relative to EU regions average conditioned to  $\alpha_i$  and  $X_{j,i,t-\tau}$

$\alpha_i$  = unobserved social/institutional factors specific for region  $i$

$\gamma_j =$  across regions constant parameters for observed factors  $X_{j,i,t-\tau}$  (physical and human capital structural indexes, relative to EU average)

if:  $\alpha_i = \alpha$  and  $\gamma_j = 0$  *absolute convergence*  
 $\alpha_i = \alpha$  and  $\gamma_j \neq 0$   $\sigma$ -convergence without fixed effects  
 $\alpha_i, \gamma_j \geq 0$  extended neoclassical growth model (decreasing marginal returns to scale)

from [1], [2], [3]

$$[4] \quad d \ln Y_{i,t} = \theta_i + \sum_j \varphi_j \ln X_{j,i,t-\tau} - \beta Y_{i,t-\tau} + \varepsilon_i \text{ if } \tau \rightarrow 1 \text{ de la Fuente (1997) general specification}$$

where

$$\theta_i = \beta \alpha_i \text{ and } \varphi_j = \beta \gamma_j$$

since  $\alpha_i \geq 0$ ,  $\gamma_j \geq 0$  we expect  $\theta_i \leq 0$  and  $\varphi_j \leq 0$

Further more for  $d \ln Y_{i,t} = 0$  then,

$$[5] \quad \ln Y_{i,t}^* = \frac{\theta_i}{\beta} + \sum_j \frac{\varphi_j}{\beta} \ln X_{j,i,t-\tau} = \alpha_i + \sum_j \gamma_j \ln X_{j,i,t-\tau}$$

$$[6] \quad Y_{i,t}^* = e^{\alpha_i} * \prod_j X_{j,i,t-\tau}^{\gamma_j}$$

## Data

The work in hand is based on the Eurostat regional statistics (NUTS 2) in the period 2000-2004 for 11 countries<sup>1</sup> and 147 regions.

Three different sub-sets of data are used:

- i) Regional demographic statistics;
- ii) Regional economic accounts (ESA 95);
- iii) Regional labour market statistics.

Proposed models adopt the following variables:

- GDP in volume per employee;
- Gross Fixed Capital Formation on GDP;
- Labour force educational levels: upper secondary and post-secondary non-tertiary education - levels 3-4 on population;
- Labour force educational levels: tertiary education - levels 5-6 on population;
- L.B. Specialization indexes on value added and employees by sector<sup>2</sup>.

<sup>1</sup> Austria, Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Sweden

<sup>2</sup> The Lo Cascio-Bagarani (LB) specialization index can be represented as:

## The estimates

Equation [4] has been tested by adopting a two waves (2002, 2004) panel fixed effects regression in two versions: first one (Minimal) includes as covariates the (ln of) GDP per employee and (ln of) Gross fixed capital formation on GDP; in the second (General) specialization indexes variables representing the structure of production and related improvement or worsening on productivity and (ln of) labour force education level variables as proxies of human capital relative level are added. Both parameters in the Minimal model are consistent with the theoretical assumption. As usual in panel regressions the dimension of GDP per employee parameter is relative high. The inclusion of the other covariates in the General model enhances the explanatory power of the model without violating economic plausibility due to absolute dimension of  $\beta$ . In both models the sign of the fixed effects coefficients is not always negative as it is expected by equation [4].

**Table 1: Productivity growth rate (minimal model)**

Dependent variable: Growth rate of GDP per employee (relative to EU average)	Minimal model
GDP per employee - relative to average (ln)	-0.42044831*** (-11.19)
Gross fixed capital formation / GDP - relative to average (ln)	-0.03351889*** (-4.05)
Constant	-0.02043454*** (-9.56)
Obs. Nr.	294
R <sup>2</sup>	0.80076
F	62.962

Legend: \* p<.1; \*\* p<.05; \*\*\* p<.01  
t in parentheses

$$LB_{i,j} = \frac{\frac{x_{ij}}{\sum_i x_{ij}} - \frac{\sum_j x_{ij}}{\sum_{ij} x_{ij}}}{\left(1 - \frac{x_{ij}}{\sum_i x_{ij}}\right) \times \frac{\sum_j x_{ij}}{\sum_{ij} x_{ij}} + \left(1 - \frac{\sum_j x_{ij}}{\sum_{ij} x_{ij}}\right) \times \frac{x_{ij}}{\sum_i x_{ij}}}$$

where  $X_{ij}$  is the value added or the number of employees of the region  $i$  in the sector  $j$ . This index has a range from 1 (highest specialization) to -1 (absence of expenses, *i.e.* lowest specialization). The difference between  $LB_j^{VA}$  calculated on value added and  $LB_j^{EMP}$  calculated on number of employees, can be considered as a measure of productivity of each region relative to the whole EU sample.

**Table 2: Productivity growth rate (general model)**

<b>Dependent variable: Growth rate of GDP per employee (relative to EU average)</b>	<b>General model</b>
GDP per employee - relative to average (ln)	-.48211476*** (-12.8)
Gross fixed capital formation / GDP - relative to average (ln)	-.02066765** (-2.61)
L.B. S index in construction sector	-.0453386** (-2.26)
L.B. S index in trade sector	-.10004402** (-2.41)
L.B. S index in financial sector	-.08914969* (-1.87)
L.B. S index of productivity in industrial sector	-.09449938*** (-3.06)
L.B. S index of productivity in financial sector	-.08493117** (-2.28)
Labour force edu level - levels 3-4 (ln)	-.0256679** (-2.26)
Labour force edu level - levels 5-6 (ln)	-0.01198949 (-1.64)
Constant	-.03785978*** (-4.31)
Obs. Nr.	286
R <sup>2</sup>	0.8485
F	21.534

Legend: \* p<.1; \*\* p<.05; \*\*\* p<.01  
t in parentheses

Under the defined transitional steady state conditions, equation [6], four components are computed starting from the General model results:

- a) Investment relative component;
- b) Fixed effects component;
- c) Structural component (product of components based on sector and productivity L.B. indexes);
- d) Human capital component (product of components based on the two labour skill variables).

A cluster k-median analysis is developed on those components to group regions in 2002 and 2004. Visual inspection and analysis of descriptive statistics coming out from different clustering trials, indicate a seven economic space partition of EU being a good explicative representation of different regional models. Descriptive statistics for each class are reported in the following prospect and tables.

*Cluster k-median - 7 classes - Year 2002*

Classes	Freq.	Percent	Cum.
1	14	9.79	9.79
2	36	25.17	34.97
3	22	15.38	50.35
4	23	16.08	66.43
5	15	10.49	76.92
6	16	11.19	88.11
7	17	11.89	100
<b>Total</b>	<b>143</b>	<b>100</b>	

*Cluster k-median - 7 classes - Year 2004*

Classes	Freq.	Percent	Cum.
1	15	10.49	10.49
2	35	24.48	34.97
3	40	27.97	62.94
4	25	17.48	80.42
5	9	6.29	86.71
6	12	8.39	95.1
7	7	4.9	100
<b>Total</b>	<b>143</b>	<b>100</b>	

**Table 3: Descriptive statistics by classes and components – Year 2002**

Variables – Year 2002	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
	<b>Class 1</b>				<b>Class 5</b>			
Transitional steady state GDP per emp.	1.333	0.120	1.208	1.646	0.897	0.021	0.864	0.933
Investment relative component	1.000	0.012	0.962	1.011	1.000	0.007	0.992	1.018
Fixed effects component	1.338	0.091	1.201	1.524	0.834	0.024	0.787	0.870
Structural component	0.988	0.030	0.956	1.064	1.027	0.031	0.969	1.069
Human capital component	1.007	0.007	0.996	1.021	1.048	0.020	0.998	1.067
	<b>Class 2</b>				<b>Class 6</b>			
Transitional steady state GDP per emp.	1.084	0.055	0.984	1.221	0.812	0.035	0.732	0.849
Investment relative component	1.001	0.006	0.987	1.016	0.995	0.010	0.975	1.015
Fixed effects component	1.059	0.049	0.979	1.170	0.804	0.036	0.745	0.895
Structural component	1.000	0.030	0.928	1.045	0.985	0.045	0.892	1.043
Human capital component	1.023	0.021	0.999	1.062	1.032	0.030	0.989	1.072
	<b>Class 3</b>				<b>Class 7</b>			
Transitional steady state GDP per emp.	0.989	0.021	0.964	1.040	0.673	0.088	0.477	0.784
Investment relative component	1.001	0.004	0.993	1.008	0.991	0.010	0.977	1.008
Fixed effects component	0.945	0.028	0.901	1.000	0.647	0.110	0.421	0.752
Structural component	1.033	0.025	0.975	1.085	0.992	0.048	0.902	1.051
Human capital component	1.012	0.013	0.999	1.044	1.066	0.053	0.988	1.141
	<b>Class 4</b>							
Transitional steady state GDP per emp.	0.926	0.025	0.870	0.968				
Investment relative component	0.999	0.003	0.992	1.005				
Fixed effects component	0.910	0.020	0.872	0.947				
Structural component	1.003	0.035	0.921	1.041				
Human capital component	1.018	0.023	0.995	1.058				

**Table 4: Descriptive statistics by classes and components – Year 2004**

Variables – Year 2004	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
	<b>Class 1</b>				<b>Class 5</b>			
Transitional steady state GDP per emp.	1.346	0.120	1.215	1.688	0.805	0.027	0.752	0.843
Investment relative component	1.001	0.010	0.969	1.013	0.998	0.009	0.986	1.015
Fixed effects component	1.327	0.098	1.170	1.524	0.794	0.019	0.754	0.813
Structural component	1.002	0.034	0.968	1.083	0.977	0.030	0.917	1.014
Human capital component	1.011	0.006	0.997	1.023	1.041	0.028	0.993	1.071
	<b>Class 2</b>				<b>Class 6</b>			
Transitional steady state GDP per emp.	1.083	0.053	0.992	1.223	0.750	0.025	0.717	0.800
Investment relative component	1.002	0.008	0.986	1.024	0.994	0.005	0.985	1.004
Fixed effects component	1.056	0.046	0.984	1.157	0.729	0.026	0.685	0.777
Structural component	1.004	0.033	0.931	1.056	0.999	0.048	0.885	1.046
Human capital component	1.020	0.013	1.002	1.048	1.037	0.042	0.991	1.132
	<b>Class 3</b>				<b>Class 7</b>			
Transitional steady state GDP per emp.	0.968	0.034	0.897	1.039	0.584	0.076	0.472	0.652
Investment relative component	1.003	0.005	0.986	1.011	0.994	0.009	0.983	1.007
Fixed effects component	0.932	0.028	0.885	1.000	0.540	0.093	0.421	0.650
Structural component	1.021	0.034	0.922	1.080	0.994	0.036	0.949	1.037
Human capital component	1.015	0.015	0.996	1.050	1.102	0.037	1.049	1.136
	<b>Class 4</b>							
Transitional steady state GDP per emp.	0.882	0.022	0.842	0.928				
Investment relative component	0.999	0.005	0.990	1.013				
Fixed effects component	0.846	0.033	0.787	0.915				
Structural component	1.013	0.036	0.921	1.074				
Human capital component	1.032	0.022	0.998	1.059				

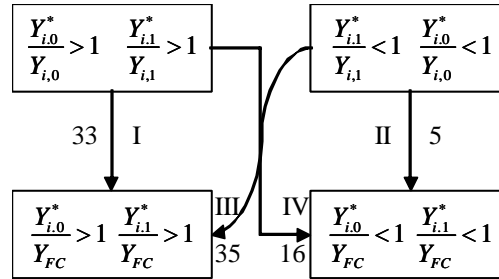
The most relevant facts emerging from previous analysis are:

- a) opportunities and threats variability in socio-institutional factors (as represented by fixed effects values,  $Y_{FC}$ );
- b) different gaps between transitional steady state and current relative productivity.

On this basis it is possible to identify four situations involving 89 regions:

- I. high expected productivity level with respect to current productivity and strong economic performance in both period (33 regions);
- II. low expected productivity level with respect to current productivity and weak economic performance in both period (5 regions);

- III. low expected productivity level with respect to current productivity and potential threats in socio-institutional environment (35 regions);
- IV. high expected productivity level with respect to current productivity and potential opportunities in socio-institutional environment (16 regions);



The first two situations (I and II) represent a condition of stability in the model even if in opposite directions. For this reason they are grouped together in carrying out a multinomial logit model (see table 4). Higher performance in terms of a correct inclusion probability is found out selecting Human capital effects and Structural effects as explanatory variables.

**Table 4: Multinomial logit on 89 regions**

	2000		2002	
	Class logit = 2	Class logit = 3	Class logit = 2	Class logit = 3
Human capital effects	-275.15309*** (-2.71)	77.49647*** (4.48)	-156.16833*** (-2.93)	61.45625*** (3.47)
Structural effects	-186.64773*** (-2.8)	27.71495** (2.41)	-103.72067*** (-3.67)	13.65083 (1.35)
Constant	461.64304*** (2.77)	-108.0351*** (-4.13)	260.53675*** (3.28)	-77.07492*** (-3.05)
Obs. Nr.	89	89	89	89
Log likelihood	-40.016156	-40.016156	-56.816732	-56.816732

(class logit = 1 is the base outcome)

Legend: \* p<.1; \*\* p<.05; \*\*\* p<.01

z in parentheses

**Final overview**

The results achieved with the multinomial logit model allow to obtain more precise characteristics of the classes coming from cluster analyses and to qualify spatial distribution of expected versus actual regional gaps.

As a consequence of that, the proposed classes definition are the following:

- Cluster 1: High socio-economic and institutional development
- Cluster 2: High development with socio-institutional constraints
- Cluster 3: Structural stability
- Cluster 4: Instability in development process
- Cluster 5: Vulnerability at socio-institutional shocks
- Cluster 6: Weak development process
- Cluster 7: Weak development process and system instability

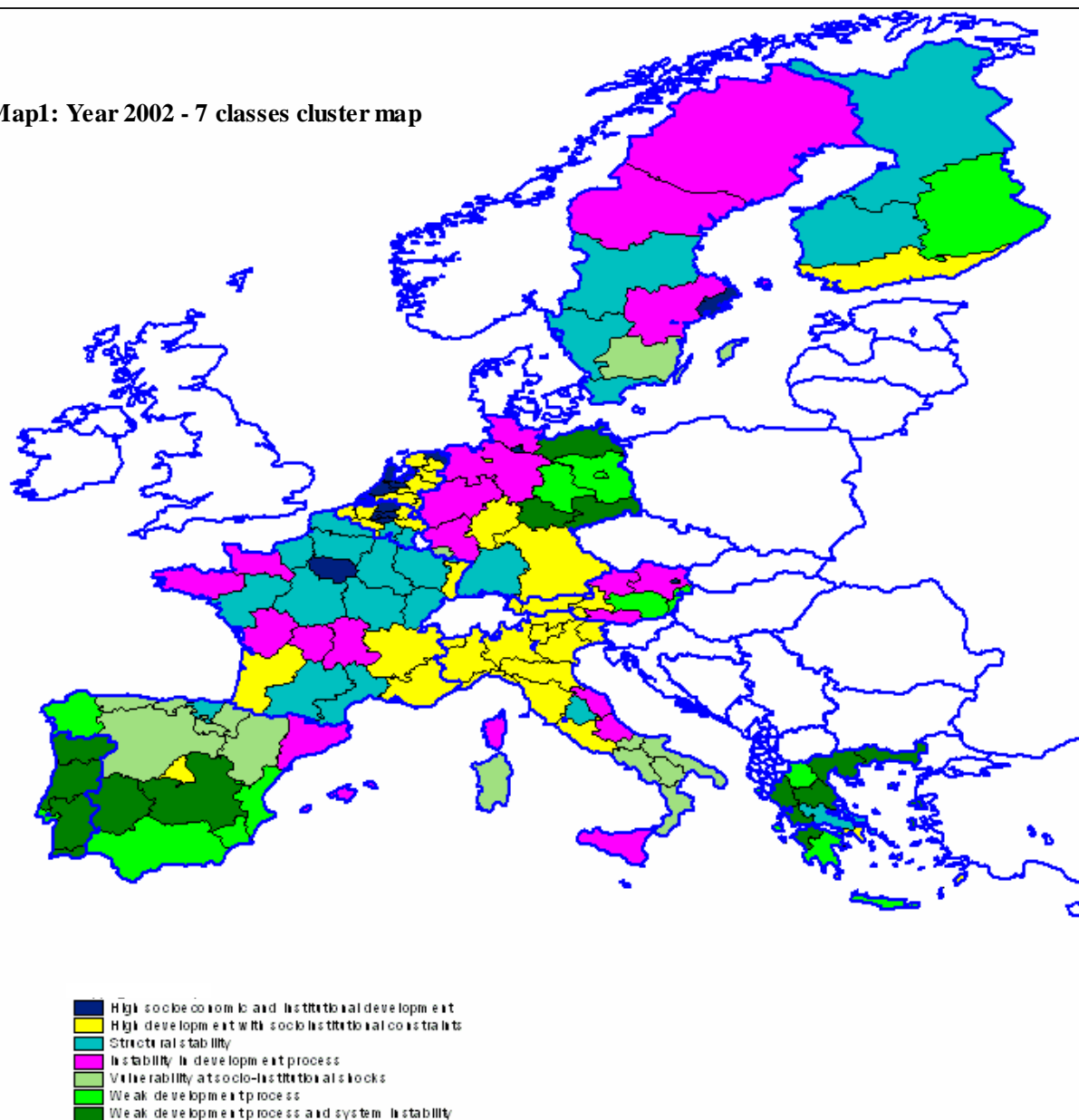
The representation of the classes on the map for both period (2002 - 2004) shows a distribution in which the weakest models are located in the southern part of EU (Portugal, Spain, South of Italy and Greece), with the relevant exception of Eastern-German regions (map 1).

In 2004 an enlargement of the central classes represented by medium-high economic developed regions in the specific area of north-central Europe is coupled with the creation of a new class at the bottom of the rank, i.e. the extreme and poorest regions of Portugal and Greece (map 2).

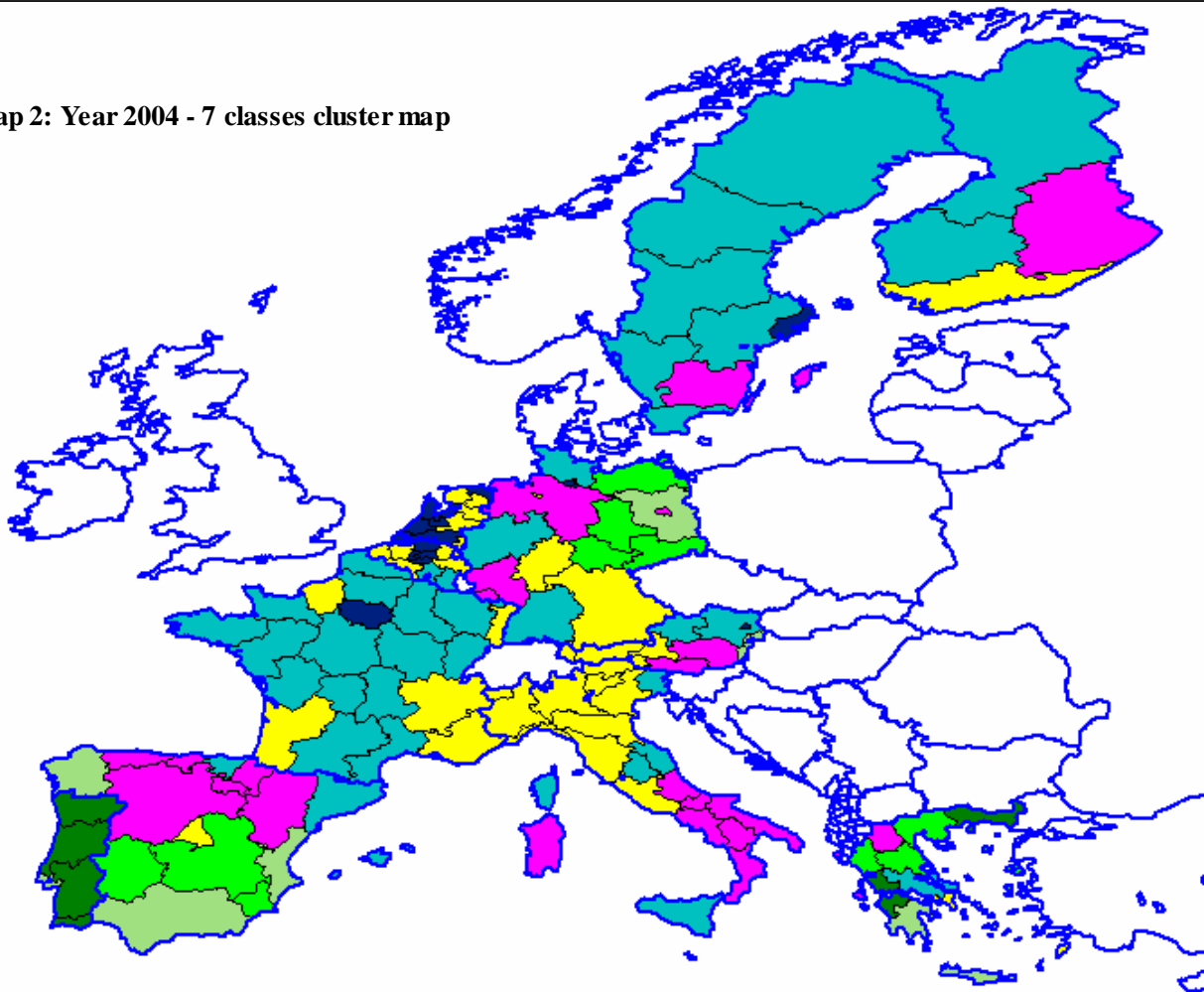
In conclusion, three main findings are proposed:

- iv) the role of enlarged neoclassical production function and, at same time, its limited weight in the average with respect to social and political factors or other stock fundamental determinants;
- v) the deep differences of above defined weight between European regions;
- vi) the need for an adaptive governance of EU finance effort, within the same strategic objective of convergence.

Map1: Year 2002 - 7 classes cluster map



Map 2: Year 2004 - 7 classes cluster map



- Map 2 clusters: ip
- High socio-economic and institutional development
  - High development with socio-institutional constraints
  - Structural stability
  - Instability in development process
  - Vulnerability at socio-institutional stocks
  - Weak development process
  - Weak development process and system instability

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