Structural Changes and Convergence in EU and in Adriatic-Balkans Region

Author:*

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Abstract. *Coming from standard economic growth theory and empirical evidences, we concentrated on the convergence process as a result of structural changes in economy. We investigate the differences among countries in EU in terms of the share in total economy of main sectors. Then, based on the spatial (empirical) distribution of such shares in EU we are proposing a model to estimate a typology of the convergence process in the European area. Taking into account the existing differences among sectors in matter of productivity, there are two versions of the model: considering the share of sectors in total employment and the share of sectors in GDP, respectively. Moreover, we developed several modelling schemes that could be useful to improve the strategies oriented to achieve a real convergence in EU and further in the Adriatic-Balkans Region. In this way, we can obtain simulations from a country or group of countries (European Union, for example) on long term and quantifying the impact of structural changes on the convergence process. Indeed, the actual global crisis seems to influence negatively the convergence process in the EU. As a rule, just newly adhered countries have been more affected by the actual crisis. Today all forecasts are suffering from uncertainty. Thus, further efforts must be allocated to evaluate the negative impact of actual crisis on the convergence process.*

Keywords: *structural changes, convergence, stages of economic development, spatial distribution*

JEL Classification: *C13, C31, E27, O11, O47, O52*

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1. Introduction

The economic theory of development postulates major changes in the structure of national economies along with the historical growth process. On historical scale, firstly agriculture predominates in national economies; then industry is the predominant sector; and finally the sector of services becomes the major part of economy. According to a general rule, during the first stage of development, along with a general increase in income, the demand for agricultural goods is growing, but slower than income due to a smaller elasticity of income relative to demand. On the contrary, in case of manufactured goods there will be a larger elasticity of income relatively to demand. Thus, the share of the secondary sector in economy will increase. However, in the historical process of development, as income is continuing to increase, from one moment people begin to consume more services, taking into account that in their case income elasticity relative to demand is even larger. Consequently, the tertiary sector will develop faster. This general rule is supposed to guide development on the historical scale, but based only on empirical facts.

Such a scheme may be sometimes false. Thus, there may exist underdeveloped by from the level of income per inhabitant, in which the tertiary sector is predominant as a consequence of an extended activity in tourism, concomitantly existing a non-developed secondary sector. This situation implies major risks. For instance, in case of a deep recession in countries supplying tourists can strongly affect income from tourism in the destination country. Further, the overall effect will compromise on a large scale the general development process in that country. In cases where there is no developed primary sector or secondary sector to be potentially re-improved, loan and increasing debt will be alone solutions.

In actual world expansion of the tertiary sector is coincident just with the emergence and fast development of the so-called new economy. Thus, the new economy is often viewed as economy of services. Many authors consider as base of a spectacular growth of the tertiary sector in developed countries during last time certain activities such as: scientific research and technological development; design and experimentation; marketing and trade (including external trade); production, stocking, processing and transmission of information; improvement of human factor, education, health, and increasing of life quality (including quality of environment, leisure, tourism); financial activity, banking, insurance societies, and capital markets, etc. Just such “services”, on which the efficiency essentially depends even in the so-called material sphere of production, demonstrate today the highest dynamics. They are either integrated

together with proper productive activities in the same system or developed as autonomous systems, such as: “banking industry”, “tourism industry”, “information industry”, etc.

2. The theoretical model and empirical evidences

Economic theory usually uses a number of stylised facts of structural changes along with economic growth process. According to it, a satisfactory theory of structural changes should be able to explain the real evolution illustrated by empirical data. Among conclusions three stylised facts are highlighted: the share of the primary sector shows continuing decrease converging in the long run to a small constant value; the share of the secondary sector increases to a maximum value but further it decreases converging in the long run to a constant value; the share of the tertiary sector shows continuing growth converging in the long run to a high value. Consequently, a model of structural changes should be able to simulate such dynamics.

In order to estimate parameters describing medium- and long-run evolution of the structure of different national economies either econometric models usually are used or alternatively they should be calibrated to fit reasonably empirical data.

To build a theoretic model, in this case essentially non-linear model, we consider some limit-values to which trajectories of the shares in case of the three sectors are asymptotically converging on long term, depending on the level of GDP per inhabitant. The basic hypotheses, plausible from theoretical viewpoint, should be also in accordance with empirical data. There are three hypotheses that we used for the model, as follows:

$$na = h = ct., \quad \text{for } y \to +\infty \tag{1}$$

$$ni = 0, \quad \text{for } y \to 0 \tag{2}$$

$$ns = d = ct., \quad \text{for } y \to +\infty \tag{3}$$

where: na, ni and ns are shares in employment of the primary sector (mainly agriculture), secondary sector (mainly industry), and tertiary sector (services) respectively. Based on these hypotheses dynamics of shares of agriculture and

services in total employment can depend on the GDP per capita, y, expressed by the following two relations:

$$na\,(y) = (A*h*y + m*B) / (A*y + m) \quad (4)$$

$$ns\,(y) = d / (1 + e^{b-c*y}) \quad (5)$$

where: A, h, m, B, d, and c are calibrated parameters (they can be also econometrically estimated); e is the base of natural logarithms. Moreover, considering the complementary relation, na+ni+ns=1, one should write also the dynamics of the share of industry in total employment:

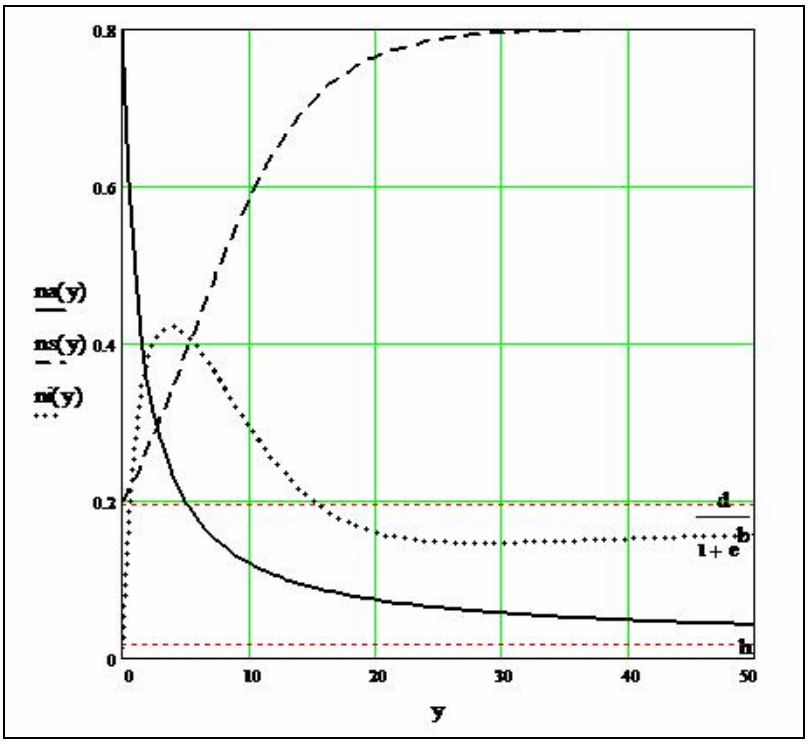
$$ni\,(y) = 1 - \{[(A*h*y + m*B) / (A*y + m)] + [d / (1 + e^{b-c*y})]\} \quad (6)$$

Also, taking into account hypothesis (2), we obtain the following implicit relation:

$$B = 1 - [d / (1 + e^{b})] \quad (7)$$

Based on available cross-section statistical data in period 1970-2000, for a number of about 100 countries (including all groups of countries, from poorest to richest), and on the hypothesis of some long-run asymptotical trajectories, we calibrated the model. Simulating the model demonstrated that in the case of industry there are a local minimum and a global maximum, corresponding to two specific critical values of income per inhabitant. Based on the model we can also simulate certain relevant long-run trajectories of structural changes. For instance, using the following set of values for parameters, A=2, h=0.02, m=3, d=0.8, b=1.12, and c=0.21, the simulation of the model resulted in case of industry in a maximum of its share in total employment, ni, equal to around 42% (corresponding to a critical value of GDP per capita y=4000 USD) and a minimum equal to around 14.7% (corresponding to y=28500 USD). The complete map of simulation is shown in Figure 1 (where y is in thousands of USD). Discrepancies among countries can be viewed now not only as difference in income per inhabitant but also in terms of structural gap. Moreover, the simulation of model demonstrates a general converging of structures on long term along with the economic growth process.

Figure 1



3. Spatial distribution of some macroeconomic variables in Europe

In the context of actual convergence policy in EU-27, it is useful to analyse the spatial distribution of some basic macroeconomic indicators. Moreover, according to recent available data from EUROSTAT for EU countries we used as output of simulation models some significant 3D graphical representations and their attached so-called geodesic maps or contour plots.

Among the selected macroeconomic variables, the most significant is GDP per inhabitant. Figure 2 shows its spatial distribution in 2007 (before the global crisis), as a stylised map of the EU, where LO is longitude (on its left side relating to the origin, 0 meridian, we changed West longitude, as it is marked usually on geographical maps, in negative values), LA – latitude, and yPPS – level of GDP

per capita in thousand Euro PPS (Purchasing Power Standards). On the stylised map of EU-27 we can see two distinct groups of regions delimited by 30 to 55 contour lines (light greys) and respectively by 20 to 10 contour lines (dark greys) representing highest and respectively lowest GDP per capita levels. As two general rules, GDP per capita level is increasing from the right side of EU stylised map (Eastern EU regions) to the left side (Western EU regions) and respectively from the bottom (Southern EU regions) to the top (Northern EU regions). Moreover, Figure 3 shows the spatial distribution of GDP per capita, as differences from the average EU level (EU-27 = 100) in 2009 (in the middle of the global crisis).

Spatial distributions in the EU of other macroeconomic variables considered in the convergence programme are presented in Figure 4 – inflation, at the end of December 2010 (2005=100), and in Figure 5 – unemployment rate, at the end of December 2010.

Figure 2

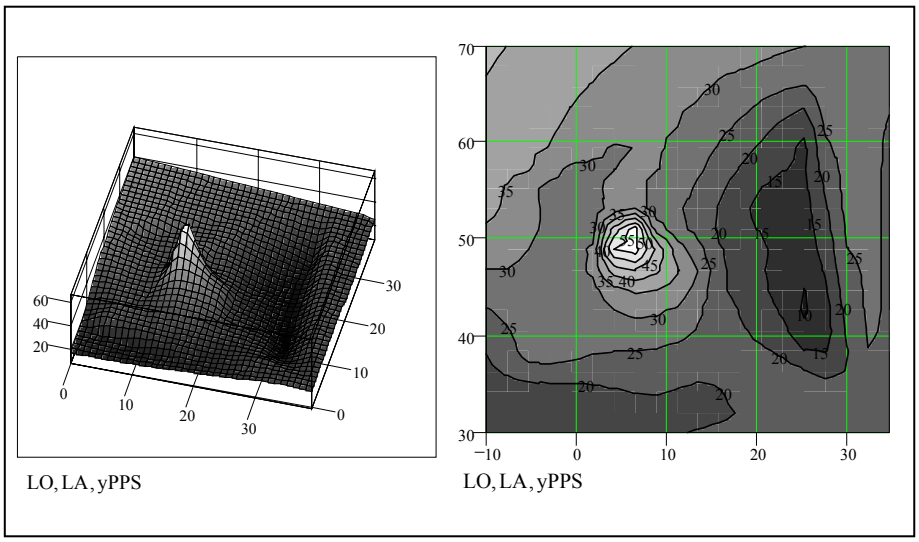


Figure 3

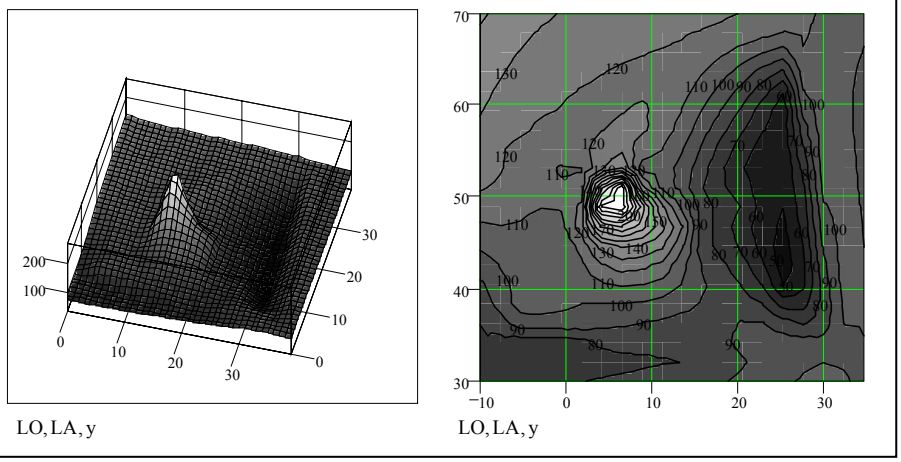


Figure 4

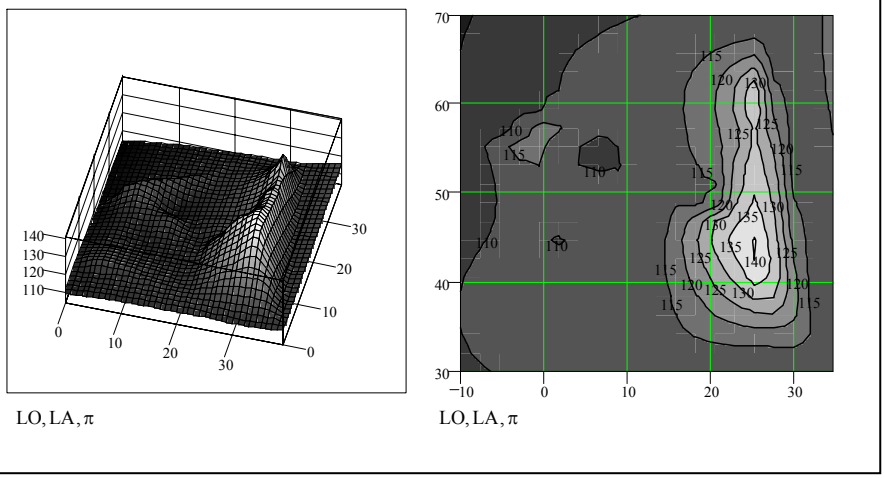
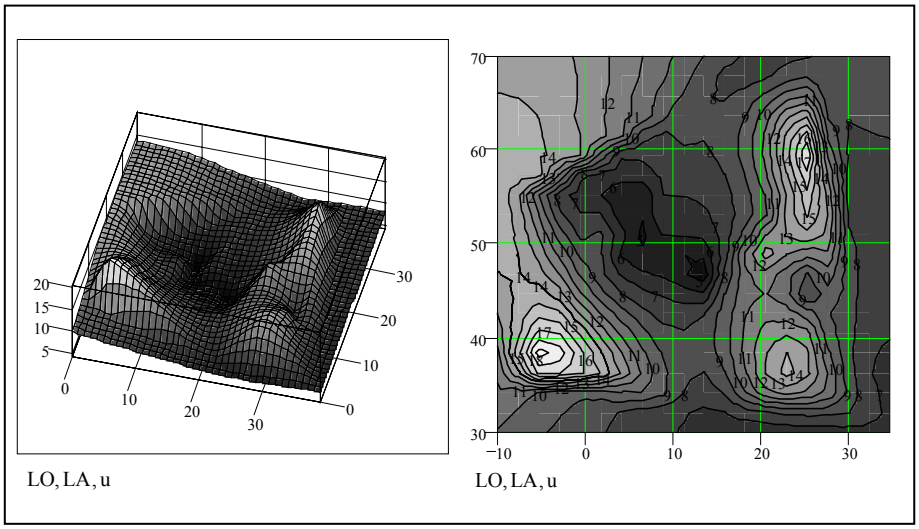


Figure 5



In order to illustrate how the global crisis affected the convergence in EU, we are presenting comparatively, in Figures 6 and 7, the distributions in the EU of the GDP growth rate in the period 2006-2007 (average annual growth rate) and respectively in the period 2008-2009 (average annual growth rate). We can see a dramatic change in GDP growth rate distribution between the years before the crisis and those in crisis (the year 2008 was excluded because some countries were already affected by crises but others were not yet affected). During the last period, the most affected countries by crisis are just those registering lower level of GDP per capita in the EU (as a rule, they are the newly adhered members located in the Eastern area of Europe). Thus, as the global crisis will delay the recovering process in less developed countries of the EU the convergence process will equally be affected.

Figure 6

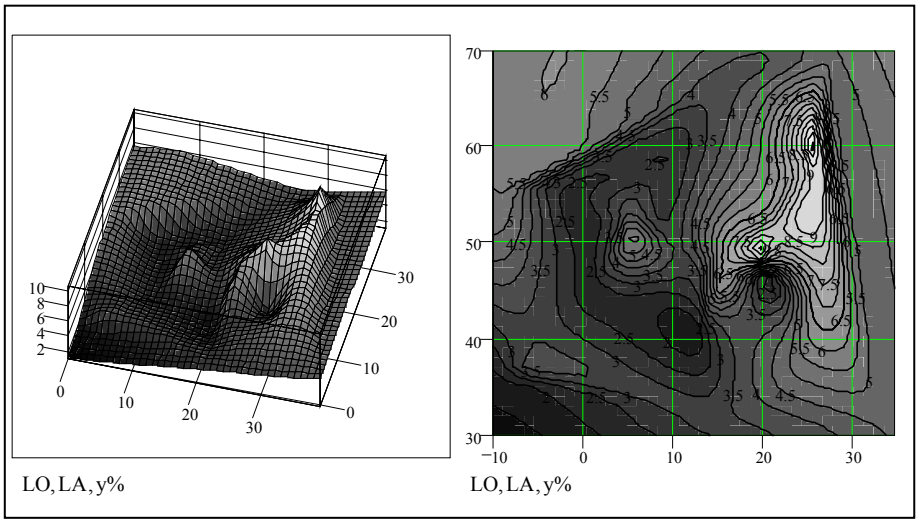
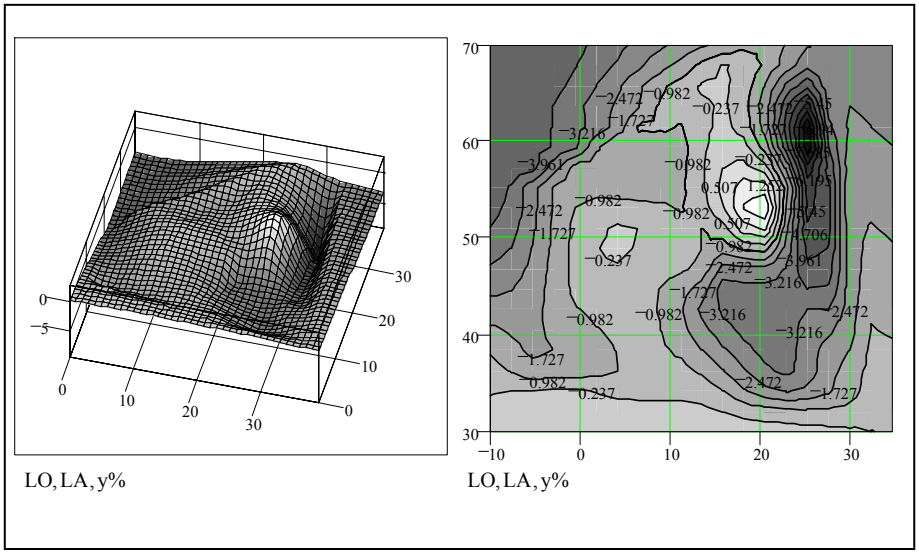


Figure 7



3. Continuing the convergence in UE-27

Based on the study of structural changes by stages of economic development it resulted that the differences among countries can be evaluated by discrepancies in the services sector contribution both in total employment and in GDP. Analysing data on the share of services in GDP in an historical short period, 1995-2007, demonstrates a strong expanding tendency for all EU countries. Regarding this criterion of convergence, Romania is the first country within the EU, registering an increase of 16.9 percentage points, from 38.8% to 55.7% (Latvia, placed on the second position, registered in the same period a growth of 16.7 percentage points, from 56.6% to 73.3%). However, Romania continues to be on the last place in the EU regarding the share of services in total GDP. Consequently, in the case of Romania, the shares of agriculture and respectively of industry in total GDP are among the highest in the EU (6.5% and 37.8%, respectively in 2007).

In order to estimate trends in structural convergence in the EU by economic growth we used a model just a little different from the previous theoretical model. Statistical data are referring to 2007 (thus, before the crisis). We calibrated the econometric model by supposing that there are certain limit-values to which each of the three trajectories are tending along with the income per capita growth. Thus the specification of the model is in line with both long-run growth theory and empirical data supplied by economic history. These hypotheses are synthetically expressed by the following equations used for regression in the case of the agriculture sector, ya, and respectively services sector, ys:

$$ya\_E\,(y) = [\,(k1*y + k2) / (k3*y + k4)\,] \quad (8)$$

$$ys\_E\,(y) = [\,k5 / (1 + k6*e^{k7*y})\,] \quad (9)$$

where: y is GDP per capita (we also used GDP per capita in Purchasing Power Standards), k1...k7 are estimated parameters, and e is the base of natural logarithms.

In order to estimate the share of the industry sector in GDP, yi, we simply operate the substitution of the above two relations in the balance relation, ya+yi+ys=1, obtaining the following equation:

$$yi\,(y) = 1 - \{[(k1*y+k2) / (k3*y+k4)] + [k5 / (1+k6*e^{k7*y})]\} \quad (10)$$

The results of applying the cross-section model (using GDP in PPS) on EU countries are presented in Figures 8-10 (where the two dashed lines delimit the confidence statistical interval). Moreover, Figure 11 shows the resulted general theoretical model at the level of entire EU for 2007. Thus, as minimum for the share of agriculture sector there resulted a value close to 0% and as a maximum for the share of services sector there resulted a value equal to about 87%. These values show that in case of newly adhered countries a significant gap relating to the average EU level in matter of structural changes still exists. In the case of the industrial sector a value of global maximum equal to about 31.1% (corresponding to a critical value of GDP level per capita equal to about 12000 PPS) resulted and a value of long-run minimum equal to about 13.4% (in case of a very large income per capita) respectively. More detailed interpretation can be extracted from the so-called surface plot or 3D map and contour plot representations of the estimated EU model (see Appendix 1).

According to the resulted cross-section model (estimated on the base of 2007 data) we can evaluate long-run dynamics structural changes for each individual country. Thus, the actual gap between newly adhered countries and average level in EU could be interpreted as delay in time, the actual structure of their economy representing a similar situation with that existing in developed western countries in EU 10-20 years ago. Moreover, there is evidence demonstrating that the long-run trends in new members of the EU will be similar to those registered in Western countries.

Figure 8

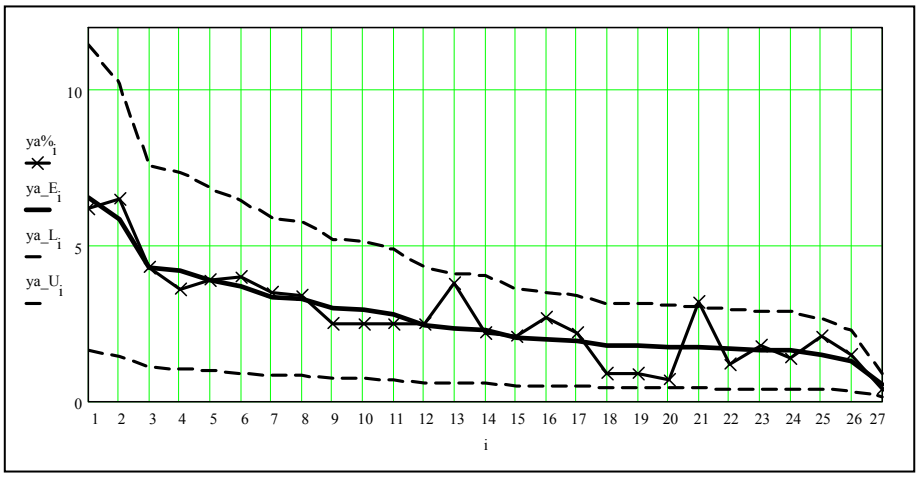


Figure 9

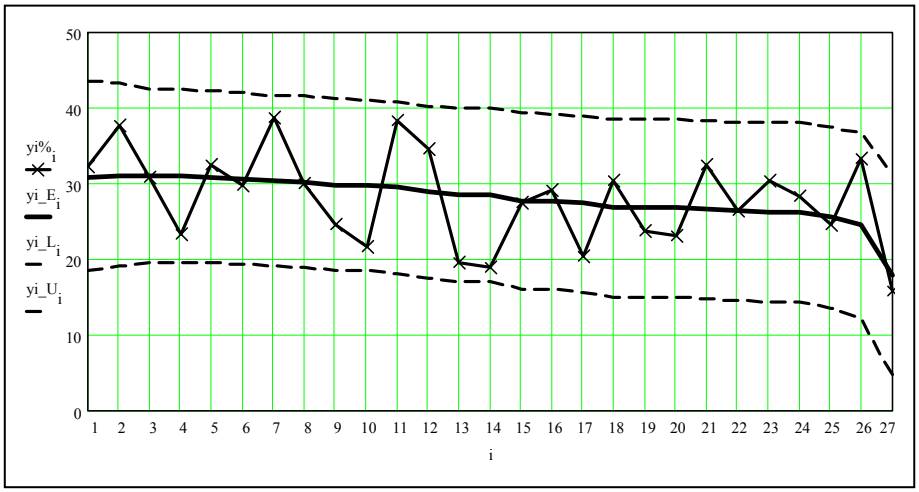


Figure 10

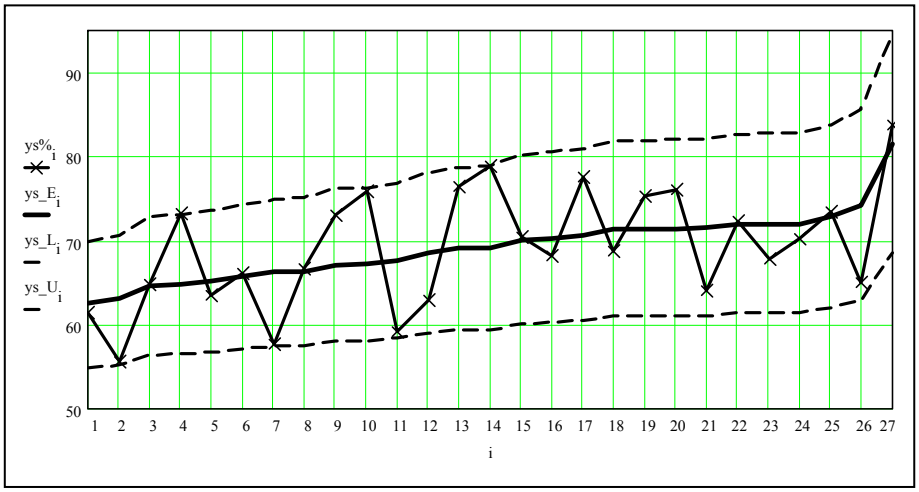
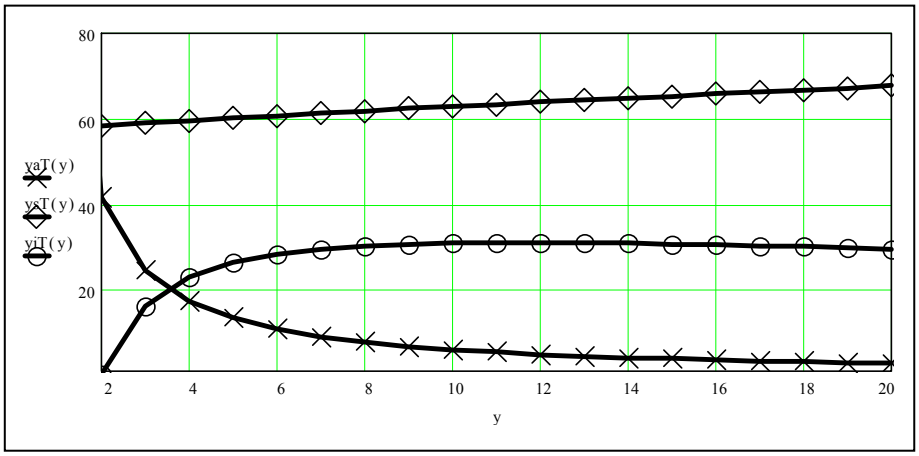


Figure 11



We also applied the model of structural changes to more digitalised data from EUROSTAT, namely NUTS2 (comprising around 395 regions in EU). The resulted estimations are somewhat different but the conclusions generally are still maintained (see Appendix 2). Moreover, according to the available data (Nuts 2 database for 2007) we analysed correlations for a number of macroeconomic variables in the case of EU-27.

4. Correlations at the European level

According to the available data (Nuts 2 database for 2007) we analysed correlations for a number of macroeconomic variables in the case of EU-27. The selected variables are as follows:

y - GDP per inhabitant in current prices (Eur);

yPPS - GDP per inhabitant in PPS (Eur);

rAC - Activity rate (active population/total population aged 15 and over,%);

rOC - Rate of occupancy (occupied population/total number of population,%);

rPop70 - Rate of population aged over 70 (%);

u - Unemployment rate (%);

rP0_14 - Rate of population aged 0-14 (%);

rEM - Employment rate (employed population/total population aged 15-64,%);

rP15_64 - Rate of population aged 15-64 (%);

ag% - Share of agriculture (plus hunting, forestry and fishing) in labour force;

in% - Share of industry (plus construction) in labour force;

se% - Share of services in labour force;

rP65_Max - Rate of population aged 65 and over (%);

rIMB - Ageing rate (population aged 65 and over/ population aged 0-14,%).

Using Nuts 2 database, at the EU-27 level, GDP per capita is strongly correlated positively with the following variables:

1. Share of services (se%) - $\text{corr}(y, se\%) = 0.675$
2. Occupancy rate (rOC) - $\text{corr}(y, rOC) = 0.588$
3. Employment rate (rEM) - $\text{corr}(y, rEM) = 0.530$
4. Activity rate (rAC) - $\text{corr}(y, rAC) = 0.438$
5. Rate of population aged 0-14 (rP0_14) - $\text{corr}(y, rP0\_14) = 0.222$

and negatively correlated with the following variables:

Share of agriculture (ag%) - $\text{corr}(y, ag\%) = -0.538$

Share of industry (in%) - $\text{corr}(y, in\%) = -0.490$

Rate of population aged 15-64 (rP15_64) - $\text{corr}(y, rP15\_64) = -0.325$

Unemployment rate (u) - $\text{corr}(y, u) = -0.264$

Moreover, between GDP and variables such as Rate of population aged over 70 (rPop70), Rate of population aged 65 and over (rP65_Max), and Ageing rate (rIMB), there are insignificant correlations (values near 0).

5. Correlations at the Adriatic-Balkans Region level

Based on the available data (Nuts 2 database) we analysed also the correlations for a number of macroeconomic variables in the case of the Adriatic-Balkans Region (the sub-regions included are: Bosnia-Herzegovina, Bulgaria, Croatia, Montenegro, Hungary, Italy - only the north-eastern part, Romania, Serbia, and Slovenia). Analysing the Adriatic-Balkans region at the level of so-called NUTS 2, the resulted spatial distributions of GDP per capita (in PPP dollars and in current dollars, in 2009) are presented, as stylised maps of the region, in Figures 12 and 13. Also, a more precise map is presented (only as a contour plot imagine) in Figure 14, obtained by considering the area of the Adriatic Sea included in the stylised map at 0 level.

Figure 12

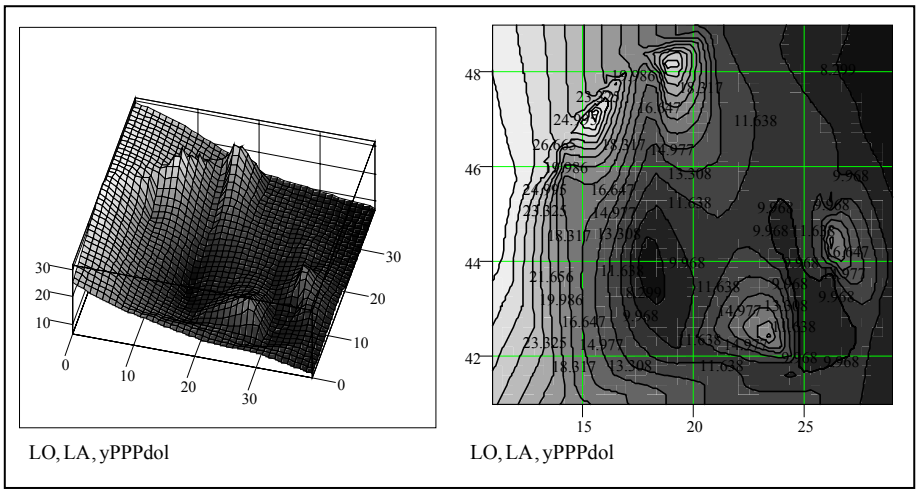
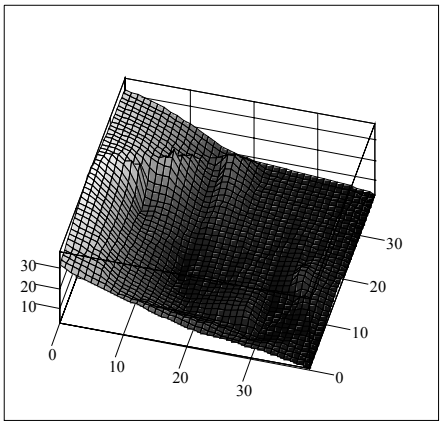
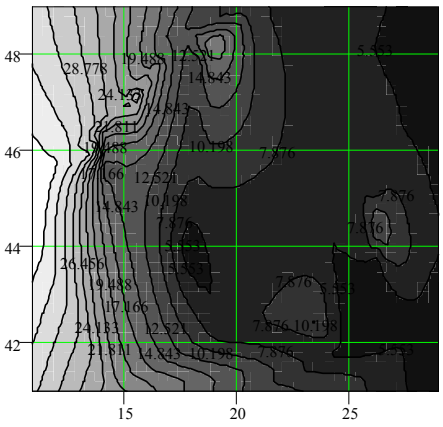


Figure 13

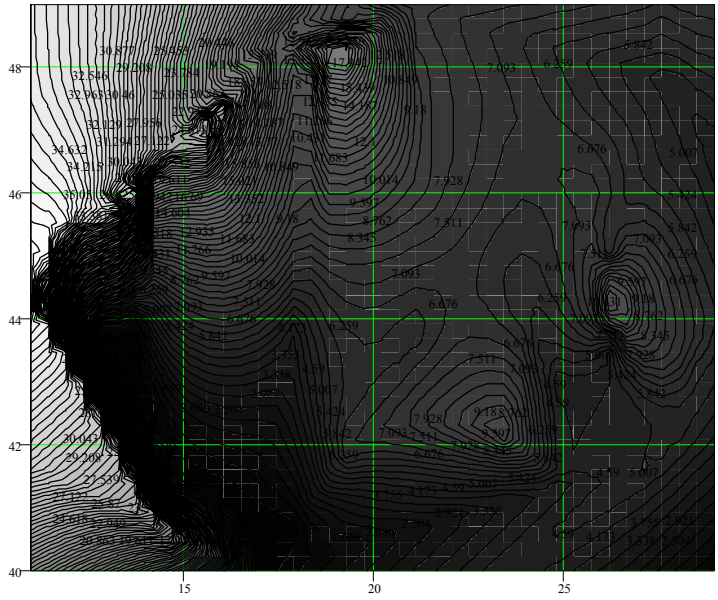


LO, LA, y_dol



LO, LA, y_dol

Figure 14



LO, LA, y_dol

Using Nuts 2 database, at the ABR level, in 2007 the GDP per capita is strongly correlated positively with the following variables:

1) *Ageing rate (rIMB)* - $\text{corr}(y, \text{rIMB}) = 0.572$
2) *Rate of population aged over 70 (rPop70)* -$\text{corr}(y, \text{rPop70}) = 0.562$
3) *Rate of pop. aged 65 and over (rP65_Max)* -$\text{corr}(y, \text{rP65\_Max}) = 0.561$
4) *Employment rate (rEM)* - $\text{corr}(y, \text{rEM}) = 0.555$
5) *Share of services (se%)* - $\text{corr}(y, \text{se\%}) = 0.462$
6) *Occupancy rate (rOC)* - $\text{corr}(y, \text{rOC}) = 0.437$

and negatively correlated with the following variables:

1) *Unemployment rate (u)* - $\text{corr}(y, u) = -0.564$
2) *Share of agriculture (ag%)* - $\text{corr}(y, \text{ag\%}) = -0.418$
3) *Rate of population aged 0-14 (rP0_14)* - $\text{corr}(y, \text{rP0\_14}) = -0.414$
4) *Rate of population aged 15-64 (rP15_64)* -$\text{corr}(y, \text{rP15\_64}) = -0.389$

Moreover, between GDP and variables as Activity rate (rAC) and Share of industry (in%), there are insignificant correlations (values close to 0). Despite of the ABR is partly included in EU-27, there are some significant differences between them in matter of how the correlations among variables are.

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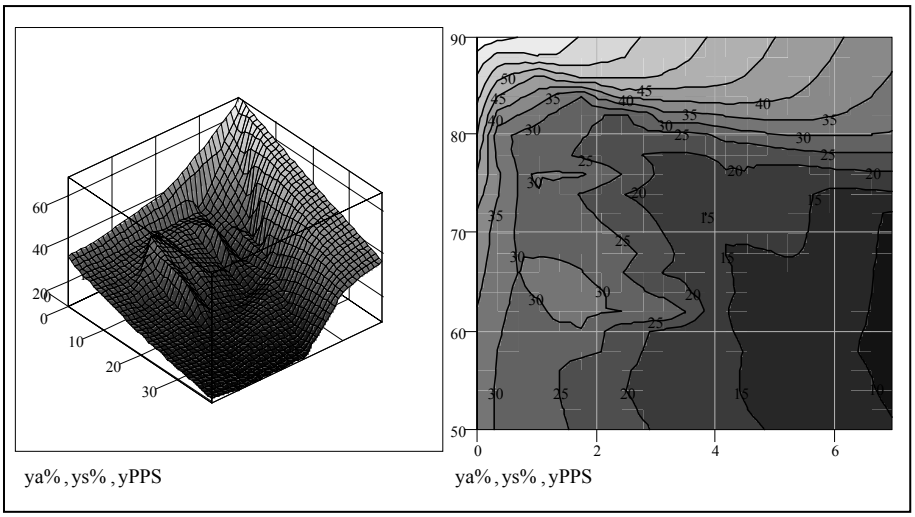
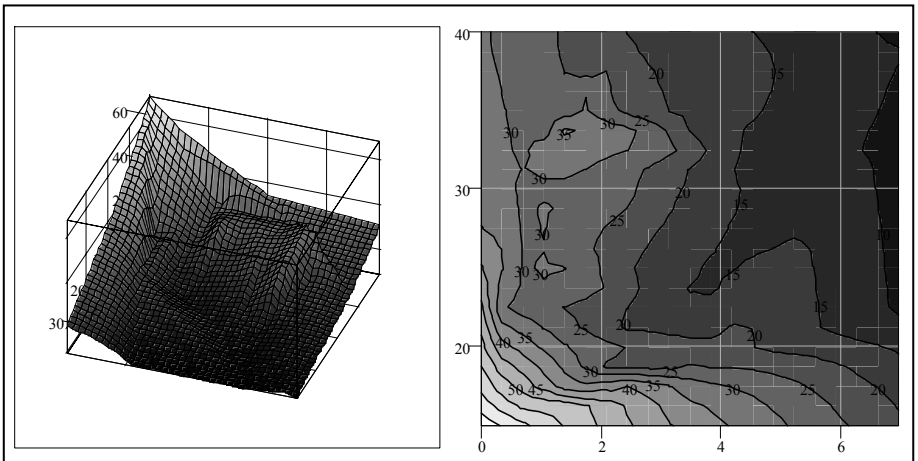
Appendix 1

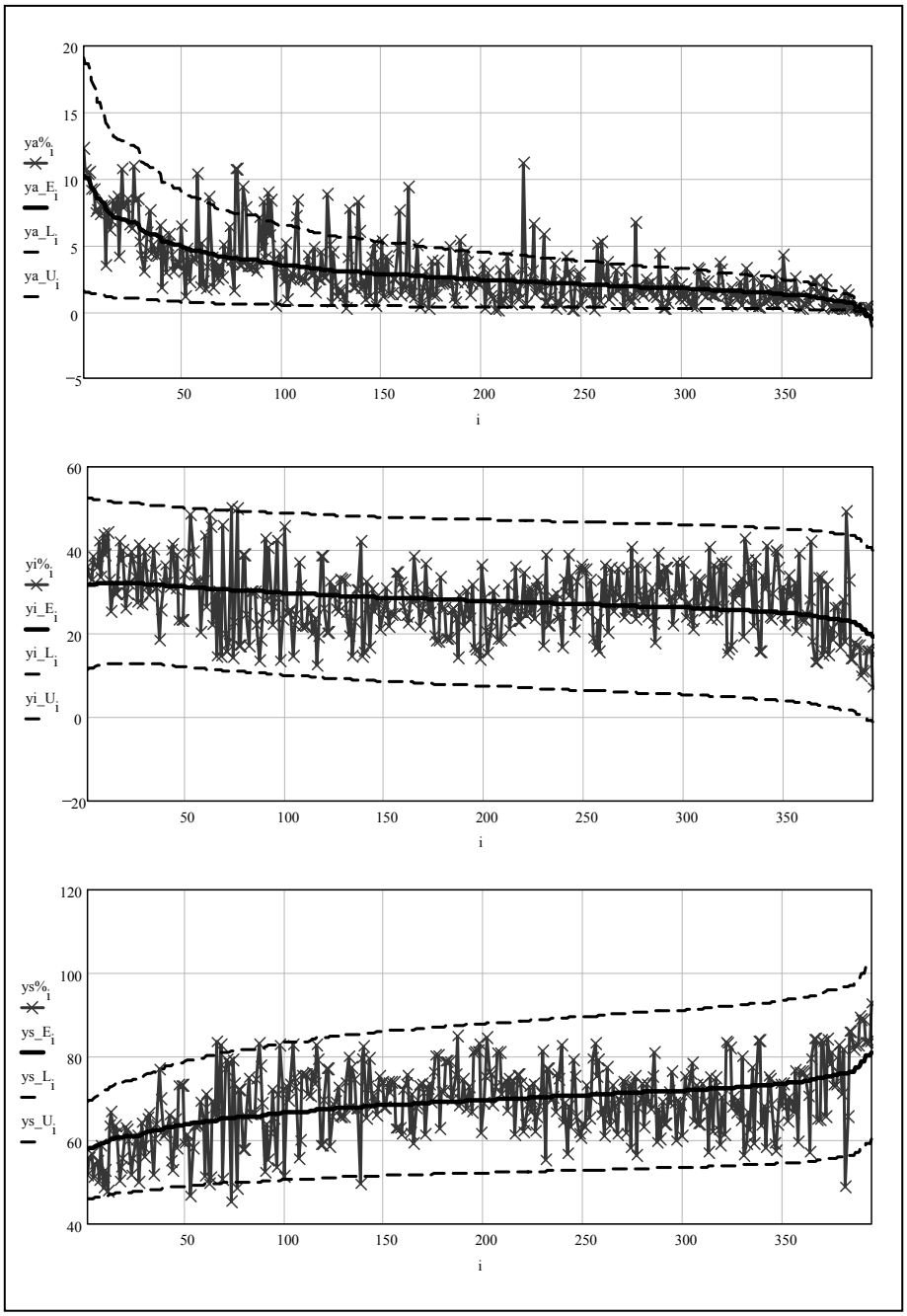


ya%, ys%, yPPS ya%, ys%, yPPS



ya%, yi%, yPPS ya%, yi%, yPPS

Appendix 2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