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Article

Disparities, Discrepancies and Specific Concentration – Diversification Trends in the Group of Central and East European Ex-Socialist Countries

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DISPARITIES, DISCREPANCIES AND SPECIFIC CONCENTRATION –
DIVERSIFICATION TRENDS IN THE GROUP OF CENTRAL
AND EAST EUROPEAN EX-SOCIALIST COUNTRIES

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Abstract

The paper identifies some major disparities and quantifies some discrepancies and gaps, as well as specific trends of concentration-diversification in today's group of the 11 former socialist economies of Central and Eastern Europe (CEEC). After a brief introduction describing the approach based on multiplied research focused on the ex-socialist economies in CEEC that have already acceded to the European Union (EU), a special section is devoted to the statistical concepts that are measurable and applied in this paper, i.e. disparity and gap or discrepancy, finally detailing an original research method that capitalizes on these statistical tools with matrices and econometric models (including those focused on associations, correlations and concentration-diversification coefficients). A set of major variables are analysed and discussed in parallel with some trends that have already been presented in the international literature, outlining the specifics of CEEC economies in the context of their real convergence to the EU average level (EU-28 and EU-16). A few final remarks identify some paradoxes of the economies analysed.

Keywords: disparities, gaps, concentration-diversification, convergence, Gini-Struck coefficient, ex-socialist Countries in Central and Eastern Europe (CEEC).

JEL Classification: C10, C19, C59, O47, O52.

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Introduction

The former socialist economies of Central and Eastern Europe, immediately after their accession to, and integration with the European Union, accelerated the complex process of economic convergence, even if some are already become members of the Eurozone, and others are due to become members. These countries changed successive strategies, trying to ensure the achievement of a number of goals of economic stability and synchronization of business cycles against asymmetric shocks (Frankel, 2004), to ensure a tendency to approximate the GDP per capita, with effects of catching up in relation to the EU-28 or EU-15 (Le Gallo and Dall’Erba, 2006), and also to gradually harmonize the level of productivity, reduce the structural economic disparities, while ensuring the complementarity of former socialist economies in a common area, or intra-EU, Central and Eastern European aggregated space (CEEC).

In the last two and a half decades several studies have been published concerning the evolution of the economies of former socialist countries, initially addressing nations with a somewhat longer history in the transition process, even prior to 1989, and therefore having a higher level of development, such as East Germany, Czechoslovakia (now the Czech Republic and Slovakia), Poland and Hungary, as the other former socialist countries were not initially included in comparative analyses, or benchmarking, focused on disparities and gaps in relation to the average European trend.

From 1970 to 1980, within the Eastern bloc, the first activities in the field of the market economy were felt with greater intensity as informal forms of trade, made between the people who formed the societies of the countries in Central and Eastern Europe (Kochanowski, 2010). From conducting a number of scientific investigations, the role of which was to compare the economies of East Germany and West Germany, a subject matter which is still an important topic in European economic research (Fritsch, Bublitz and Sorgner, 2014), research gradually shifted to benchmarking (or comparative analyses), first addressing only two national economies, for which even grants were created, with a development-supportive role (PHARE), namely Hungary and Poland (Commander and Coricelli, 1992), and then involving even trilateral comparisons of the countries in Central Europe, adding the Czech Republic to the former countries (Samitas and Kenourgios, 2005).

Many successful economic researches are focused on multidimensional databases having to do with quantifying the progress in the accession to, and integration into the European Union, as the conceptualization of EU convergence has constantly been changing in terms of structures, areas and potential indicators, thus resizing the group of the ex-socialist Central and Eastern European nations (CEEC).

Thus, this group of former socialist countries, facing the impact of accession and integration, implicitly of the analyses of the disparities, gaps and trends specific to concentration-diversification, continuously evolved from CEEC-6, comprising Bulgaria, Poland, the Czech Republic, Romania, Slovakia and Hungary (Wachtel, 1999; Rainnie, 2000), to CEEC-7, including Slovenia (Hertel, Brockmeier and Swaminathan, 1997), and then by including the Baltic nations and East Germany to make up CEEC-11 (Williams and Horodnic, 2015), and even CEEC-12, in anticipation of Croatia’s accession after 2014 (Kavkler, Borsic and Beko, 2012; Borsic, Baharumshah and Beko, 2012).

The expansion of the former socialist economies continued, thus exceeding the area of the EU towards the concept of *transition economies* in Central and Eastern Europe (TECEE), and the group increased to 16 countries by including Bosnia-Herzegovina, Macedonia (FYROM), Montenegro, Serbia (Ifinedo, 2011), or reaching the maximum expansion, through the concept of *post-socialist economies*, as 25 countries (Pilc, 2015).

By making use of various arguments, by restructuring various geographical areas, by quantifying the performance of countries in the processes of accession and integration, and more especially as convergence, the research focused on the economies of Central and Eastern Europe (CEEC) has provided an unstable number of countries, and obviously a panel of similar data, over the last 26 years, on the subjects tended to be of rather narrow specialization.

The authors of this paper preferred the criterion of localization or geographical delimitation in Europe, correlated with EU membership, excluding East Germany from the already standard version of CEEC-12, as it actually does not exist any longer as an independent state, nor as a distinct database. Throughout the analyses of disparities, gaps and specific trends of concentration-diversification for the group of the former socialist countries of Central and Eastern Europe, the following standard abbreviations were used: BG – Bulgaria, CZ – the Czech Republic, EE – Estonia, HR – Croatia, LT – Lithuania, LV – Latvia, PL – Poland, RO – Romania, SI – Slovenia, SK – Slovakia, HU – Hungary, and EU-28 and EU-15 for the relevant European averages.

The Strategy of Europe, Horizon 2020 (European Commission, 2015) lists among its major objectives: “*increasing the EU’s competitiveness, keeping its model of social market economy, and significantly improving the efficiency of its resources*”, while aiming specifically at reducing the economic and social disparities between the various regions of the European Union, as well as strengthening the cooperation between the member states in order to ensure a sustainable and balanced development. Reducing the disparities involves diminishing the gaps between the levels of development of the respective countries, namely drawing closer the values of the benchmarks established, as well as some specific trends of concentration-diversification expected and even validated.

1. Specificity of the analyses of the disparities, gaps or lags and trends of concentration and diversification in territorial approaches

The statistical concepts of disparity and gap or lag at one time had the same general sense of “*mismatch or incongruity, indicating absence of similarity*”, thus identifying a difference in level, structure, rank, in space or in time, etc. (Collins English Dictionary, 2012a). Even in this approach focused on synonymy, disparity has a statistical significance much more pronounced in terms of territoriality, while a gap is only one of two possible states of the territorial placement, or temporal states before/ahead of someone or something else, or behind /following someone or something else.

Disparity also conceptualizes the “*lack of connection, harmony, or matching between the analysed elements*”, describing an association and even an intrinsic link between elements, with special emphasis on structural correlation (DEX, 2012a). Statistically, disparity identifies a “*major difference*”, a considerable deficit or excess, which is relevant and important especially territory-wise. Statistical and demographic specificity of disparities is

characterized by inequality, disproportionality and inadequacy, being marked as contrast, rarely minor, and mainly major. The most common, and therefore most commonly analysed, disparities are those in terms of gender, tariff (significant difference in price of the same product applied according to customs duties), but especially the infra-regional or inter-regional disparity (within a region or between regions), etc.

The specificity of statistical gap lies in the very time or distance that someone or something is usually behind, or in the past, but also in the status or condition of slowing or falling behind someone else (Collins English Dictionary, 2012b). The prevalently econometric meaning of the concept of gap or lag in today's world is the time interval between two events, or, more precisely, between an action and its effect; the territorial meaning of spacing is preserved in classical statistics, though it is being increasingly substituted by the time distance between two or more facts or events (DEX, 2012b).

In the classical statistical context, strictly related to the analysis of territorial series using a specific system of indicators, absolute lag (1) and lag rate (2) are resorted to, and when the terms of the territorial series of territorial can be aggregated, coefficients of concentration (specialization) or territorial diversification of the Herfindahl–Hirschmann type (3), or Gini-Struck type (4), etc., are also made use of:

$$\Delta_{ij} = (y_i - y_j) \tag{1}$$

where:

$\Delta_{ij} < 0$ = absolute gap
or $\Delta_{ij} > 0$ = absolute advance

$$\Delta_{ij} = (\Delta_{ij} : y_j) \times 100 = (I_{ij} - 1) \times 100 \tag{2}$$

where:

I_{ij} represents the gap index

$$H-H = n \sum g_i^2 \tag{3}$$

where:

$g_i = [y_i : \sum y_i]$

$$C_{G-S} = \{ [n \sum g_i^2 - 1] : [n-1] \}^{1/2} \tag{4}$$

where:

$$0 \leq C_{G-S} \leq 1$$

The analysis of solutions (3) and (4) in the context of the ABC curve allowed to identify a range of concentration or specialization, beyond whose value (0.409) the territorial, and even time data series become excessively concentrated, while a *moderate* concentration is delimited by a value C_{G-S} of about 0.3 (Săvoiu, Iorga-Simăn and Crăciuneanu, 2012).

In the economic research the statistical concepts of disparity and gap between the different versions of the same variable (territorial, demographic, economic, etc.) are frequently made use of, and original methods are drawn on in order to cover the shallowness of current statistical and econometric solutions.

The explanatory factors of this methodological relativization are diverse, bringing together the general geographical position of the entire area examined as disparities and gaps or lags. “Traditional methods of measuring disparities ignored the factor of geographical position, and therefore may fail to truly reflect the spatial characteristics of disparities” (Xie et al., 2014). Another significant factor is supplied by the stationarization of the variables analysed, based on statistical considerations of value comparability, through inflationary or deflationary processes (Săvoiu and Popa, 2012), or through the rigor of econometric modelling, drawing on series derived through differentiation, applying logarithms, etc. (Maddala and Lahiri, 2012), before the model is specified and parameterized. This paper proposes an original and complex method focused on modelling the trends of concentration-diversification rendered by the concentration and diversification coefficients, thus providing more appropriate visibility and interpretation of the real convergence processes in the framework of the economies in CEEC, and adding to the originality of a previous statistical methodology approach (Săvoiu, Crăciuneanu and Țaicu, 2010) by a necessary econometric approach.

2. Some characteristic disparities, specific gaps and trends of concentration or diversification within the group of CEEC economies

The range of issues relating to the analysis of regional disparities, and implicitly of the gaps or lags at EU level, is a highly debated topic in European economic literature. Discussions about regional disparities have led to tackling the process of real convergence taking place within a number of state communities that decide to remove barriers of any kind. There is also an increasing interest in spatial analysis models concerning the inequalities between regions, reducing regional disparities in terms of income levels, infrastructure, etc. (Antonescu, 2012). In fact, this is a fundamental objective of the Cohesion Policy of the EU, which, through the Structural Funds, provides support for countries and regions with low development. The higher the degree of real convergence, the lower the financial effort will be, through the Community budget devoted to cohesive developing, by means of reducing economic disparities.

Studies have demonstrated that the degree of regional divergence showed a downward trend as income levels increased in each country (Smetkowski, 2014). Also, major events in the evolution of the European Union (EU expansion by 10 countries in 2004, and another two in 2007, and the 2008 economic crisis) had a significant impact on regional convergence (Dumitrescu – Moroianu, 2015).

Jan Svejnar tried, in a significant study, to identify the growth strategies of the CEEC countries after the fall of communism (Svejnar, 2006). The study, which included indicators such as GDP, inflation, government budget balance, the GDP share of the private sector, foreign direct investment, unemployment rate, income distribution, etc. Based on the statistical analysis of these data, the author identified six important elements for the success of the development strategy of those countries: maintaining macroeconomic stability, maintaining competitiveness and creating new jobs, maintaining or increasing the flows of foreign direct investment and increased efficiency for domestic companies, improving the level and efficiency of human capital, maintaining democratic freedoms and observing human rights.

There is some evidence that the heterogeneity of GDP per capita stands for a new polarization of the North-West-East type, as this disparity has become rather pronounced in EU-25 (Ertur and Koch, 2006).

Eric Labaye and collaborators developed a model of growth for only eight CEEC countries (Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia), which focuses on three major lines: *“increasing exports and their added value, labour productivity growth and increasing investment in the less developed sectors, as well as increased rates of domestic savings to finance investment as aggregate demand increases”* (Labaye et al., 2013). The authors argue that the CEEC should base their growth strategies on supporting investments to the detriment of consumption, while also considering infrastructure and labour skills. Based on the similarities and differences between these countries, the authors proposed a general model of development, and also claimed that it requires an adaptation, given the specificities of each state.

Leon Podkaminer analyzed the patterns of development in Central and Eastern Europe during the transition and following the accession to the EU (Podkaminer, 2013). Following his comprehensive study conducted in 2014, Podkaminer concluded that CEEC countries tend to converge towards the lower growth rates that characterize Western Europe nations. However, such increases do not promise reaching very soon the kind of Western levels of income. CEEC countries have proved less resistant to the crises affecting Western Europe, and they also suffer from high unemployment rates. Economic and social cohesion is also a problem facing these countries, and is conducive to political radicalism. Podkaminer believes that the fact that transition started too late is one of the causes of this situation. If the transition to a market economy had started in the 1960s or 1970s, the disparities compared to Western Europe would have been smaller. To substantiate his assertions, the author analyzed the differences in GDP per capita between the nations in Central and Eastern Europe (CEEC) and those in Western Europe since the 19th century. He however included in his study much more variables, such as real GDP growth rates, inflation rate, the level of trade with OECD countries, commercial balance, wages, monetary and fiscal policies, imports, current account balance, foreign exchange rates. Podkaminer also identified a possible vector of development for the CEEC countries, i.e. the R&D sector, which *“could provide the CEEC economies with streams of unique technological innovations, making it possible to obtain products with high added value, and increase the employment of labour”*. *This opportunity is accompanied by proportionate risks, as, “the way things are now, the sectors of research and development in the CEEC countries are close to extinction, with the well-trained staff leaving for the US or Western Europe, while production, banking and trade are controlled by foreign capital companies”*.

Balázs Forgó and Anton Jevčák analyze the progress of ten CEEC countries in terms of real and nominal economic convergence, compared to twelve EU member states belonging to the Eurozone. Their very well documented study, based on a variety of indicators, allowed drawing the following conclusions (Forgó and Jevčák, 2015):

- a) most of the CEEC countries analyzed scored a real and nominal convergence as compared to Western Europe after the year of their accession (2004 or 2007);
- b) after the 2008/2009 global financial crisis, the general government balance of most countries improved in the post-crisis period;
- c) external imbalances deepened before and during the crisis, but improved subsequently;
- d) all CEEC states entered the EU with underdeveloped financial sectors, but the latter developed at an accelerated pace after their accession, supporting domestic demand growth;

e) the exchange rate regime (either free or floating) was not an important factor of economic performance scored by these countries.

Leszek Balcerowicz and collaborators analysed economic growth in the EU during the period 1980-2012, based on a variety of financial indicators (Balcerowicz et al., 2013). The authors of the study analyse the differences between countries in terms of economic growth, based on three factors: initial conditions; external conditions; and policies. They believe that the differences in growth between the EU states after 2007 can be explained econometrically based on the initial conditions. The main solutions identified by the study authors to solve the problem of economic growth are internal. Measures taken at a European level cannot replace internal reforms. Similarly, the authors found that growth is negatively correlated with the boom of investment in the pre-crisis period, and positively with the national economies in the same period. The researchers concluded that *“the European economy remains a highly heterogeneous with policies and results that vary greatly from one country to another. However, it can be noted that, in this diversity, there are clear and consistent models that will differentiate the winners from the losers”*.

The analysis conducted in this article is devoted to disparities and gaps, and equally to the trends of association in group convergence and concentration–diversification, and capitalizes on solutions that are simultaneously statistical and econometric, by means of the Eviews software package, while focusing on the data of the group of 11 ex-socialist economies in the CEE over a period of 15 years after 2000, by appealing to the source of EUROSTAT, 2016 (<http://ec.europa.eu/eurostat/data/database>).

The essential hypothesis focuses, beyond the analysis of the reduction of disparities and gaps, on the ability of a statistical tool like Gini-Struck coefficient, whose medium- and long-term values, when presenting a decreasing trend, also falling below the value of 0.3, reveal a phenomenon of diversification, indicating trends of eliminating those disparities described, and mitigating the disparities quantified, up to the complete homogenisation of a group of economies investigated.

The investigation into the temporal and spatial disparities in GDP per capita reveals, in keeping with the absolute level of the average value, primarily a specific hierarchy within the group of former socialist economies of CEE. Thus as many as seven countries are in an interval between 7,700 and 9,900 euro per capita (PL, LV, LT, HU, HR, SK and EE), and a minimum pole is gradually taking shape (BG, RO), as well as a maximum pole (CZ, SI), and polarization decreases from a ratio of the minimum values of 1/6 towards a ratio of the maximum values of 1/3, over the last one and a half decade (table no. 1).

Table no. 1: The average, median, minimum and maximum level of GDP per capita, and its standard deviation over the last 15 years (current prices, in euros)

	EU-28	EU-15	BG	RO	PL	LV	LT	HU	HR	SK	EE	CZ	SI
Mean	24020	28427	3993	4867	7747	7873	7887	8840	8940	9453	9893	12100	15687
Median	24500	29100	4300	5900	8200	8500	8500	9300	10200	10400	10600	13400	17400
Maximum	27400	31700	5900	7500	10700	11800	12400	10700	11200	13900	15200	15600	18800
Minimum	19600	24000	1800	1800	4900	3600	3600	5000	5300	4100	4400	6500	11000
Std. Dev	2529	2470	1519	2107	2139	2973	2988	1751	1910	3709	3558	3267	2620

Data source: EUROSTAT, 2016. Data further processed by Eviews.

Except for the minimum pole of the group (BG, RO), where the standard deviation reveals an obvious heterogeneity in the period under review, the remaining economies have homogeneous development values at higher rates than the EU-28 and EU-15 average. These two signals certify a process of real convergence, with an emphasis on the economies that underperform at the time of their accession, which proves the practical realization of expected trends in integrative context.

Within the final data range of 2000-2014, the importance of the year 2008, and hence of global financial recession as a factor mitigating disparities and significant decrease of the maximum and minimum gaps relative to the average level reached in EU-28 and EU-15, is revealing as shown in the figure no. 1, reconstructing, in mean values, the gap or difference between the three levels (EU-28 and EU-15, obviously as averages, and the group of former socialist economies as a minimum in the group).

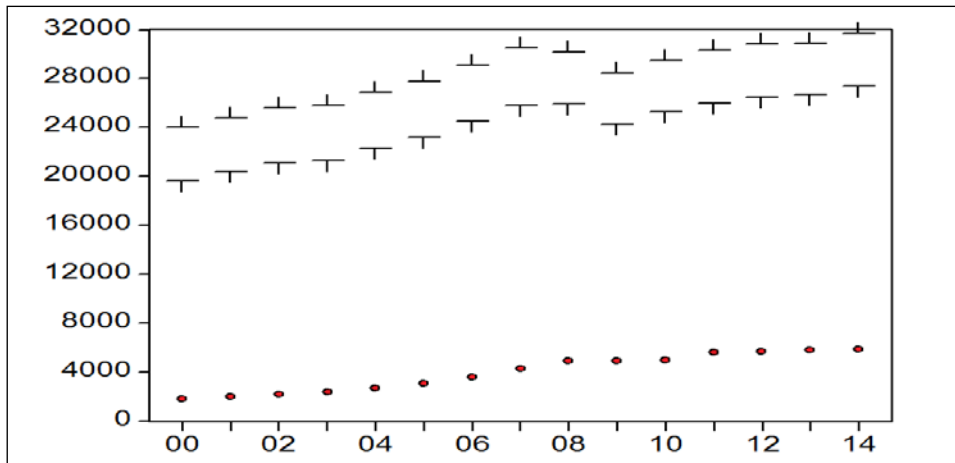


Figure no. 1: Tendencies of mitigation of the gap between the GDP averages of EU-28 and EU-15 and the minimum of the ex-socialist CEE group

Data source: EUROSTAT, 2016. Chart further processed by Eviews

The year 2008, as a final year of a process of a more pronounced reduction of the disparities and gaps, is characterized, in the chart, by a relative inflection, the previous trend being resumed after the global financial recession, which turned into a factor delaying convergence trends in EU, applying to the comparison with both EU-28 (figure no. 2 right) and EU-15 (figure no. 2 left).

An important conclusion is strictly related to the very intense association of the development dynamics of GDP, applying a matrix or grid of correlation between the values of the EU-28 and EU-15 average and the average of the group of former socialist economies of CEE. Except Croatia (HR), though it also has a 0.936 level of the correlation ratio with EU-28 (easily explainable by joining EU late, in 2014), the remaining members are placed in a very high association range, between 0.948 – Hungary and 0.994 – Estonia (table no. 2a and table no. 2b).

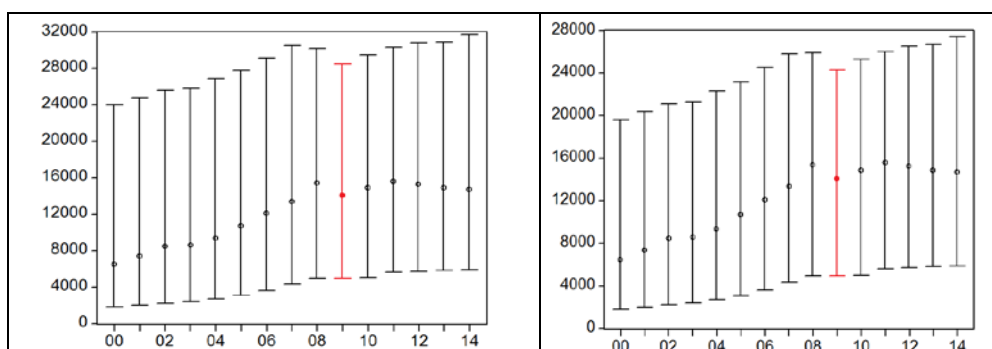


Figure no. 2: A stiffer gap reduction between the GDP average of EU-28 (left) and of EU-15 (right), and the average of the group of ex-socialist CEE economies, after 2008

Data source: EUROSTAT, 2016. Charts further processed by Eviews

Table no. 2a: Matrix of correlation between EU-28 or EU-15 and the group of the CEE ex-socialist states regarding the level of GDP (current prices, in million euros)

	EU-28	EU-15	BG	CZ	EE	HR	LV
EU-28	1.000000	0.999361	0.971732	0.965361	0.994310	0.936382	0.964766
EU-15	0.999361	1.000000	0.963743	0.956872	0.993501	0.930637	0.961454

Data source: EUROSTAT, 2016. Data further processed by Eviews.

Table no. 2b: Matrix of correlation between EU-28 or EU-15 and the group of the CEE ex-socialist states regarding the level of GDP (current prices, in million euros)

	LT	HU	PL	RO	SI	SK
EU-28	0.990203	0.948116	0.960492	0.982481	0.965068	0.971145
EU-15	0.986644	0.949414	0.951772	0.976221	0.958363	0.962993

Data source: EUROSTAT, 2016. Data further processed by Eviews.

There is a distinct trend of the Hungarian economy, the only one that correlates with the EU-15 more intensely than it does with the EU-28 according to the ratio of specific correlation ($0.9494 > 0.9481$), even if this is done on a relatively lower level in comparison with the other countries in the same area.

The real convergence of the group of the former socialist economies CEE is also demonstrated, with the highest degree of relevance, through the Gini-Struck coefficient (GS), preceded by finding the Herfindahl-Hirshmann coefficient (HH), as both instruments have the ability to certify a trend of diversification by value and, especially, by the declining dynamics, by nearly 50% from the baseline (permanent decrease from 0.16 to 0.89 over the last 15 years).

The impact of the global financial recession after 2008 does not significantly affect the group of ex-socialist CEE states as regards GDP per capita, but deeper influences are felt in terms of their total GDP, according to the statistical tools for analyzing the processes of concentration-diversification, applied mainly at the territorial level.

A graphical view of a compared type of the trends of the G-S values of GDP per capita (figure no. 3 left) and, respectively, of the total GDP (figure no. 3 right) of each country in the group of ex-socialist CEE economies is apt to emphasize the evolutionary processes of relative emergence through economic growth (implicitly the negative impact of recession after 2008), worsened by the influence of favourable demographics and submitted to a process of osmosis through emigration in search of jobs in other more developed EU-15 countries.

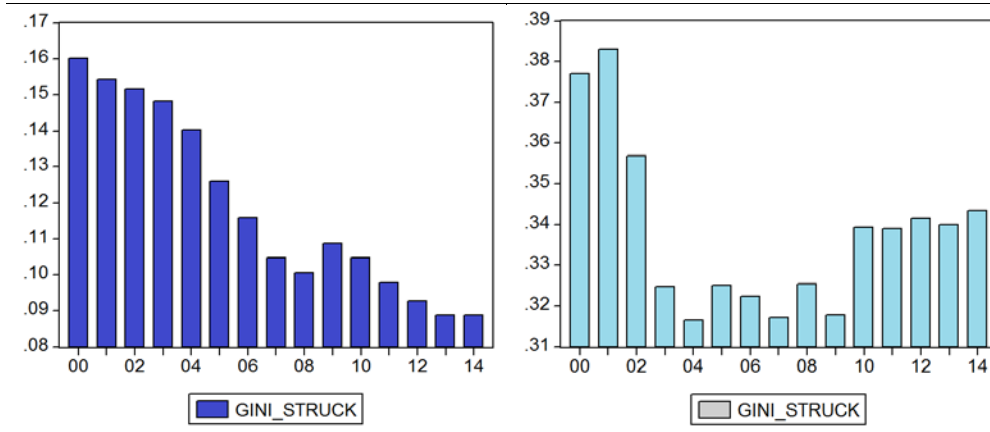


Figure no. 3: Evolution of the Gini-Struck coefficient (G-S) values for GDP per capita (left) and general GDP (right)

Data source: EUROSTAT, 2016. Charts further processed by Eviews.

Total wage developments is an equally important dynamics for the analysis of real convergence of the group of former socialist countries in EEC, which has unfortunately no comparable data for Croatia (HR), unavailable through EUROSTAT. The statistical instrument of G-S is much more sensitive and realistic, being able to identify a higher level of concentration in the group, slightly above the limit of excessive theoretical concentration in 2000 at the beginning of the period (0.414 exceeding the limit of 0.409), but which, in the 15 years, gets down closet o the average (to 0.319 in 2007 and to 0.348 at the end of 2014, both of which values are fairly close to 0.3). The total wages and their dynamics represent the most accessible benchmark of the logic of the convergence of the group of ex-socialist CEE economies to EU, still highlighting a high level of concentration, which approaches a mean methodological G-S value, and also a similarity to the evolution of total GDP (figure no. 4).

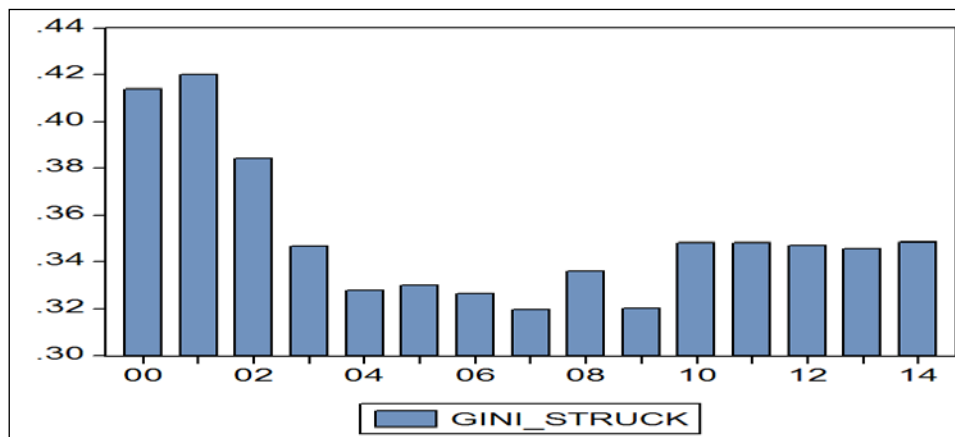


Figure no. 4: Evolution of Gini-Struck (G-S) coefficient calculated for the total amount of wages

Data source: EUROSTAT, 2016. Chart further processed by Eviews

The developments of the disparities and gaps in labour productivity, gross fixed capital formation, government debt and total research and development expenditure are presented in the tables no. 3a-3d (capitalizing less volatile averages, which are also more relevant for the period of the last decade and a half).

Table no. 3a: The average, median, minimum and maximum labour productivity levels, and its standard deviation over the last 15 years (euro per hour)

	EU-28	EU-15	BG	RO	LV	LT	PL	EE	HU	SK	CZ	SI
Mean	30.41	36.98	4.15	4.70	6.47	8.21	8.76	9.49	10.46	10.99	11.91	18.81
Median	30.80	37.40	4.20	5.05	6.75	8.25	8.70	9.85	10.95	11.40	12.60	19.70
Maximum	32.10	38.80	4.90	5.60	8.40	10.60	10.60	11.40	11.50	13.20	13.30	21.40
Minimum	27.90	34.40	3.40	3.00	4.20	5.60	6.90	7.00	8.40	8.20	9.30	15.40
Std. Dev.	1.358	1.470	0.478	0.889	1.492	1.555	1.180	1.469	0.991	1.635	1.401	2.237

Data source: EUROSTAT, 2016. Data further processed by Eviews.

* Note: no data for Croatia (HR), comparable with the Eurostat methodology

The maximum / minimum ratio of GDP per capita in the group investigated was 400%, and compared with EU-28 and EU-15, it was 600% and 710% (the minimum benchmark in the group analyzed was the Bulgarian economy), in a certificated context of real convergence.

Regarding labour productivity, the same ratio increased intragroup to 450%, proving a stronger heterogeneity, and compared with EU-28 and EU-15 the ratio grew more substantial, reaching 730% and 890% (in the same real context that, at the beginning of the period, exceeded 820% in 1010). As far as labour productivity is concerned, the Gini-Struck coefficient identifies two major inflection points after 2004 and 2008 in the group analyzed, which keeps a significant convergence trend by increased diversifying (figure no. 5).

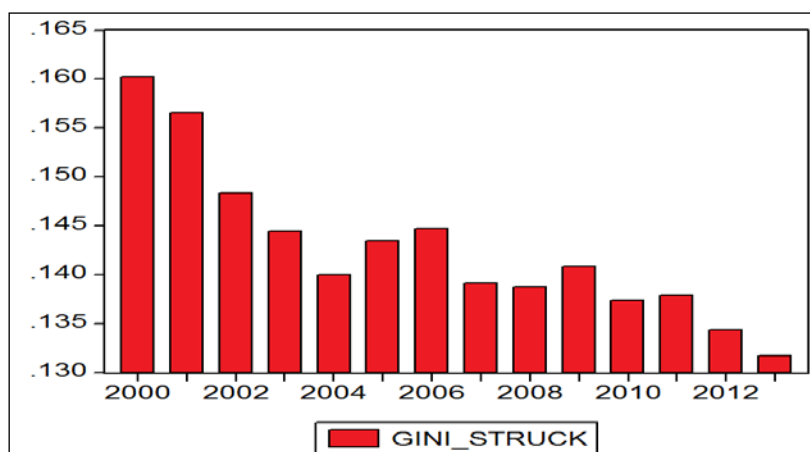


Figure no. 5: Evolution of Gini-Struck (G-S) coefficient calculated for labour productivity

Data source: EUROSTAT, 2016. Chart further processed by Eviews

Gross fixed capital formation in the group of the ex-socialist CEE states, compared for the past 15 years with the EU-28 (89,892 million euros), or with the EU-15 average (154,761 million euros), highlights the persistence of a principle of investment convergence, even in series of heterogeneous data (BG, LV, RO).

**Table no. 3b: The average, median, minimum and maximum level
of gross fixed capital formation and its standard deviation over the last 15 years
(current prices, million euros)**

	BG	CZ	EE	HR	LV	LT	HU	PL	RO	SI	SK
Mean	7096.0	34681.7	3817.8	8905.9	4525.3	5235.0	19977.5	59959.6	27171.9	7694.3	12311.3
Median	8490.8	38693.5	3704.9	8617.7	4292.3	4911.4	20099.6	66463.4	31297.5	7323.9	13923.2
Maximum	12283.8	46714.2	5941.6	13525.9	8253.1	8513.3	25034.1	82050.6	54686.4	11230.0	16946.2
Minimum	2410.4	20449.0	1642.4	4704.0	2171.5	2389.0	13038.9	34933.2	7862.9	5994.9	6093.1
Std. Dev.	3032.9	8536.1	1333.5	2364.3	1869.0	1866.1	3179.2	17771.7	14361.2	1484.7	3900.0

Data source: EUROSTAT, 2016. Data further processed by Eviews.

Ranking in terms of domestic investment effort undertaken places in the top four positions the countries with economies having more substantial macroeconomic results and / or significantly stronger geographic areas and demographic (PL, CZ, RO, HU), finally giving the annual Gini-Struck coefficients the atypical allure of a “U-shaped” distribution (Annex no. 1).

A further potential resource in point of impact in the real process of real convergence, government debt, does not contribute significantly to a prevalent investment context apt to diminish gaps and mitigate disparities and turn into a support of the diversification of the group analyzed faced with EU-28 averages of 235,733 million euros and EU-15 averages of 351,336 million euros. The data series of public or governmental debt is a heterogeneous dominant in the group of ex-socialist EEC states (the debt dynamics polarizing the values for the last decade and a half).

**Table no. 3c: The average, median, minimum and maximum amounts
of government debt, and its standard deviation over the last 15 years (in million euros)**

	BG	CZ	EE	HR	LV	LT	HU	PL	RO	SI	SK
Mean	4584.9	35298.6	175.3	12153.4	2001.4	5532.3	48765.3	115931.4	13733.7	10538.2	18158.7
Median	4528.3	34109.7	170.8	10506.5	1214.4	4134.7	54566.8	127065.4	5025.2	7186.0	14475.8
Maximum	7017.3	63773.8	278.4	22659.9	5504.6	11726.7	66593.7	183875.3	41148.5	26340.7	35178.7
Minimum	2998.9	7864.80	43.7	5858.0	596.7	1534.3	19403.1	36231.5	3055.0	4234.9	5072.1
Std. Dev.	1345.2	19249.8	76.7	5076.8	1407.8	3633.6	14513.2	49849.0	13210.6	6687.7	10259.3

Data source: EUROSTAT, 2016. Data further processed by Eviews.

The evolution of the Gini-Struck coefficient for government debt is ascending prior to the onset of the global recession, and declining after that (Annex 1), the central tendency being to concentrate solely in a few economies in the group (PL, CZ, HU, SK)

One of the contemporary explanatory factors of economic development in the medium and long term is the cost of research and development, whose data series is not homogeneous in time or structurally in the countries of the group, and the disparities and gaps there are maximum compared to the EU-28 (the only one available and comparable), and the ratio between the EU-28 average and the minimum values of BG and RO reaches 2100% and 2080%, respectively (table no. 3d).

Table no. 3d: The average, median, minimum and maximum level of research and development expenditure, and their standard deviation in the last 15 years (euro per inhabitant)

	UE-28	BG	CZ	EE	HR	LV	LT	HU	PL	RO	SI	SK
Mean	451.87	21.55	171.99	136.47	78.21	44.74	64.95	95.37	54.23	21.75	288.17	59.41
Median	460.60	18.40	175.60	129.30	78.40	50.40	69.90	97.10	46.30	27.20	249.00	46.90
Maximum	558.40	46.30	294.00	289.10	98.70	81.30	125.60	144.70	101.60	39.20	454.10	123.60
Minimum	351.60	8.70	72.40	26.40	62.90	15.80	20.80	39.60	27.10	6.60	149.60	26.50
Std. Dev.	68.16	11.59	76.0	91.08	9.22	23.55	32.70	31.44	25.15	10.96	114.61	33.94

Data source: EUROSTAT, 2016. Data further processed by Eviews.

*Note: no data related to EU-15, being comparable methodologically to Eurostat.

Research and development expenditure have a Gini-Struck coefficient similar to the GDP per capita trends, showing a clear trend to diversify in the group analyzed (figure no.6).

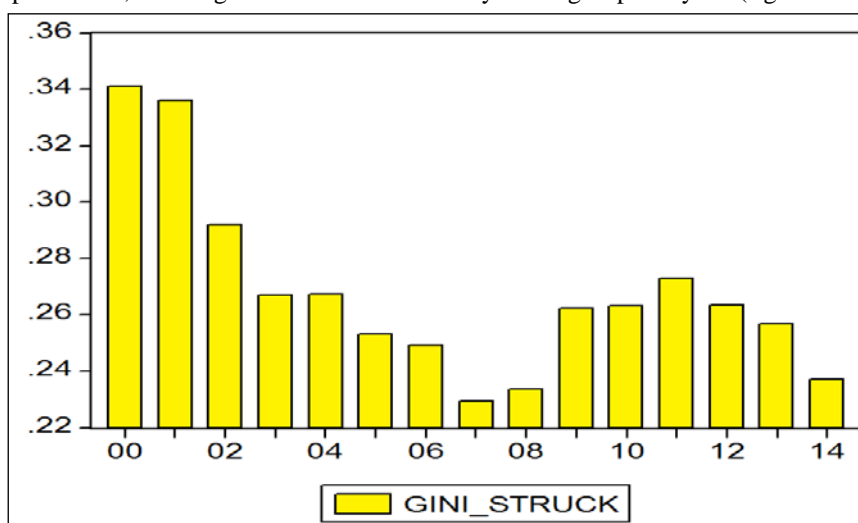


Figure no. 6: Evolution of Gini-Struck (G-S) coefficient calculated for R & D expenditure

Data source: EUROSTAT, 2016. Chart further processed by Eviews.

A Gini-Struck trend, once validated as diversification in parallel with the existence of higher rates of growth of the group of ex-socialist CEE states, relative to levels or external average values (EU-28 or EU-15) allow factorial modelling centred on the Gini-Struck coefficient of GDP per capita as an endogenous variable and a set of similar exogenous variables (Gini-Struck coefficients) regarding productivity, expenses, salaries, (governmental) debt, investments etc.

Starting from the actual values of the G-S coefficient in the Annex, a grid or matrix of correlation is obtained, which allows modelling real convergence expressed by the Gini-Struck (G-S) coefficient regarding the evolution of GDP per capita (as an endogenous variable) based on those exogenous variables which are most intensely associated with the resultant GDP variable and have the highest correlation ratio (table no. 4).

Table no. 4: Matrix of correlation of the Gini-Struck values, calculated for 2000-2014

G-S	GDP per capita	Wages	Productivity	Investment	Public (governmental) debt	R & D expenses C-D
GDP per capita	1.00000	0.61789	0.88568	0.14524	-0.03059	0.74286
Wages	0.61789	1.00000	0.73050	0.80304	-0.51328	0.90569
Productivity	0.88568	0.73050	1.00000	0.35933	0.04264	0.82883
Investment	0.14524	0.80304	0.35933	1.00000	-0.65058	0.71097
Public debt	-0.03059	-0.51328	0.04264	-0.65058	1.00000	-0.35928
R&D expenses	0.74286	0.90569	0.82883	0.71097	-0.35928	1.00000

Data source: EUROSTAT, 2016. The table was further processed based on the data in the Annex no. 1 by means of Eviews.

The two or even three unifactorial models centred on the values of the G-S productivity coefficient determined for research and development expenditure and salaries are invalidated by the Durbin-Watson test, despite having high values of correlation coefficients. Another complete multi-factor model (including all explanatory variables) analyzed by the major hypothesis of this type of modelling is placed under the impact of multi-collinearity (the wage variable). Finally, an efficient and competitive model is identified, which can be validated against the G-S coefficients of productivity (which remains the essential exogenous factor), of investment and public debt (associated negatively or correlated indirectly), as well as the expenditure for research and development (table no. 5).

Table no. 5. A competitive multi-factor model of G-S for GDP per capita

Dependent Variable: G-S GDP per capita Method: Least Squares				
Sample: 2000 2014 Included observations: 15				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.042033	0.064605	-0.650622	0.5300
G-S Productivity	2.162911	0.633710	3.413090	0.0066
G-S Investment	-0.555570	0.119486	-4.649661	0.0009
G-S Public debt	-0.220317	0.084725	-2.600389	0.0265
G-S R&D expenses	0.439666	0.197099	2.230692	0.0498
R-squared	0.933972	Mean dependent var		0.118862
Adjusted R-squared	0.907561	S.D. dependent var		0.025641
S.E. of regression	0.007796	Akaike info criterion		-6.609293
Sum squared resid	0.000608	Schwarz criterion		-6.373277
Log likelihood	54.56970	F-statistic		35.36288
Durbin-Watson stat	2.458705	Prob (F-statistic)		0.000007

Data source: EUROSTAT, 2016. The table was further processed based on the data in the Annex no. 1 by means of Eviews.

The model described above highlights, in an econometrically viable manner, the fact that in eliminating disparities, reducing disparities in the medium and long term, confirming the trends of real convergence of the group of ex-socialist CEEC towards the EU, the essential factor is progress primarily related to approximate the level of productivity labour per hour (G-S with increasing values close to zero), then the relative equalization of expenditures for research and development and investment, as well as a special dynamics of public debt.

Conclusions

Although the convergence towards EU of the group of ex-socialist CEE states is revealed, successively and clearly, by their GDP per capita, the total GDP and total wages, productivity, investment, public (government) debt and research and development expenditure, there appear several interesting paradoxes which ensure the specificity of the domain examined.

The first paradox can be summarized in the phrase “changing the benchmark in advance”, and belongs to the evolution of Hungary’s economy, which although having a relatively lower level of intensity of association with the EU’s GDP in the group, is more clearly associated with the EU-15 rather than the EU-28.

Another paradoxical aspect is emphasized by the gap between the maximum / minimum ratio of GDP per capita in the group investigated, confronted with EU-28 and EU-15, which reaches 600% and 710% and the maximum / minimum ratio of labour productivity, which is substantiated, in the same confrontation, as 730% and 890%, respectively. In few words, the paradox can be defined as that of “higher productivity disparities generating lower gaps in macroeconomic results.”

The paradox of government debt, whose trends of concentration are opposite to the specific G-S diversification in the analysis of real convergence of the group, given that such public debt was found more in consumption and less investment, which is easy to express statistically by the graphic formula “diversification of the macroeconomic result arising from the concentration of public debt.”

Research and development expenditure offers the broadest field of spreading (at least double compared to any other variable) in the group of economies investigated, but they have a Gini-Struck dynamic relatively similar to the tendencies of the same ratio of GDP per capita: the paradox derived from here can be worded as “completely different disparities and gaps in research and development, which can provide similar trends in economic growth per capita”.

The attenuation of disparities, and especially the reduction of the disparities in the post-communist CEE economic group, represents a reality confirmed by the developments towards diversification of the Gini-Struck coefficient, but the comparisons of averages or the maximum / minimum ratios in relation to EU-28 or EU-15 generate both paradoxes and econometric significant tendencial models, the main cause being the speed of changes, together with the complex impact of the global financial recession.

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Annex no. 1

Gini - Struck coefficient values for the group of ex-socialist CEEC for the essential variables of eliminating disparities and mitigating gaps, contributing to real convergence towards the European Union

	GDP per capita	Wages	Productivity	Investment	Public (governmental) debt	R & D expenses C-D
2000	0,1602190	0,4137795	0,1602498	0,3781322	0,3928552	0,3410157
2001	0,1543698	0,4201396	0,1565345	0,3470244	0,4109896	0,3361467
2002	0,1516666	0,3842692	0,1483618	0,3104578	0,4101004	0,2920213
2003	0,1481389	0,3469244	0,1444525	0,2794255	0,4075246	0,2669843
2004	0,1401885	0,3278050	0,1400122	0,2682593	0,4342789	0,2673427
2005	0,1259551	0,3299570	0,1434896	0,2688614	0,4716040	0,2531133
2006	0,1157599	0,3263044	0,1447417	0,2656724	0,4750505	0,2490860
2007	0,1046619	0,3197917	0,1391516	0,2737270	0,4824741	0,2293926
2008	0,1006207	0,3357789	0,1387360	0,2888437	0,4618747	0,2335955
2009	0,1086961	0,3203540	0,1408157	0,2986055	0,4435124	0,2623239
2010	0,1047635	0,3482219	0,1373385	0,3267798	0,4416745	0,2632430
2011	0,0978700	0,3480999	0,1379242	0,3260670	0,4163704	0,2729401
2012	0,0926075	0,3471605	0,1343559	0,3242026	0,4070379	0,2633853
2013	0,0886944	0,3457454	0,1316737	0,3144359	0,3950362	0,2567678
2014	0,0887238	0,3484528	0,1316737*	0,3244975	0,3453474	0,2371004

Data source: EUROSTAT, 2016. Table further processed by Eviews.

*Note: Given the lack of definitive and comparable Eurostat data, they were kept at prior-year level.