

## Conference Paper

# A Model to Simulate the Convergence Process in the EU and in the Balkans Region Based on Empirical Evidence

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## Abstract

In the context of many new challenges for the EU economy, convergence continues to be one of the main goals in the long run. This paper provides empirical evidence in support of a significant trend of convergence for the EU28 countries after 2000. Investigating the drivers of this trend, we concurrently developed an analysis of convergence for each of the three EU conventional groups and we document rather different results, i.e. strong convergence for the group of former eastern communist countries (EU11E), slow convergence in the group of Southern countries (EU6S), and a trend of slow divergence for the group of North-Western countries (EU11NW). Moreover, taking into account the new Western Balkan candidate countries (EU6B, comprising Albania, Bosnia and Herzegovina, Kosovo, North Macedonia, Montenegro, and Serbia), we analysed the convergence among these four groups of countries in an extended EU, conventionally denoted as EU34. Our study suggests the existence of complex dynamics that feature the EU34 economic system of heterogeneous economies. When separating the region into two zones based on the average level of income per capita, we notice completely different behaviours: on the left side an accelerated convergence to the average level of the system prevails, while the right side features a general slow divergence interrupted by some periods of convergence; the distribution could be far from a normal distribution for which the behaviour is linear; around the average level the behaviour may change dramatically, uncovering an instability sub-zone, with higher stability only far from the average level on the right side.

**Keywords:** European Union, Balkans region, Convergence, Divergence, Economic Growth, Behavioural regimes

**JEL CLASSIFICATION codes:** C31; C82; E17; O47; O52

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## 1. Introduction

The convergence among countries and regions is one of the crucial goals of the European Union. In this context, taking into account that a remaining problem for the future negotiations with Balkan countries from former Yugoslavia concerns the

low level of economic development, an analysis of their progress in converging to the EU countries is of elevated interest. Therefore, using data for the period starting in 2000, we analyse the dynamics of real convergence to the EU average for the group of six countries from Western Balkans (noted as B6). We also extend the analysis by developing a comparison with the convergence dynamics of three conventional groups of current EU members (North-Western, Southern, and Eastern). Starting from the estimated trajectories of convergence, we try to identify some main patterns of convergence or behavioural regimes.

Real Convergence is quantified by the employment of the standard GDP per capita in international dollars PPP (Purchasing Power Parity). Data are collected for the 2000-2018 period and originate from the World Bank database, while for the period up to 2024 we employ data from the IMF forecast (IMF Report, April 2019). The Variation Coefficient (as cv) is the indicator used to evaluate the convergence/divergence process. We will consider that we have evidence in support for *Convergence* when the variation coefficient descends and reversely, when it increases, we conclude that we acknowledge *Divergence*.

The three conventional groups of EU countries were ad-hoc built to reflect our dichotomous findings in the dynamics of convergence. These groups are the following: 1) EU11NW North-Western states (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Sweden, and United Kingdom); 2) EU6S Southern countries (Cyprus, Greece, Italy, Malta, Portugal and Spain); and 3) EU11E Eastern states (Bulgaria, Czechia, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia).

The literature that deals with the phenomena of convergence/divergence focuses on the relations between the main factors of economic growth and the convergence process. Studies that explore the relations between dynamics of macroeconomic fundamentals (such as labour force or human and fixed capital) and financial markets are rather scarce and we mention: [1-18], among others.

The study of EU convergence remains an actual topic, investigated also in very recent contributions in relation to a wide array of economic elements. For example, in an investigation with a similar focus, [19] aim to determine income convergence in terms of regional GDP per capita for a batch of 269 EU regions. Using an endogenous broad capital model and incorporating a Markov chain approach, the article points to a poor process of overall income convergence. Moreover, for Central and East European countries, the authors report traces of a poverty trap.

[20] study the presence of a potential convergence process for banking and stock markets of EU countries. They report that both markets tend to converge over time and present several key drivers for the process. Moreover, the authors argue in favor of a successful financial integration process in the EU.

[21] study price convergence for both tradable and nontradable goods in the EU focusing on the 1996 -- 2016 timeframe. Though oriented towards another area, their results are quite interesting for the present research. The authors observed that the convergence process was faster for those countries facing a catching-up situation, i.e. being placed well-below the average. Moreover, the study concludes that EU prices tend not to continue the substantial convergence process noticed in the 2000s. On a different note, [22] study economic growth and convergence in relation to the 2008 financial crisis. The main takeaways of the article, obtained via both cross-sectional and also dynamic panel data approaches hint towards the fact that the crisis led to a greater absolute convergence and not a divergence.

This paper contributes to the literature in several ways. On one hand we employ our ad-hoc metrics to investigate the existence and evolution of the phenomenon of convergence / divergence for all EU countries and on the other hand we produce evidence on the extent to which this phenomenon is shared by the three main group of countries that are divided by means of economic development.

## 2. Empirical Evidence on the Real Convergence in EU

Convergence at all levels is one of the main goals of the European Union. In this context, and given the general target of diminishing poverty on one hand and the concerns on the low level of economic development in the case of a significant number of countries, regions or counties on the other, an analysis on the progress in terms of convergence to the EU average can be of real interest.

For each country is important to increase the level of homogeneity among the component regions (meaning reducing the variation coefficient) and simultaneously improve the country position against the EU average (meaning a positive trajectory of proportion in EU average).

This ambitious goal must be supported by national efforts together with specific EU policies. Moreover, in EU countries, both the central and regional governments must be preoccupied with the attenuation of the difference among component counties in terms of per capita income level.

Following other studies demonstrating empirically the complex road to convergence in EU, our research highlights a quasi-general rule: a group of countries starting at a relatively small level of income per capita (far on the left side at that moment from the general average level) will strongly converge to this average, but this will lead to increased divergence among component countries.

We previously confirmed this rule in the case of increasing the degree of data digitalization (thus, increasing the resolution of our "magnifying glass"), by dividing each country in its component regions (NUTS 2 database at Eurostat), by dividing each region in its component counties (NUTS 3 database) and so on. A selected study focusing on the convergence in EU from country level to regional level and to counties level will be reported in a future study. In the present investigation, we are presenting some adjacent facts. After 2000 there was a strong convergence in the EU both at country level and at country-group level. Moreover, starting from a higher heterogeneity, regions and counties exhibited also a trend of convergence toward the average level of GDP per capita (in the conditions of a general quasi-continuous growing). Thus, it is demonstrated that general economic growth has a positive impact on convergence at all levels. This is more accentuated when a country, a region or a county is placed far under the average level of income per capita. When its level is closer to the average level, the speed of convergence is decreasing.

For geographical or administrative entities, registering a high level of income per capita far on the right side of the average level could translate as an expected trend of divergence. Only adequate policies can exploit the opportunities to continue convergence in cases of high levels of income per capita (for example in times of economic boom).

The main conclusion is that contrarily to the EU double goal, at least after 2000 it is practically impossible for a country to obtain in the same period both an improvement of its position in EU in matter of GDP per person and a convergence among its component regions or counties (only Germany as an exception succeeded to fulfill both objectives in 2000-2017 period).

In the specialized literature, there are numerous classes in which EU countries are grouped, depending on the goal of the studies. In our study, on the basis of a detailed analysis of their economic structure and macroeconomic specificities, in addition to considering their geographic position, we classify countries in three major conventional groups.

We prefer this type of classification to the so-called convergence clubs or clustered (identified only by statistical methods) because in our opinion it is better anchored to reality, being already demonstrated by empirical studies.

Not at all surprisingly, our classification by the geographic criterion is in accordance with the economic structure (by the three main sectors, agriculture, industry, and services). As an example, we are presenting the structure of employment in the three conventional groups of countries in 2000 and 2017, as follows:

- Agriculture (% of total employment)
  - EU11 - 21.2% in 2000; 10.9% in 2017
  - EU6 - 7.6% in 2000; 4.8% in 2017
  - EU10 - 3.4% in 2000; 2.1% in 2017
- Industry (% of total employment)
  - EU11 - 31.2% in 2000; 30.0% in 2017
  - EU6 - 30.9% in 2000; 22.8% in 2017
  - EU10 - 29.0% in 2000; 23.1% in 2017
- Services (% of total employment)
  - EU11 - 47.6% in 2000; 59.1% in 2017
  - EU6 - 61.5% in 2000; 72.4% in 2017
  - EU10 - 67.6% in 2000; 74.8% in 2017

We can see three clear patterns, corresponding to the three conventional groups of countries in the EU, in the distribution of employment by economic sectors.

The raw data used to analyse the convergence process in both the EU economy (EU28) and the extended EU (EU34) are shown in Table 1. The convergence/divergence process in terms of income per capita related to the average level of EU28, denoted by  $g\%$ , is shown in Figure 1. The average level of GDP per capita (in thousands of dollars PPP) increased in selected groups, as follows (in brackets is the ratio to average EU28 level):

*EU11E 11.4 (46.7%) in 2000; 31.0 (71.7%) in 2018; 41.7 (78.8%) in 2024*

*EU6S 25.7 (105.5%) in 2000; 38.4 (88.9%) in 2018; 46.2 (87.1%) in 2024*

*EU11NW 29.2 (119.9%) in 2000; 49.9 (115.5%) in 2018; 60.2 (113.5%) in 2024*

*B6 5.7 (23.4%) in 2000; 15.3 (35.5%) in 2018; 21.6 (40.7%) in 2024.*

As it can be observed, in nominal terms we are not able to identify a clear general trend of convergence: the differences among groups of countries increasing in considered period (excepting the diminishing gap between the Southern and Eastern groups of the EU).

TABLE 1: GDP per capita (thousands of international dollars PPP),  $\gamma$ , and coefficient of variation, cv (as %) in EU34, 2000-2024.

	EU34yM of which:						cvEU34 of which:					
		B6yM		EU28yM of which:				cvB6		cvEU28 of which:		
		EU11NW	EU6S	EU11E	cv11NW	cv6S		cv11E				
2000	23.644	5.697	24.327	29.171	25.661	11.370	29.066	14.914	25.334	5.239	11.324	19.537
2001	24.693	6.066	25.400	30.318	26.837	12.037	28.581	13.464	24.758	5.127	10.639	18.165
2002	25.401	6.454	26.119	31.027	27.463	12.729	27.688	14.379	23.899	4.662	9.991	17.918
2003	26.171	6.847	26.902	31.780	28.152	13.592	26.632	14.169	22.885	3.838	9.074	17.610
2004	27.481	7.487	28.237	33.223	29.330	14.772	25.610	15.830	21.914	3.800	8.430	16.725
2005	28.875	8.280	29.650	34.782	30.486	16.021	24.731	17.750	21.124	4.006	7.813	17.263
2006	30.708	8.997	31.521	36.844	32.095	17.638	23.725	17.877	20.258	4.394	7.185	16.952
2007	32.464	9.849	33.306	38.831	33.472	19.314	22.687	18.018	19.486	5.177	6.700	16.232
2008	33.235	10.650	34.071	39.579	33.737	20.604	21.440	17.938	18.487	5.818	5.970	13.993
2009	31.976	10.635	32.762	38.017	32.240	20.101	20.845	16.165	17.947	5.422	4.966	11.051
2010	32.918	10.962	33.723	39.348	32.657	20.695	21.394	15.795	18.525	6.406	6.036	12.634
2011	34.134	11.487	34.959	41.005	32.936	21.914	21.712	15.863	18.879	7.128	7.403	12.697
2012	34.595	11.709	35.425	41.823	32.434	22.577	21.914	15.264	19.342	7.052	7.609	12.333
2013	35.249	12.276	36.076	42.717	32.402	23.351	21.955	15.560	19.761	6.872	7.123	11.753
2014	36.490	12.609	37.344	44.155	33.238	24.584	21.839	14.525	19.640	7.146	6.501	11.911
2015	37.646	13.146	38.514	45.295	34.274	25.844	21.218	13.959	19.034	7.555	6.666	11.840
2016	38.761	13.763	39.643	46.351	35.364	27.042	20.541	13.964	18.375	7.791	6.808	11.069
2017	40.478	14.400	41.394	48.115	36.863	28.953	19.857	13.405	17.686	8.063	6.783	10.335
2018	42.206	15.311	43.148	49.856	38.361	30.956	19.133	13.765	16.983	8.314	6.635	10.344
2019	43.512	16.132	44.468	51.167	39.369	32.622	18.603	13.870	16.485	8.417	6.205	10.445
2020	45.107	17.092	46.082	52.834	40.725	34.340	18.151	14.100	16.065	8.664	5.965	10.401
2021	46.742	18.119	47.735	54.585	42.038	36.078	17.814	14.318	15.764	8.880	5.746	10.286
2022	48.425	19.218	49.435	56.394	43.361	37.879	17.506	14.523	15.493	9.061	5.560	10.156
2023	50.161	20.392	51.187	58.247	44.731	39.766	17.181	14.827	15.207	9.179	5.371	10.032
2024	51.959	21.561	53.007	60.159	46.165	41.745	16.852	14.652	14.905	9.256	5.199	9.894

Source: Estimated on the basis of WB data.

In opposition to these first-hand results, in relative terms (i.e. EU28 average income per capita as 100%), the trajectories demonstrate a general convergence process, as it is shown in Figure 1, where continuous trajectories are black for the Eastern group (EU11E), blue for the Southern group (EU6S), red for the North-Western group (EU11NW), and dashed for the West Balkan group (B6). The forecasted period (2019-2024) is denoted by small circles on trajectories.

A rather more relevant trend is uncovered when we replace years (on the horizontal axis) with income per capita. The results are depicted in Figure 2. Using the EU average income per capita (noted as the 100% line) as a separator, two distinct regions can be identified. The behaviour seems to be completely different in these two zones: increasing trajectories to the 100% line should prevail below (as we can notice for the cases of the Eastern group, EU11E, and the Balkan group, B6), while above the threshold

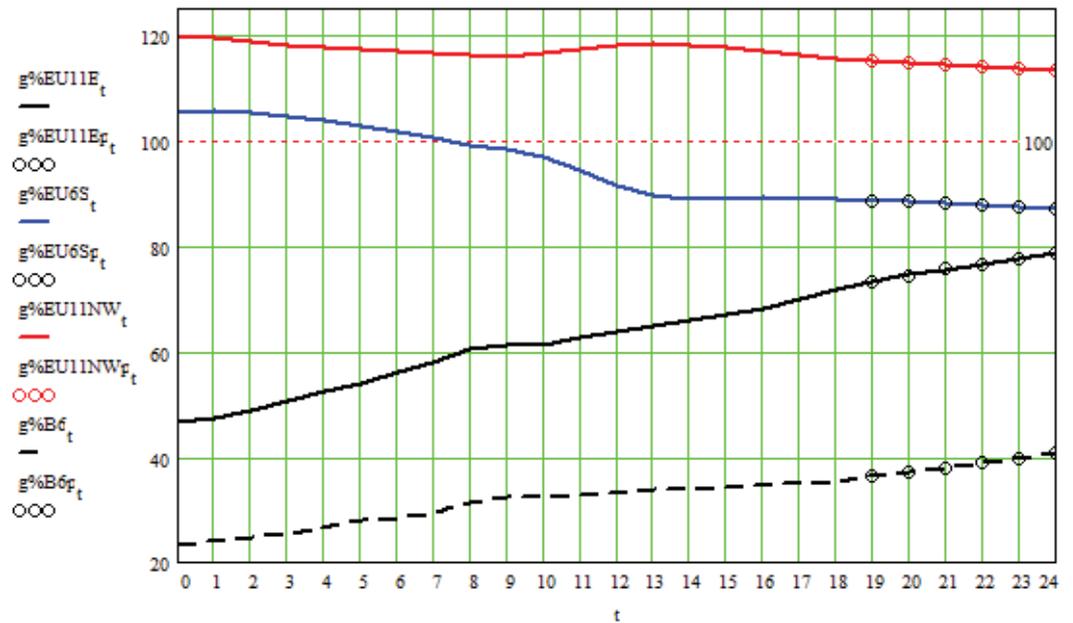


Figure 1: Convergence patterns for the sample groups.

decreasing trajectories should prevail (as in cases of the North-Western group, EU11NW, and the Southern group, EU6S).

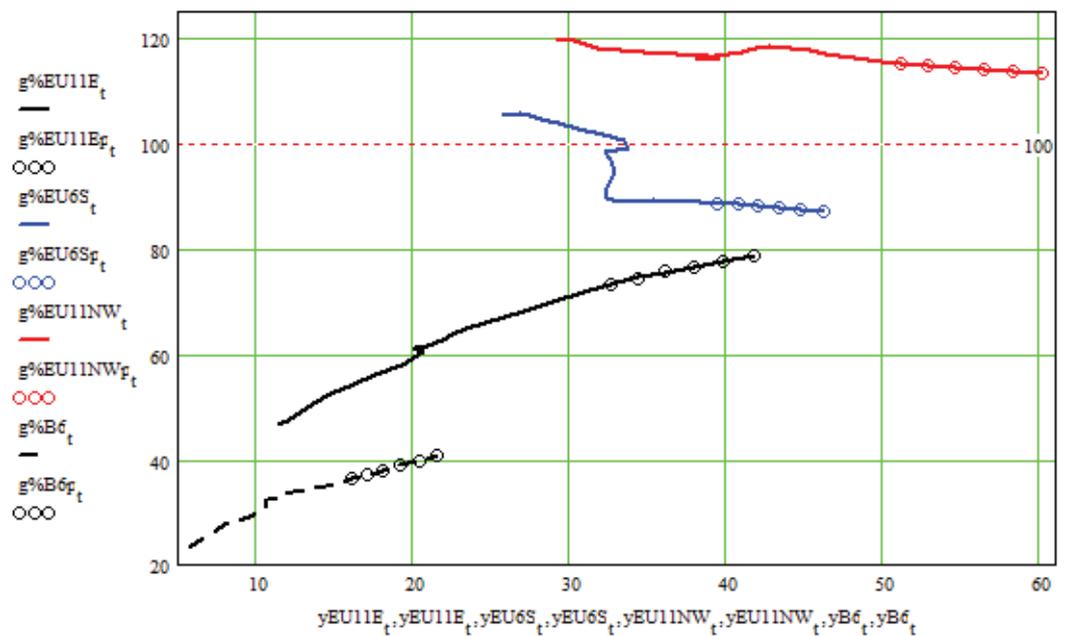


Figure 2: Convergence patterns in relation to income per capita.

### 3. Convergence/divergence inside Groups of Countries

Besides our main initial evidence in support of heterogeneity in the Eastern group (proved by relative high values of the variation coefficient), a small homogeneity in the Southern group, and a high homogeneity in the North-Western group, during the considered period, we document a trend of convergence inside each of the two groups of countries (EU11E and EU6S), and a trend of divergence inside of EU11NW.

These phenomena are depicted in Figure 3, where the values of the variation coefficient are on the vertical axis (as %). An interpretation of these results should obviously weigh the EU convergence and cohesion programmes, which favour the convergence of Southern and Eastern groups of countries. Inside the Balkan group of countries, after 2004 the value of the variation coefficient keeps the highest level when compared to the groups of the EU, oscillating between 13.4% and 18.0%.

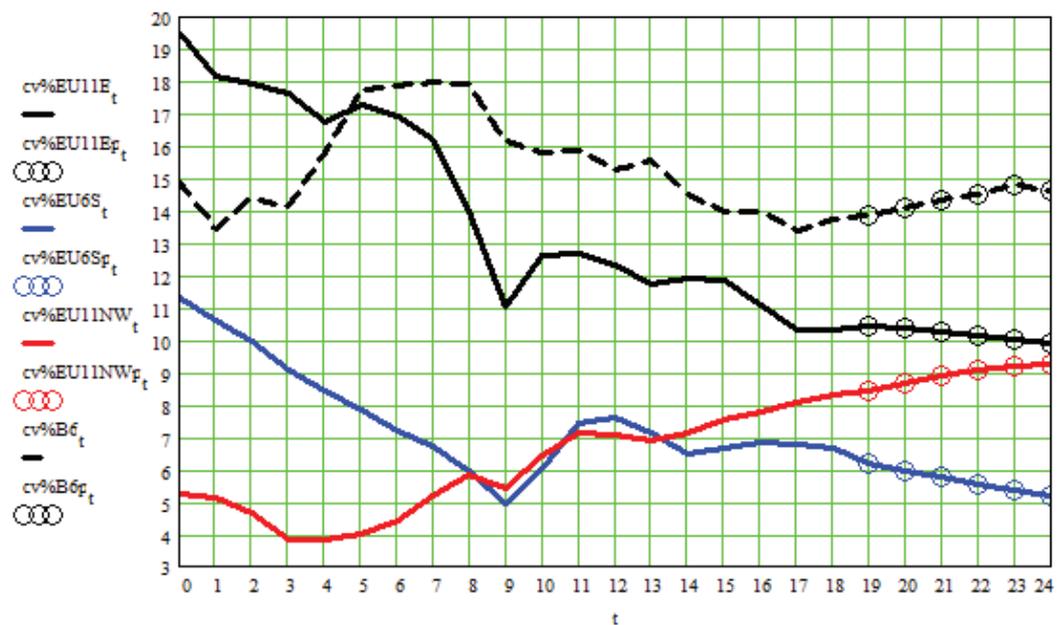


Figure 3: Convergence/divergence by variation coefficient.

Moreover, when we replace time with GDP per capita on the horizontal axis, we find evidence for four distinctive regimes, presented in Figure 4.

The positive impact of the general economic development (expressed by growth in income per capita) on real convergence inside a conventional group of countries is illustrated by a strong negative correlation between  $y$  and  $cv\%$  for the Eastern group and the Southern group (the value of the correlation coefficient being  $-0.884$  and  $-0.794$ , respectively, for the whole period of 2000-2024). For a small income per capita, as is

the case of the Balkan group, the growth has a positive impact on convergence, but in a non-significant manner (is the value of the correlation coefficient being only -0.336).

Contrarily, in the case of a very high level of income per capita, a divergence process should prevail, as is the case of the North-Western group (the value of the correlation coefficient being +0.938).

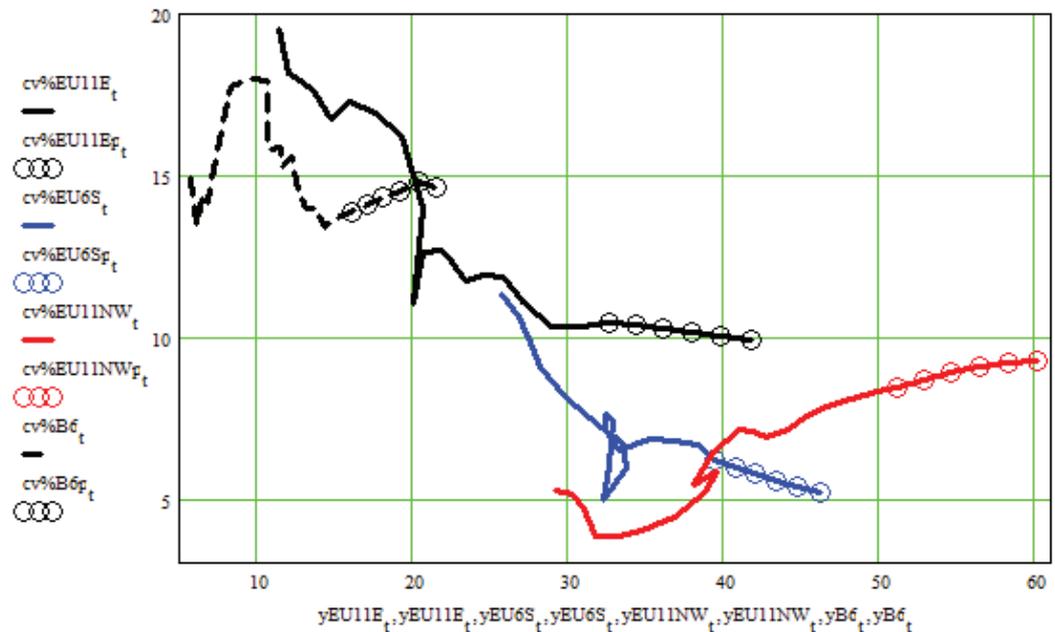


Figure 4: Convergence/divergence by variation coefficient.

Taking into account such behavioural regimes suggested by empirical evidence, in order to find an alternative to four discrete time regimes, we develop a nonlinear model for the correlation coefficient specified by a continuous function that changes with income per capita:

$$z(y) = y / \left[ a + b \cdot y + c \cdot y^{\frac{1}{2}} \right]$$

where a, b, and c are parameters to be estimated.

The estimation of this model, performed by means of nonlinear optimization, yielded the following estimated values for our parameters: a = +2.954290154, b = +0.3604561963, and c = -1.898399453, with the corresponding t-ratio values: +10.08507992 (for a), +16.12135549 (for b), and -11.63529786 (for c).

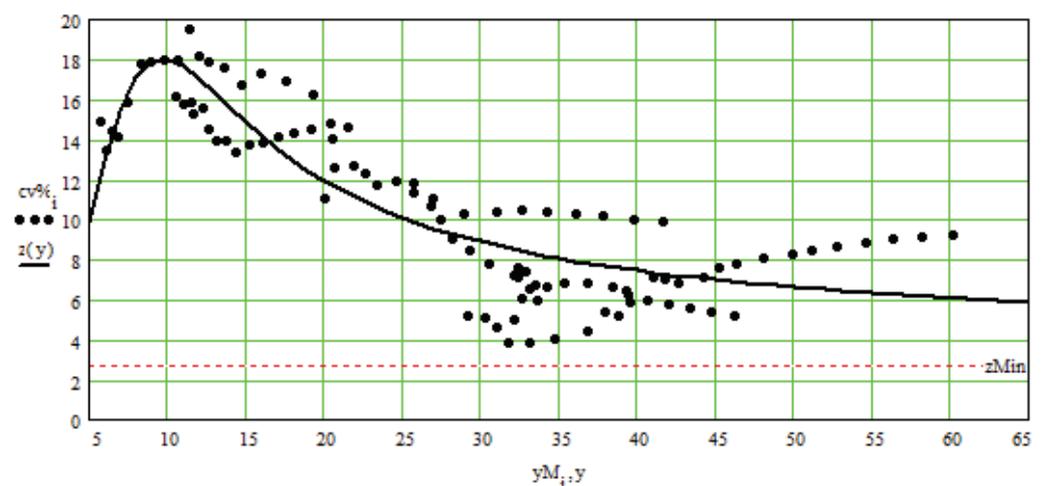
The rest of the estimation parameters are the following: Coefficient of Multiple Determination ( $R^2$ )= 0.77; Proportion of Variance Explained = 76.95%; Adjusted coefficient of multiple determination ( $R_a^2$ ) = 0.76; Durbin-Watson statistic = 1.61.

Figure 5 depicts a graphical representation of the nonlinear model by means of a solid continuous trajectory, in comparison to the registered and forecasted data (set of

points, as average income per capita for all years of the investigated period and all groups of countries).

On one hand, a simulation of this (theoretical) model reveals a relatively high heterogeneity inside the conventional EU34 group (as in the case of the Balkan group) for very small income per capita, hence a maximum level of the variation coefficient of around 18-20%.

On the other hand, for higher income per capita (more than 30 thousands of dollars PPP) a high degree of homogeneity will emerge inside a group of countries (as is the case of the North-Western or Southern groups in EU), hence a level of the variation coefficient less than 10% (the minimum level for the function  $z(y)$  is asymptotically converging to a theoretical value less than 3%).



**Figure 5:** Convergence/divergence by variation coefficient in relation to income per capita.

## 4. Conclusions

The economic convergence is one of the main objectives for the achievement of prosperity within the European Union. Measured at the macroeconomic or regional level, the convergence seems to be situated in strong relation with income per capita, i.e. with the development level.

In nominal terms, a general trend of convergence among groups of countries in the EU is not very clear, but in relative terms (compared to the EU28 average income per capita), a general convergence process is demonstrated.

We can, therefore, highlight two zones, separated by the EU average income per capita (noted as the 100% line in our charts). The behaviour should be completely

different in these two zones: below this threshold increasing trajectories converging towards the 100% (as in cases of Eastern group and Balkan group) should prevail, while above this threshold decreasing trajectories (as in cases of North-Western group and Southern group) should prevail.

Under the general context of heterogeneity in Eastern group, small homogeneity in Southern group, and high homogeneity in North-Western group, during the period 2000-2018 and up to 2024, as forecast data, a trend of convergence inside of Eastern and Southern groups, and a trend of divergence inside of North-Western group of countries are demonstrated.

A favourable impact of economic growth on the real convergence inside a group of countries is illustrated by a strong negative correlation between income per capita and the variation coefficient in the cases of the Eastern group and Southern group. Within the Balkan group, the value of this correlation coefficient, although negative, is too small, as a consequence of missing support from Brussels for convergence and cohesion like in the case of the last two groups of countries. For the very high level of income per capita, a divergence process should prevail, as revealed by the situation of the North-Western group.

The employment of a simulation-based on a non-linear model revealed a relatively high level of heterogeneity inside a conventional group (as is Balkan group) and a maxim variation coefficient of around 18%. Moreover, for higher income per capita, a big degree of homogeneity will emerge inside a group (as is the case for the North-Western or the Southern groups) and the variation coefficient will be less than 10% (converging asymptotically to a theoretical value of about 2.8%).

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