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Catching Up and Catch-Up Effect: Economic Growth in Post-Communist Europe (Lessons from the European Union and the Eastern Partnership States)

Vladimer Papava [a], [*]

[a] Ivane Javakhishvili Tbilisi State University, Georgia

Abstract

The article discusses the economic growth models in post-Communist countries of European Union and Eastern Partnership states. According to the combinatorial augmentation concept, there are new combinations for which the resources for old combinations are practically useless as they require the usage of qualitatively new resources. The combinatorial augmentation process revealed itself in the EU's post-Communist countries in a special way when new technologies are mainly concentrated in some Western European and other developed countries while older technologies were mostly left for the EU's post-Communist countries. For the EU's post-Communist countries, falling behind are more characteristic than catching up which is a result of the unfortunate fact that the national innovation systems in these countries are weakly developed. Economic growth types of Eastern Partnership are based on the extremely falling behind model. Excluding the catch-up effect is of special importance in making a quantitative assessment of the differences between the economic growth indicators. The economic growth types of the Eastern Partnership states are not satisfactory – the characteristic to these countries are falling behind (or, more accurately, extremely falling behind) and coat-tail growth.

Keywords: economic growth models, catching up, catch-up effect, falling behind, post-Communist countries, European Union, Eastern Partnership.

1. Introduction

The economic growth model a country chooses to implement is very important for its economic development. This is the challenge primarily faced by countries with developing economies which place the process of increasing their level of economic development as one of their main goals in order to advance to the category of countries with developed economies. This problem is quite relevant for the relatively new member states of the European Union (EU) as well, including Bulgaria, the Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. According to the established terminology, Central and Eastern Europe is the geographic term for the group of these countries. For the purposes of our study, however, their geographic location is not as important as their economic (and general social and political) origins, including their economic past (meaning the command economy and the process of transition to a market economy).

In order to broaden the scope of comparison between the EU in general with European post-Communist countries, this study also includes six Eastern Partnership (EP) states – Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine which are also post-Communist countries.

[*] Corresponding author
E-mail addresses: vladimer.papava@tsu.ge (V. Papava)

The EU's post-Communist countries and EP states have common economic (and not just economic) pasts. More specifically, these countries (as well as those of any other post-Communist country) were characterized by their command economies. On the other hand, after the collapse of the Communist-type governance and the command economy, the countries of Central and Eastern Europe and the former Soviet Union were forced to face a severe reality: most of their enterprises (especially in manufacturing) were unable to produce competitive production. Hence, a so-called necroeconomy (Papava, 2002) was formed in these countries whose existence is largely sustained by government support provided to necroenterprises.

It should be noted that in the EU's post-Communist countries as well as those formerly members of the USSR, investments result (and continue to do so) in the imports of older and out-of-date technologies rather than anything high-tech and cutting-edge which facilitates the maintenance of an overall technological backwardness in these countries. As a result, a retroeconomy is formed (Papava, 2017a, 2017b).

For the EU's post-Communist countries and the EU in general, it is characteristic to move towards innovative development based upon the establishment of a knowledge-based economy (Berulava, Gogokhia, 2016; Burduli, Abesadze 2017) as put forward in the Lisbon Strategy (Meshaikina, 2013: 14). In this sense, it is interesting to know how useful the experience of the EU's post-Communist countries will be for EP states.

The purpose of this study is to analyze those models of economic development which are used by the EU's post-Communist countries and apply them to the EP states (if appropriate). At the same in this study we will try to find out the quantitative difference between the economic growth of the EU members states with a non-Communist past and that of the Central and Eastern European states with a Communist past.

2. On the Economic Growth Models

There are multiple models of and economic growth (Acemoglu, 2009; Barro, Sala-i-Martin, 2004; Hudson, 2015; Weil, 2005) in the field of economics. According to one modern classification, there are three different types of economic growth (Hudson, 2015: 34-35):

I. "Frontier growth" which is characteristic to countries (for example, the United States) which create qualitatively new products and new production based on new technologies (it should be noted that instead of the term "frontier," one can also use "forging ahead" (Abramovitz, 1986) or "getting ahead" (Gottinger, 2005));

II. "Coat-tail growth" which is characteristic to countries exporting oil or food products whose economic growth is dependent on the supply of these products;

III. "Catch-up growth" which is characteristic to countries that use existing technologies with minimum spending so that they can export their products to high-income countries.

It is difficult to agree with the given definition of *catching up*[*] as the existing technologies may not include cutting-edge technologies at all; without such technologies, it is impossible to catch-up with the economic development levels of the top developed countries (Matthews, 2006: 314) which is further confirmed by the experience of South Korea (Kim, 1997). Hence, *catching up* should not only mean growth based upon existing technologies but also on cutting-edge technologies (Abramovitz, 1986; Matthews, 2006).

It is also known that *catching up*, in itself, facilitates a convergence between countries with developed economies and those with economies which are still developing (Korotayev et al., 2011; Lim, McAleer, 2004).

The aim of the *catching up* model is to develop a country in a way when a relatively economically backward country is able to catch up to those at the top. This model is based upon finding the resources for one's own development for which principled improvements in a country's educational system is very important as well as the facilitation of scientific and engineering research (Åslund, Djankov, 2017: 143-145). This is necessary in order for highly-skilled personnel to be able to not only use the imported technologies from developed countries and use them successfully but also become actively involved in the process of creating these technologies.

[*] It is very important to underline, that *catching up* type of economic growth does not simply imply a "catch-up effect."

Based upon the *catching up* model, respective countries develop sectors of the economy where more value added is being created and which facilitates the expansion of exports of the production output of these particular sectors of the economy.

The *falling behind* model (Abramovitz, 1986; Dunford, Smith, 2000; Gottinger, 2005; Kim, 2007; Nassif et al., 2013; Record et al., 2018; Stokey, 2012) of economic growth is principally different from the *catching up* model as it facilitates a divergence of developed and developing countries and not a convergence.

When the share of the production of labor-intensive and resource-based goods holds a dominant position in the national economy of a country, then we have a trend of *falling behind* (Nassif et al., 2013).

It is well-known that the de-industrialization (Rowthorn, Wells, 1987) of the economy causes the pace of *catching up* to slow down and, in the worst case scenario, facilitates the transfer of the economy to the *falling behind* model (Palma, 2005; Rowthorn, Ramaswamy, 1999).

The *falling behind* model must be differentiated from the abovementioned *coat-tail growth* model as, according to the former, economic growth is determined by the usage of existing, non-cutting-edge technologies at their maximum while the latter purports that economic growth is based upon the exports of oil products and/or food products. Theoretically, it is absolutely possible for the *falling behind* and *coat-tail growth* models to co-exist.

In order to move from the *falling behind* model to the *catching up* model, human resources are of vital importance. More specifically, this concerns those specialists who must become the main creators of the process of *catching up*. As a rule, they must have obtained their education in developed countries where development is based upon cutting-edge technologies (Kim, 2007). Their role is vital in the creation and development of the national educational and scientific systems when the country will be able to move to the *catching up* model using its own resources.

2. From the "New Combinations" and "Creative Destruction" to the "Combinatorial Augmentation"

Joseph Schumpeter's interpretation of economic development in his *Theory of Economic Development* is useful for obtaining a better understanding of economic growth models. More specifically, Schumpeter states that economic development is a process of implementing "new combinations" (Schumpeter, 2012: 139). This means creating new production, new services and new means of production, finding new markets and new sources for supply of raw materials and also carrying out a new organization of industry (Schumpeter, 2012: 66).

At first glance, the impression is that the implementation of an innovation merely requires that resources be redistributed in favor of the innovator. The reality, however, is much more complicated. Specifically, Schumpeter justly remarks that the new combinations, as a rule, form side-by-side with the old ones (Schumpeter, 1987: 219).*

In a certain sense, this statement contradicts the economic dynamics theory also proposed by Schumpeter in another book, *Capitalism, Socialism and Democracy*, which says that the essence of capitalism is the process of "creative destruction" or a process of economic mutation which almost constantly destroys old structures from within and creates new ones (Schumpeter, 2008: 83). The nature of this contradiction is that according to creative destruction, new combinations must only be replacing the old ones while Schumpeter himself, in the abovementioned *Economic Development Theory*, does not exclude the existence of new combinations in the presence of older ones when the new combinations use principally new resources and not the ones already being used by the older combinations (Tatarkin et al., 2017: 7-8).

As a rule, the truth must lie somewhere in between and the nature of this "between" is that the new combinations and creative destruction happen in the same economic space; again, side-by-side and meaning that they co-exist. This is possible in the cases when some older combinations are replaced by new ones through the creative destruction process while other old combinations continue in their existence and are not so much replaced but, rather, witness the creation of new combinations next to them.

* Here, it must be pointed out that this idea was appropriately translated into Russian (Schumpeter, 1982: 288) in Schumpeter's original work (in German) (Schumpeter, 1987: 219) although it is unfortunately missing in the English edition (Schumpeter, 2012: 83).

In the modern era, when new sectors of the economy such as space exploration, the nuclear industry and electronics are operating successfully, a significant part of the resources used by the older combinations are even useless for the new ones (Sukharev, 2013: 9).

It is clear that given the economic realities, the old and new technologies, as already pointed out above, co-exist not so rarely which means they are represented at the same time. Often, this co-existence of old and new technologies is also guaranteed by the fact that they are found in different sectors (or sub-sectors) of the economy of one country which is mainly due to the usage of the means of production carrying differing content which is because of the technical and technological differences between these means.

It should be pointed out that an economic crisis, as shown by international experience, hinders the development of techniques and technologies (Sukharev, 2013: 2) which is not at all surprising as both the fundamental as well as applied sciences suffer the most under an economic crisis (Sukharev, 2013: 6). Hence, we definitely cannot exclude the fact that in order to overcome a crisis and ensure the post-crisis growth of the economy, special emphasis must be made on the older combinations (Sukharev, 2013: 9). This is not very surprising as under the conditions of an economic crisis, the availability of the resources necessary for the implementation of new combinations is much more limited. As a result, the implementation of new combinations in such a situation, if not completely excluded, is at least difficult to achieve.

The concept of "combinatorial augmentation" must also be considered to be a continuation of Schumpeter's economic development theory according to which the combinatorial augmentation is a new combination which does not require resources from old combinations as it is based upon qualitatively new resources (Sukharev, 2013: 9; 2014).

The process of encouraging combinatorial augmentation does not need to mean refusing creative destruction – on the contrary, where possible, new combinations must replace the old ones.

Hence, within the margins of possibility, the facilitation of the replacement of old technologies with new ones or creative destruction, together with the stimulation of the combinatorial augmentation, must become an important tool for economic development.

If we take the recommendations of the *Evolutionary Theory of Economic Change* (Nelson, Winter, 1982) into account, a country's economic policy needs to facilitate the process of combinatorial augmentation, on the one hand, while creating an environment where the process of creative destruction does not face any artificial obstacles, on the other hand, in order to stimulate economic development. For the latter of the two processes, it is important for the government to utilize active and complex measures (qualitative improvement of the education system, budgetary stimulation of innovative technologies, perfecting the legal norms of bankruptcy and others) (Papava, 2017b).

It is noteworthy that theoretically the realization of *catching up* can be achieved most quickly through Schumpeter's creative destruction process; however, in this case the biggest opposition comes from the forces standing behind the old combinations (more specifically, the political forces supporting them).

In the case of combinatorial augmentation, such opposition is weaker as the old and the new combinations can co-exist as they exist in different sectors (or sub-sectors) of the economy of a single country. For the creative destruction of these old combinations, on the other hand, it is important for the government to facilitate the process of combinatorial augmentation as in this case a relatively high level of economic growth can be achieved which will, in its own right, facilitate in overcoming "technology traps" (Balackij, 2012: 57) which exist on the basis of the old combinations.

In order to further explain this phenomenon, let us remember that a technology trap is a condition when a company favors older, less-effective technologies even when there is a possibility of moving to a newer, more modern technology (Balackij, 2003). The technology trap itself is created by a situation when the companies favor resolving short-term rather than long-term tasks. The primacy of short-term interests, as opposed to long-term ones, is mostly due to political, legal and macroeconomic instability (Balackij, 2012). In order for the escape from the technology trap to be possible, it is important to take a whole range of complex steps. Specifically and first of all, the government must facilitate the creation of economic optimism (Balackij, 2010) in society as an optimist, as is well known, aspires to achieve maximum benefits, having become used to the idea of

a high risk, while a pessimist tries to minimize the risks given some acceptable levels of guaranteed benefits (Keselman, Matskevich, 1998). In its own right, the high pace of economic growth in a country facilitates increased economic optimism. Hence, in order to overcome the technology trap, it is important to make a "technology leap" which is possible through the government's facilitation of the combinatorial augmentation process.

Creating economic optimism is very important in countries where companies favor resolving short-term rather than long-term tasks due to political, legal and macroeconomic instability (Balackij, 2012). This shows that a government's facilitating of the combinatorial augmentation process is especially important for such countries.

3. On the Innovative National Systems and Extremely Falling Behind

Today, the prevalent idea is that post-Communist countries have fully overcome the difficult heritage of their Communist past, manifested in a necroeconomy while a retroeconomy is still the main powering sector of the economy. The situation in these countries, in reality, is not so simple.

The economic development of these countries was seriously influenced by the preparation period for EU membership. Specifically, for almost a decade, there was a purposeful restructuring of their individual economies aimed at reducing the spending of enterprises and a qualitative renewal of production processes to be in line with both European and international quality assessment standards (ISO – International Organization for Standardization) (Vlaskin, Lenchuk, 2005: 66). As a result, the necroeconomy is no longer a major problem for the EU's post-Communist countries.

Under a command economy, the majority of the EU's post-Communist members which were also Warsaw Pact members at the time (except Slovenia and Croatia) had rather important scientific and technological systems which were mainly focused on the necessities of the military-industrial complex. When we talk about the initial innovative potential of these countries, the existence of highly-qualified scientists and engineers should be taken into account first and foremost as they were involved in this scientific and technological work (Abukhovich, 2011). This, unto itself, made these countries especially attractive (first of all, in the aero-cosmic and electronic manufacturing industry, the production of telecommunications and their instruments and in the fields of chemistry and pharmacy (Vlaskin, Lenchuk, 2005: 66)) for transnational corporations even before they became EU members. This must be especially underlined as the domestic markets of these countries, before joining the EU, were limited with their own external state border which created the relatively small size of these markets. Consequently, as is well known, the small size of the domestic market of a country, all things being equal, significantly reduces the attractiveness of making investments in any real sector of the economy. We should also emphasize that apart from the small sizes of domestic markets, the abovementioned post-Communist countries bordered the EU directly which, in certain ways, increased the attractiveness of these countries for Western European investors (Shah, 2002: 6).

It was a mistake to rely on the idea that, given neo-liberal and neo-classical expectations, integration into the large economic space of the EU was enough for the newly-integrated member countries to adopt the *catch-up* model of growth (Dunford, Smith, 2000: 192).

It is noteworthy that the abovementioned highly-qualified scientists and engineers had lower wages as compared to their colleagues from Western Europe and the ratio of the nominal wage to labor productivity was clearly in favor of the EU's post-Communist countries.

It was the investment attractiveness caused by the initial innovation potential of these countries that outweighed the problems caused by the relatively small size of the domestic markets of these countries. This turned the EU's post-Communist countries into mainly producing countries rather than consuming countries.

In these member countries (specifically, Poland, Slovakia, the Czech Republic and especially Hungary), the participation of Western European capital in the economy is very important (Vlaskin, Lenchuk, 2005: 69). Such capital, on the other hand, was mostly attracted through the privatization of state assets. The process was also facilitated by respective tax breaks.

As a result, the EU's post-Communist countries managed to achieve more-or-less stable economic growth and an expansion of their export potential. At the same time, it is practically impossible to say that these countries also managed to create their own innovative national systems as the innovative potential inherited from the former command economy was practically

"used-up" by the transnational corporations in their own interests rather than in the interests of the country (Vlaskin, Lenchuk, 2005: 66).

Under the conditions of the domination of transnational corporations, the EU's post-Communist countries had small resources (if any at all) left to develop innovative national systems of their own which is why these countries are economically and technologically fully dependent on the developed states (including the Western European ones) (Vlaskin, Lenchuk, 2005: 66). It is well known that in the case of having a small amount of resources, the chances of success in innovation is rather small which is evidenced by the fact that, for example, the level of unsuccessfulness of innovative activities in the United States is estimated to be about 90 % (Mindeli, 2002: 82).

It is a fact that the EU has fallen behind the US and some parts of Asia in terms of innovations (Åslund, Djankov, 2017: 133-135). Today, the EU (and mostly Luxembourg, Sweden, Finland, Germany, Denmark and the Netherlands) has a real potential for catching up (Åslund, Djankov, 2017: 135).

As a result of the combinatorial augmentation processes taking place in some Western European countries, it has become a clear priority for these countries to facilitate the development of companies based upon cutting-edge technologies and moving traditional manufacturing, based upon the so-called old technologies, to the EU's post-Communist members (and some Western European countries as well). In other words, if the combinatorial augmentation process is mostly characterized by the co-existence of the old and new combinations in various sectors or sub-sectors of a single country in the case of the EU's single economic area, the older combinations were mostly shipped off to the post-Communist member states while some Western European members mainly prioritized cutting-edge technologies.

As a result, the applied research conducted in the EU's post-Communist countries is mostly oriented on the adaptation of technologies created in Western and some Asian countries. This, in its own right, facilitates the migration of the few remaining highly-qualified scientists and engineers from the EU's post-Communist countries to the Western European members or the US and developed Asian countries in search of better remuneration.

In addition, for the better adaptation of the technologies created in other countries, the EU's post-Communist countries are becoming more and more dependent on imports of some raw materials, machinery and technologies from these countries.

Taking all of these conditions into account, it can be inferred that the phenomenon of retroeconomy is clearly present in the economies of the EU's post-Communist (and not only post-Communist) states.

It is an unfortunate fact that innovative national systems are weakly developed in the EU's post-Communist states (Vlaskin, Lenchuk, 2005) which is why these countries are characterized not so much by *catching up* but, rather, by *falling behind* when the economic development of these countries is clearly technologically behind the standards of the economic development of the US and some Asian and Western European countries.

The creation of the EU single market for innovative products is very important for the transition to *catching up* for the EU member-countries (Åslund, Djankov, 2017: 139-141).

From the aforementioned types of economic growth, practically none can be found in the EP states which is a result of a clearly primitive plans.

Unfortunately, chronic poverty and the lack of the development of export potential is characteristic for the EP states economies.

The economic growth type which is characteristic to the EP states, I believe, can be assessed as *extremely falling behind* (Papava, 2018) when, unfortunately, the national innovation system is practically non-existent (at best it is in an extremely embryonic state) and where not only the usage of innovative technologies but also imitation, which is the copying and usage of already existing technologies, is almost impossible.

Taking all of the abovementioned into account, it is necessary for EP states to formulate the strategies which will enable it to move from *extremely falling behind* to *catching up* even if that means going through a period of *falling behind* as an intermediate step.

4. On the Catch-Up Effect Problem

In order to assess the economic growth indicators more or less objectively, we will use the data of the World Bank from before the start of the global financial and economic crisis and from a period maximally removed from that point. More specifically, the analysis will be done for the years 2006 and 2016. With this approach, we tried to maximally exclude the influence of the crisis on the economic growth of the countries included in the study. It should also be pointed out that the gross domestic product (GDP) data of various countries is in international dollars, taking its purchasing power parity (PPP) into account.

As is well known, the indicator (r) is used in order to measure economic growth which expresses the ratio of the real GDP change (meaning the difference between the reporting period (Y^1) of the GDP and the base-period (Y^0) of the GDP or $\Delta Y = Y^1 - Y^0$) to the real GDP base-period:

$$r = \frac{\Delta Y}{Y^0}$$

This indicator is used by economists to measure the economic growth of a given country and also how the economic growth indicator changes over the years.

Using these indicators, it is impossible to compare two or more countries. More specifically, in this case, due to diminishing returns on capital and with all other things being equal, it is possible to achieve a higher economic growth rate in countries with a lower level of economic development than in countries with higher levels of economic development. This fact is called the *Catch-Up Effect* (Mankiw, 2004: 546-547).

If we consider the economic growth rates (WB, 2018a) of the EU post-Communist member states as well as those of the EP states, it is easy to notice that generally in the post-Communist countries and especially in 2006, just before the global crisis, their economic growth was clearly higher than in the EU (see Table 1).

Table 1. Economic Growth and Economic Development Indicators in EU Post-Communist Countries and EP States in 2006 and 2016

No.	**Countries**	**Indicators of Economic Growth** (in percentage terms)		**GDP per capita, PPP** (in current international $)	
		Year		**Year**	
		2006	**2016**	**2006**	**2016**
	EU Post-Communist Countries				
1	Bulgaria	6.8	3.9	11,377.90	19,509.00
2	Croatia	4.8	3	16,934.70	23,731.80
3	Czech Republic	6.9	2.6	23,790.20	35,139.60
4	Estonia	10.3	2.1	19,269.10	29,620.00
5	Hungary	3.9	2.2	18,308.50	26,996.80
6	Latvia	11.9	2.1	15,761.60	25,932.50
7	Lithuania	7.4	2.3	16,494.00	29,966.10
8	Poland	6.2	2.9	15,150.90	27,922.70
9	Romania	8.1	4.6	11,694.30	23,626.40
10	Slovak Republic	8.5	3.3	18,875.50	30,706.10
11	Slovenia	5.7	3.1	25,778.00	33,421.20
	Eastern Partnership Countries				
12	Armenia	13.2	0.2	5,607.60	8,849.90

13	Azerbaijan	34.5	-3.1	9,830.20	17,282.20
14	Belarus	10	-2.6	11,389.60	18,090.70
15	Georgia	9.4	2.8	4,985.30	10,024.00
16	Moldova	4.8	4.1	3,190.10	5,342.60
17	Ukraine	7.3	2.3	7,184.20	8,271.80
	European Union	3.3	1.9	29,783.10	39,838.20

Based upon Table 1 and due to the *catch-up effect*, it is practically impossible to determine which countries are characterized with catching up growth with regard to EU economic growth and which have the *coat-tail growth* or are *falling behind*. For example, the fact that Azerbaijan had the highest actual economic growth in 2006 (34.5 %) does not mean that Azerbaijan necessarily had *frontier growth*.

It is quite clear that the economic development levels of the countries presented in Table 1 are different, for example, by the fact that the past (and in some cases the present, too) of the post-Communist countries is burdened with a *necroeconomy* (Papava, 2002). Hence, given a lower starting point (in which the post-Communist states found themselves due to their level of economic development), it is easier for post-Communist countries to achieve high economic growth due to the catch-up effect than it is for non-post-Communist countries.

The level of economic development is usually assessed through the GDP per capita. It is clear that this indicator is very different if we compare the EU member states to the EP countries (see Table 1) (WB, 2018b).

Hence, in order to be able to compare the economic growth indicators of the countries with different starting points in terms of economic development, it is necessary to exclude the *catch-up effect* which can be achieved, for example, by using the method based upon the *hypothesis of proportional overlap* (Papava, 2012, 2014). More specifically, let us agree on the level of hypothesis that the more economically developed a country is as compared to another one, the more difficult it is for the first country to achieve the same level of economic growth which is achieved by the second country.

If we use N to signify the population of a given country, then the GDP per capita (y) will be

$$y = \frac{Y}{N}$$

Stemming from the essence of the *hypothesis of proportional overlap of the catch-up effect*, the proportional overlap coefficient of the catch-up effect α_{ij} shows how many times the GDP per capita for i country (y_i) exceeds the same indicator of a j country (y_j):

$$\alpha_{ij} = \frac{y_i}{y_j}$$

At first glance, it is better to take a country with the biggest GDP per capita (in our case, Luxembourg) as the i country (or, provisionally, the *Etalon* country), making it more difficult for this country to achieve a high level of economic growth. It must be noted that it is also acceptable to take the respective indicators of any other country to set as the *Etalon* country as the ratio of the final results (meaning the adjusted economic growth indicators) does not change due to the *invariance theorem* (Papava, 2016).

Given the goals of this study, it is logical to take the GDP per capita of the EU ($\bar{y}$) as the *Etalon* indicator as in this case it will enable us to compare both the EU post-Communist member states as well as those of the EP to the EU's economic growth and its level of economic development. Hence, for the goals of this study, the proportional overlap coefficient ($\bar{\alpha}_j$) will be

$$\bar{\alpha}_j = \frac{\bar{y}}{y_j}$$

These coefficients are presented in Table 2. The parameters given in this table show how many times the GDP per capita of the EU is more or less as compared to the respective indicators of the individual countries.

Table 2. Proportional Overlap Coefficients of the Catch-Up Effect (Ratio of the GDP per capita of the EU with the Same Indicators of Individual Countries)

No.	Countries	Years	
		2006	2016
	EU Post-Communist Countries		
1	Bulgaria	2.617627	2.042042
2	Croatia	1.758703	1.678684
3	Czech Republic	1.251906	1.133712
4	Estonia	1.54564	1.344976
5	Hungary	1.626736	1.475664
6	Latvia	1.889599	1.536227
7	Lithuania	1.805693	1.329442
8	Poland	1.965764	1.426732
9	Romania	2.546805	1.686173
10	Slovak Republic	1.577871	1.297403
11	Slovenia	1.155369	1.192004
	Eastern Partnership Countries		
12	Armenia	5.311203	4.501542
13	Azerbaijan	3.029755	2.305158
14	Belarus	2.614938	2.202137
15	Georgia	5.974184	3.974282
16	Moldova	9.336102	7.456706
17	Ukraine	4.145639	4.816146
	European Union	1	1

Taking into account that the actual economic growth of a country j was r_j, while the ratio of the economic development level of the EU with that of the country j is $\bar{\alpha}_j$, it follows that the adjusted economic growth of the country j ($\bar{r}_j^*$), taking the proportional overlap hypothesis of the catch-up effect into account, will be

$$\bar{r}_j^* = \frac{r_j}{\bar{\alpha}_j}$$

In other words, $\bar{r}_j^*$ does not show the actual economic growth of a country j but, rather, its adjusted indicator, taking into account the difference between the economic development levels of the EU and the country j. The adjusted economic growth data are presented in Table 3.

Table 3. Adjusted Economic Growth Data

No.	Countries	Years	
		2006	2016
	EU Post-Communist Countries		
1	Bulgaria	2.597773	1.909853
2	Croatia	2.729285	1.787114
3	Czech Republic	5.511595	2.293351
4	Estonia	6.663904	1.561366
5	Hungary	2.397438	1.490855
6	Latvia	6.297633	1.366986
7	Lithuania	4.09815	1.730049
8	Poland	3.153989	2.032618
9	Romania	3.180456	2.728071
10	Slovak Republic	5.387006	2.543542
11	Slovenia	4.933489	2.600663

	Eastern Partnership Countries		
12	Armenia	2.485313	0.044429
13	Azerbaijan	11.38706	-1.34481
14	Belarus	3.824182	-1.18067
15	Georgia	1.573437	0.70453
16	Moldova	0.514133	0.549841
17	Ukraine	1.760887	0.47756
	European Union	3.3	1.9

If we compare the adjusted economic growth data in Table 3 with the actual economic growth data in Table 1, we will find essential differences.

Basing upon the adjusted economic growth indicators, in order to clearly imagine the quantitative differences between the EU, the post-Communist countries of the EU and the EP states, it is advisable to present these indicators graphically. For this, it is necessary to rank the levels of the economic developments of each given country with regard to the level of the EU's economic development. For this purpose, we will divide the GDP per capita by individual country by the respective EU indicator ($\bar{\beta}_j$)

$$\bar{\beta}_j = \frac{y_j}{\bar{y}}$$

The appropriate indicators are presented in Table 4.

Table 4. Ratio of the GDP per capita by Individual Country to the Same Indicator of the EU

No.	**Countries**	**Years**	
		2006	**2016**
	Post-Communist Countries		
1	Bulgaria	0.382025	0.489706
2	Croatia	0.568601	0.595705
3	Czech Republic	0.798782	0.882058
4	Estonia	0.646981	0.743507
5	Hungary	0.614728	0.677661
6	Latvia	0.529213	0.650946
7	Lithuania	0.553804	0.752195
8	Poland	0.508708	0.700903
9	Romania	0.392649	0.593059
10	Slovak Republic	0.633765	0.77077
11	Slovenia	0.865524	0.838923
	Eastern Partnership Countries		
12	Armenia	0.188281	0.222146
13	Azerbaijan	0.33006	0.43381
14	Belarus	0.382418	0.454104
15	Georgia	0.167387	0.251618
16	Moldova	0.107111	0.134107
17	Ukraine	0.241217	0.207635
	European Union	1	1

In order to represent the adjusted economic growth data of the countries as well as their level of economic development on a graph, we will take the ratio of the GDP per capita by country to the same indicator of the EU $\bar{\beta}_j$ on the abscissa axis and the data adjusted basing upon the proportional overlap hypothesis of economic growth ($\bar{r}_j^*$) on the ordinate axis. On every graph presented below, 1 on the abscissa axis corresponds with the GDP per capita of the EU according to

which the same indicators of every country are ranked while for the 2006 graphs we see the EU economic growth rate – 3.3 and for 2016 – 1.9 on the ordinate axis (see Tables 1 and 3).

After excluding the catch-up effect in the post-Communist countries of the EU (Figures 1 and 2) as well as the EP states (Figuress 3 and 4), we have an interesting picture.

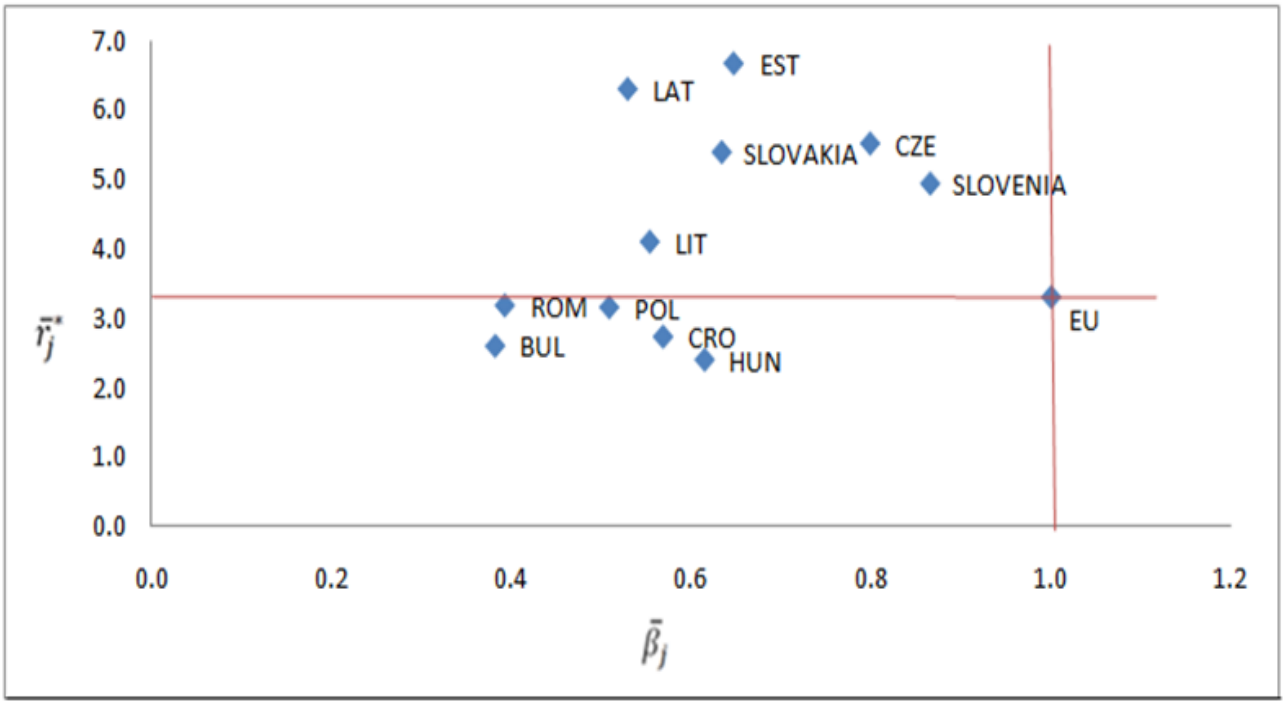

Fig. 1. Adjusted Economic Growth of the Post-Communist Countries of the EU and their Economic Development Level as Compared to that of the EU in 2006

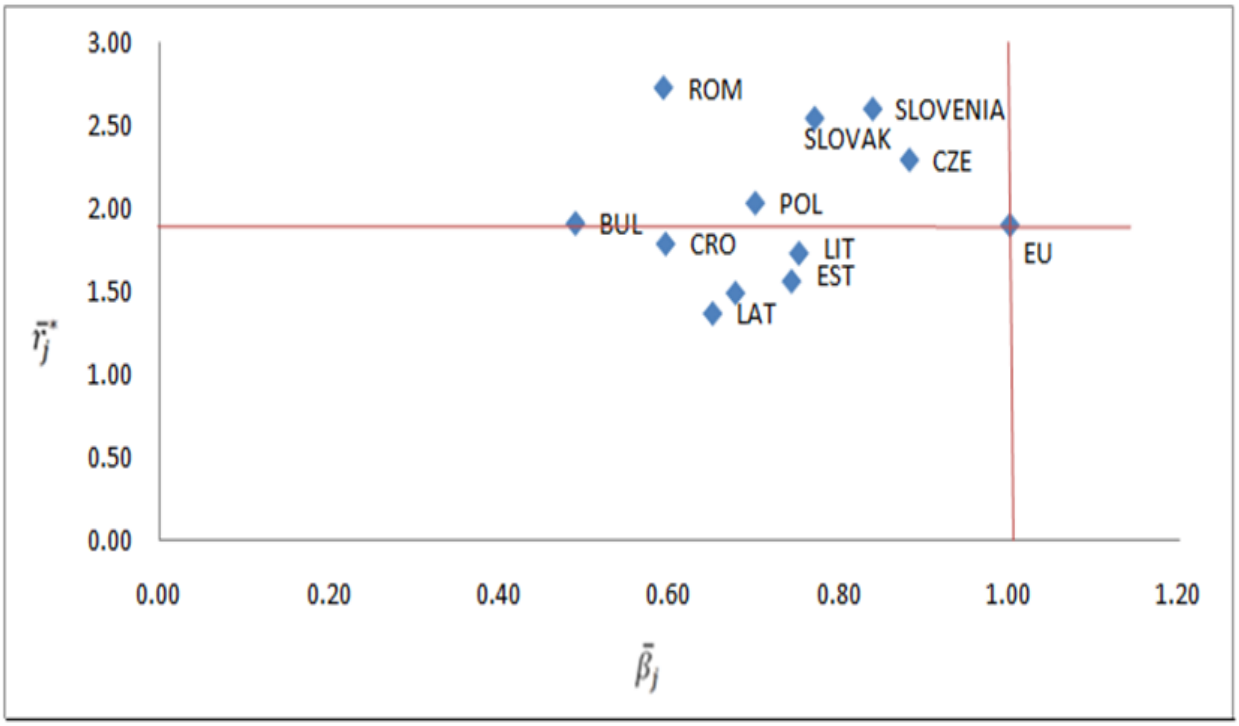

Fig. 2. Adjusted Economic Growth of the Post-Communist Countries of the EU and their Economic Development Level as Compared to that of the EU in 2006

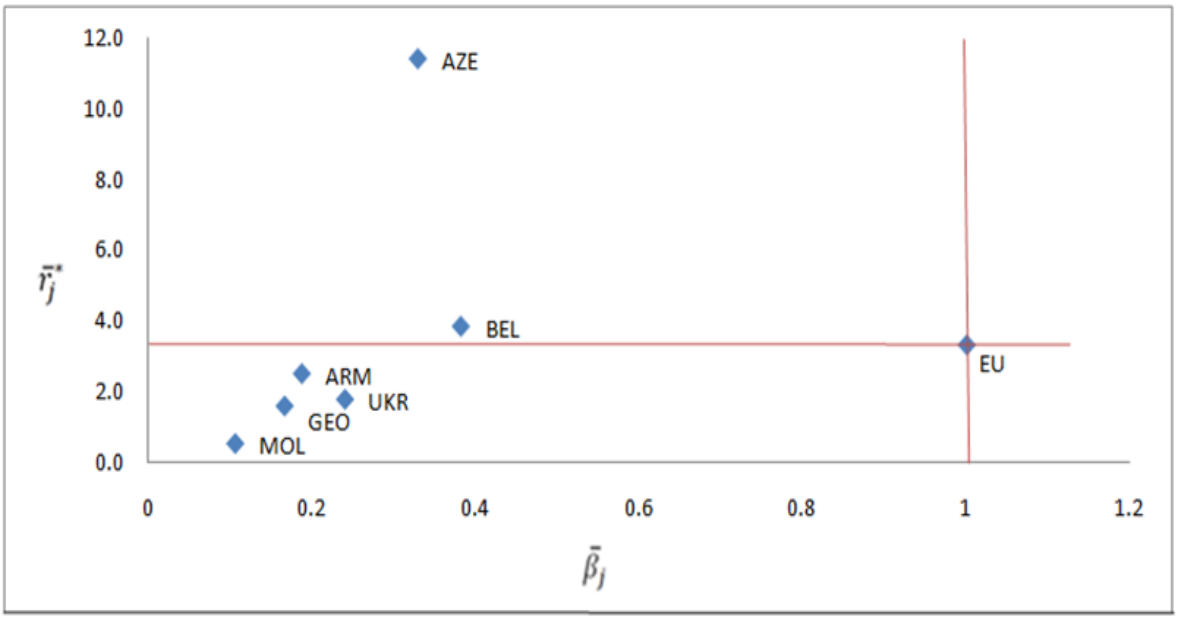

Fig. 3. Adjusted Economic Growth of the EP States and their Economic Development Level as Compared to that of the EU in 2006

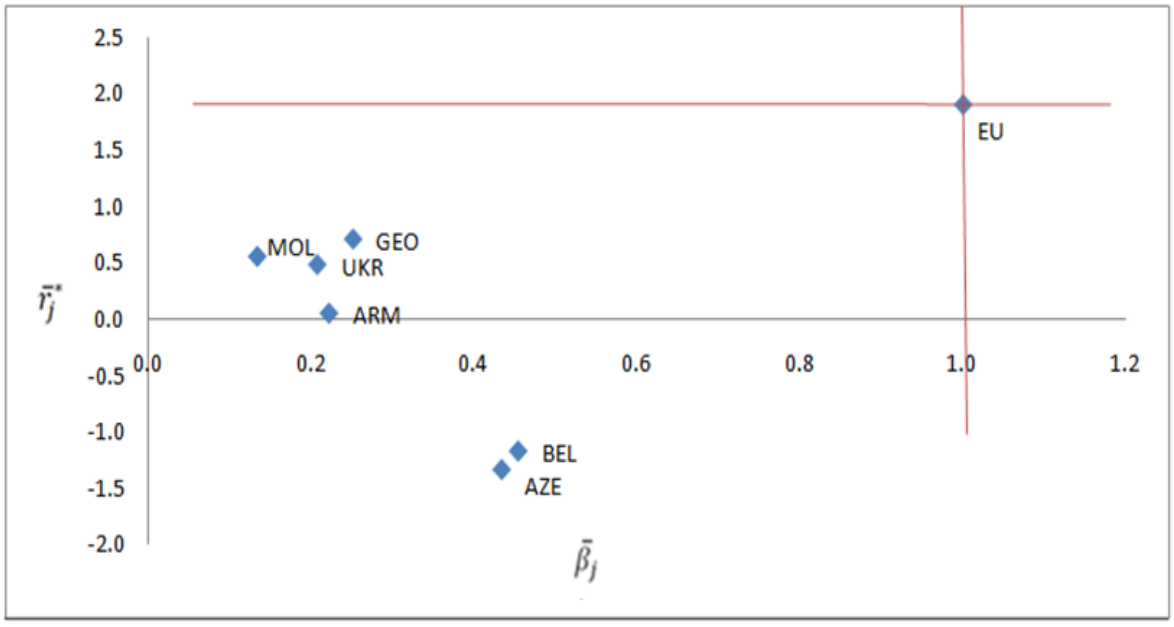

Fig. 4. Adjusted Economic Growth of the EP States and their Economic Development Level as Compared to that of the EU in 2016

Figures 1 and 2 make it clear that based on a ten year interval, in 2006 and 2016, only Slovakia, Slovenia and the Czech Republic from the post-Communist countries of the EU had clearly defined and relatively high economic growth while other countries showed no such stability with the economic growth indicators of Hungary and Croatia pointing to a clearly defined *falling behind*.

It is clear that in order to diagnose what type of economic growth the abovementioned countries have, it is not enough to merely exclude the catch-up effect – it is necessary to use a whole system of indicators (UNIDO, 2005). In addition, it is advisable to take a more-or-less lengthy time period in order for the economic growth trends to be better revealed. It is no less important that from this time period, the points of global or regional economic and crisis periods be excluded so that the crisis does not distort the image of the economic growth type under consideration.

In this regard, the adjusted economic growth indicators of the EP states are even more troubling (see Figures 3 and 4).

Both in 2006 as well as in 2016, the EP states seriously lag behind the indicators of the EU when it comes to the level of economic development.

Even after excluding the catch-up effect for 2006, only Azerbaijan can be singled out due to its high level of economic growth; however, this does not mean that this country can be characterized by *catching up*. If we remember that the economy of Azerbaijan is characterized by the production and exports of oil and gas (in which terms 2006 was also a special year (Papava et al. 2009: 50)), it is undeniable that the economic growth type of this country is *coat-tail growth*. The reduction of oil prices on the world market had quite painful results for the economy of Azerbaijan which was one of the important reasons for the economic recession of 2016.

It can be concluded unequivocally that the EP states are not characterized by *catching up* at all and, unfortunately, the type of their economic growth is either *falling behind* (maybe even *extreme falling behind*) or *coat-tail growth*. In order to tell which one has which, it is necessary to study the main features of individual economies.

5. Conclusion

The EU's post-Communist countries as well as the EU in general are participating in the implementation of the Lisbon Strategy which aims to create an economy of knowledge. The usage of *catching up* is extremely important in achieving this strategy's goals as it will ensure a convergence between economically developed countries and developing countries.

Falling behind, on the other hand, facilitates a divergence between developed countries and developing countries as labor-intensive and resource-based goods hold the dominant place in the national economy in this model.

Based on practice, it is a fact that both modern as well as old technologies are often simultaneously present in the differing sectors or sub-sectors of a country's economy.

The combinatorial augmentation concept is a continuation of Schumpeter's economic development theory if we take modern realities into account.

Almost a decade of preparation for EU membership has had a very important influence on the EU's post-Communist countries. This period was allocated for the restructuring of the individual economies in order to reduce production expenditures and qualitatively reform production processes.

Starting from the 1990s, the EU began investing in the geographically neighboring post-Communist countries on or near its borders. More specifically, the relative low wages required by highly-qualified scientists and engineers from these countries, as compared to those from Western Europe, was beneficial for transnational corporations. In this way, it became possible for the EU's post-Communist countries to achieve a more-or-less stable economic growth and expand their export potential.

Unfortunately, these countries failed to create their own national innovation systems as transnational corporations used up the innovative potential inherited by these countries from the command economy solely according to their interests.

The combinatorial augmentation process revealed itself in the EU's post-Communist countries in a special way when old and new technologies not only co-exist in different sectors or sub-sectors but have also been distanced in terms of geography: new technologies are mainly concentrated in some Western European and other developed countries while older technologies were mostly left for the EU's post-Communist countries.

As a result, the dependence of the EU's post-Communist countries on imports, especially machinery, from some Western European countries (and, in general, from the developed world) is growing. It is clear that the economies of the EU's post-Communist countries are a good polygon for maintaining a retroeconomy and implementing the combinatorial augmentation process in this way.

For the EU's post-Communist countries, *falling behind* are more characteristic than *catching up* which is a result of the unfortunate fact that the national innovation systems in these countries are weakly developed.

Unfortunately, economic growth types of Eastern Partnership are based on the *extremely falling behind* model.

Excluding the catch-up effect is of special importance in making a quantitative assessment of the differences between the economic growth of the states of Central and Eastern Europe that did have a Communist past. For this purpose, the method based upon the proportional overlap hypothesis can be used.

After excluding the catch-up effect, the most promising economic growth in the post-Communist countries of the EU can be found in Slovakia, Slovenia and the Czech Republic.

Unfortunately, the economic growth types of the EP states are not satisfactory. It is clear that characteristic to these countries are *falling behind* (or, more accurately, *extremely falling behind*) and *coat-tail growth*.

In order to study the economic growth type for each country with more precision, after the catch-up effect is excluded, the use of a special system of indicators is necessary.

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