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On Determinants Of The Economic Growth Of European Countries During 2005–2015

Abstract

The aim of the paper is to examine the economic growth of 32 European countries from 2005 to 2015. This period was characterized by a strong growth prior to 2009, when the Great Recession started, and lasted until 2012–2013 in the majority of examined countries. The growth between 2005 and 2015 was studied with regard to six selected socio-economic factors: initial level of the gross domestic product, economic openness, democracy index, human capital, physical capital, and foreign direct investments. The main result is that the growth was directly proportional to human and physical capital, and indirectly proportional to the initial level of GDP and the democracy index. Furthermore, cluster analysis showed that the historical division of Europe into "West" and "East" still persists to a considerable extent.

Keywords: *economic growth, economic openness, democracy index, human capital, physical capital*

JEL: *C21, F43, O47, O57*

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1. Introduction

National economic growth is a result of many factors and the literature on the determinants of the growth is rather extensive. Barro and Sala-i-Martin (Barro and Sala-i-Martin 1992) and other similar works (Barro 1996, 2003), noted that the growth is usually indirectly proportional to the initial level of the gross domestic product (GDP). This relationship is called the beta-convergence, or simply the "catch-up effect". Countries with a lower GDP tend to grow faster, and this development is well documented at the national or regional levels, see e.g. (Evans and Karras 1996), (Sala-i-Martin 1996) or (Young et al. 2008). But the initial level of the gross domestic product is not the only determinant of the economic growth. Empirical studies on the topic have utilized many other variables such as fiscal policy, inflation, human and physical capital, the level of democracy, trade openness, life expectancy, fertility rates, government consumption, research and development funding, and technological progress, see e.g. (Kormendi and Meguire 1985), (Mankiw et al. 1992), (Fischer 1993) or (Easterly and Rebelo 1993).

Human capital, measured as both the education level and health, can be considered a primary source of an economic growth. Barro (Barro 1991) found that the initial human capital positively influenced the real GDP growth per capita on a sample of 98 countries from 1960 to 1985. Benhabbib and Spiegel (Benhabbib and Spiegel 1994) showed that the higher is the level of human and physical capital, the higher is the national production and competitiveness. Mankiw, Romer and Weil (Mankiw et al. 1992) used an augmented Solow model to demonstrate that adding human capital to physical capital excellently described the cross-country data they examined.

The influence of democracy on the growth was studied by Helliwell (Helliwell 1994) and Barro (Barro 1996). Helliwell concluded that it is not possible to identify any systematic net effect of democracy on the growth, while Barro found that political freedom had only a weak effect on the growth, but this effect was more visible for less democratic countries.

The effect of foreign direct investment (FDI) on economic growth was studied by, e.g., Borensztein, De Gegorio and Lee (Borensztein et al. 1998). They state that FDI is an important tool for the transfer of technology, contributing relatively more to growth than domestic investment. Zhang (Zhang 1999, 2001) concludes that FDI more likely enhances economic growth when host countries adopt a liberalized trade regime, improve education and thereby human capital,

encourage export-oriented FDI, and maintain economic stability. On the other hand, Moudatsou (Moudatsou 2003) obtained evidence that unlike previous empirical findings concerning developing economies, the growth effect of FDI is not influenced by the level of human capital in developed host countries.

Also, the link between economic openness and the growth was studied by, e.g., Gallup, Sachs and Mellinger (Gallup et al. 1998). They concluded that open economies import new technologies and new ideas from the rest of the world in a better way than their less open counterparts, and that this advantage allows them to grow faster. However, other empirical studies do not support this claim. In particular, Rodriguez (Rodriguez 2007) demonstrates that the degree of openness and growth are basically uncorrelated.

Although the literature on the topic is extensive, the aforementioned studies are predominantly from the 1960s to the 1990s, and they focus more on developing countries than the developed ones. So the question arises: What is the driving force behind growth in Europe in the 21st century? The short answer is we don't know, because up-to-date studies of developed countries are rather lacking.

Therefore, the aim of the paper is to examine the economic growth of 32 European countries (all European countries with available data) in the last decade (from 2005 to 2015) with regard to selected factors, including the initial level of GDP, economic openness, the democracy index, human capital, physical capital, and foreign direct investments.

The examined period is characterized by a strong growth in the majority of European countries until 2008, when the Great Recession commenced. The economic downturn lasted for three to five years, with the European periphery (the Baltic countries, the Balkans and Greece) being the most affected regions, see (Mazurek and Mielcová 2013) or (Mazurek 2016).

The paper is organized as follows: In the next section 2 the method and the data are described; in section 3 the results are presented; and the conclusions there from close the article.

2. Method and data

The dependence of economic growth during 2005–2015 of 32 European countries (all European countries with available data) on six selected socio-economic variables was examined via the linear regression model. The data used for the model included:

- *Economic growth* (abbreviated as *GROWTH* hereinafter). given in % as the change from 2005 to 2015, using the data source (Eurostat 2016).

- *Initial* (2005) *level of GDP* (*iGDP*) given in millions of Euros, (Eurostat 2016).
- *Economic openness* (*OPEN*) in 2005 given as the ratio of trade to the national GDP, in %, (WorldBank 2016a).
- *Democracy index* (*DEM*) in 2006, (the Economist Intelligence Unit 2016).
- *Human capital* (*HCAP*), given in the number of years of schooling of adults in 2005, (Human Development Reports 2016).
- *Physical capital* (*PCAP*), given as the number of personal computers per 100 people in 2005, (WorldBank 2016b).
- *Foreign direct investment* (*FDI*), given as net inflows in % of GDP, using the average from 2005-2014, (World Bank 2016c).

The years of schooling of adults and the number of personal computers per 100 people were selected as the proxies for human capital and physical capital, respectively. For the linear model, the values of four variables (iGDP, OPEN, HCAP and PCAP) were taken from the initial year of examination (2005) in order to determine how these variables affected the growth in the following ten years. On the other hand, the values of the FDI variable were averaged over the examined period because of their high inter-annual volatility.

As the democracy index was introduced only in 2006, this value was used for the analysis. The Economist Intelligence Unit's index of democracy (from 0 to 10), is based on the ratings of 60 indicators grouped in five categories: the electoral process and pluralism; civil liberties; the functioning of government; political participation; and political culture. Again, each category is rated on the 0 to 10 scale, and the overall index of democracy is the simple average of the five category indexes (see the Economist Intelligence Unit 2016 for details). All the data are provided in Appendix A.

The linear model takes the following form:

$$GROWTH_k = \alpha + \beta iGDP_k + \gamma OPEN_k + \delta DEM_k + \varepsilon HCAP_k + \phi PDCAP_k + \eta FDI_k, \quad (1)$$

where $k \in \{1, 2, ..., 32\}$.

As for the estimation method, the Ordinary Least Squares (OLS) method is the best linear estimator if certain assumptions regarding data are met. In the event these assumptions of the OLS method are violated, in particular when a significant heteroscedasticity is present, the Pseudo Poisson Maximum Likelihood (PPML) method, the Nonlinear Least Squares (NLS) method, or the Feasible Generalized Least Squares (FGLS) methods were proposed.

As an additional method, cluster analysis via the k-means clustering method was employed to assess (dis)similarities between countries, and to answer the question whether a division between Western and Eastern Europe still persists. The

method's name was coined by MacQueen (MacQueen 1967) and the standard algorithm comes from Lloyd (Lloyd 1982). The method divides a set of n observations into K clusters so that observations in each cluster are similar (close) to each other. The method requires variables that are (preferably) continuous with no outliers, as discrete data may cause problems. Each observation j is an m-dimensional vector x_{ij}, $i = 1$ to m. Let's assume the k-th cluster contains n_k objects. Then the clustering aims to partition n observations into K sets ($K < n$) so as to minimize the within-cluster sum of squares for K clusters (WSS_K), as follows:

$$WSS_K = \frac{mn}{mn-m} \cdot \sum_{k=1}^{K} \sum_{i=1}^{m} \sum_{j=1}^{n_k} \left(1 - \delta_{ijk}\right)\left(z_{ij} - c_{ik}\right)^2 , \qquad (2)$$

where c_{ik} is the average of i-th variable in k-th cluster, δ_{ijk} denotes the (eventual) missing value of the i-th variable in the j-th object for the k-th cluster, and z_{ij} is a standardized value of x_{ij}.

Goodness-of-fit is given by the percentage of variation, PV_K, as follows:

$$PV_K = \frac{WSS_K}{WSS_1} \cdot 100 , \qquad (3)$$

where index K is the number of clusters. PV_K gives the within-sum of squares for K clusters (WSS_K) as a percentage of the within sum of squares without clustering (WSS_1).

3. Results

The highest GDP growth during 2005-2015 was experienced by Romania and Slovakia (almost 100%), followed by Bulgaria (84%) and Estonia (82%). On the other hand, Greece was the only country with an overall economic decline (by almost 12%). Interestingly, the first seven countries with the highest growth belonged to the former communist bloc (Eastern Europe). While Eastern European countries grew by 66% on average, the West grew only by 28%. Although both sets included only 13 (East) and 19 (West) countries, the difference in the average growth between both groups was found statistically significant at the 0.001 level.

The correlation matrix of all variables included in model (1) is shown in Table 1. As can be seen, correlation coefficients were not particularly high with the exception of PCAP and DEM (0.848). Therefore, the data were examined for a potential multicollinearity via the Variance Inflation Factor (*VIF*), $VIF_i = 1 / (1 - R_i^2)$, where R_i^2 is the proportion of variance in the i-th independent variable associated with other independent variables in a model. A rule of thumb

states that for values of *VIF* larger than 10, the multicollinearity of a model can be considered a serious problem. In model (1) the *VIF* of all explanatory variables were: 1.56, 4.31, 4.38, 4.91, 1.56 and 3.23, indicating that the multicollinearity of the model was not a problem.

The variables most correlated with GDP growth were the democracy index (negatively) and the economic openness (positively); see also Figures 1 and 2. Figure 3 provides a graphical relationship between the GDP growth and FDI.

For the regression model (1) the data from Appendix A were used. The regression was performed via the statistical software Gretl. Residuals were examined for exogeneity, normality, and heteroscedasticity. All assumptions of OLS were satisfied with the exception of heteroscedasticity. Therefore, Gretl's built-in OLS with the corrected heteroscedasticity method (the weighted least squares method) was used for the estimation. The results are provided in Table 2. The adjusted coefficient of determination $R^2 = 0.642$.

From the estimation results shown in Table 2 it is clear that the most significant factors *positively* contributing to national GDP growth are human and physical capital. On the other hand, the democracy index was found negatively proportional to the GDP growth as well as the initial level of GDP. The latter relationship is the well-known "catch-up effect": countries with a lower GDP (thus a lower baseline) tend to grow relatively faster. The former relationship might be associated with the observation that countries from the former communist bloc grew faster than their western counterparts in the last two decades, but their democracy index is still much lower when compared to majority of western countries. Somewhat surprisingly, the effect of economic openness and foreign direct investments was shown to be statistically insignificant in the model, although a simple regression in the case of economic openness and GDP growth showed a positive relationship.

As mentioned in the first paragraph of this section, the economic growth of countries from the former communist bloc (East) differed significantly from the growth of the Western countries (West). This indicates Europe might be still divided into two blocs. To investigate this possibility, a cluster analysis via NCSS11 was performed. The input variables were again the 32 European countries, along with their data given in Appendix A (7 parameters for each country). For the clustering, two clusters were selected. The results are shown in Figure 4. As can be seen, the East-West division still persists to a considerable extent. Only the Czech Republic and Estonia switched their positions to the West, while some South European countries, such as Spain, Portugal, Italy and Greece, "moved" to the East. Therefore, a new geographic pattern appeared: the division is not simply the East versus the West, but rather the Southeast versus the Northwest.
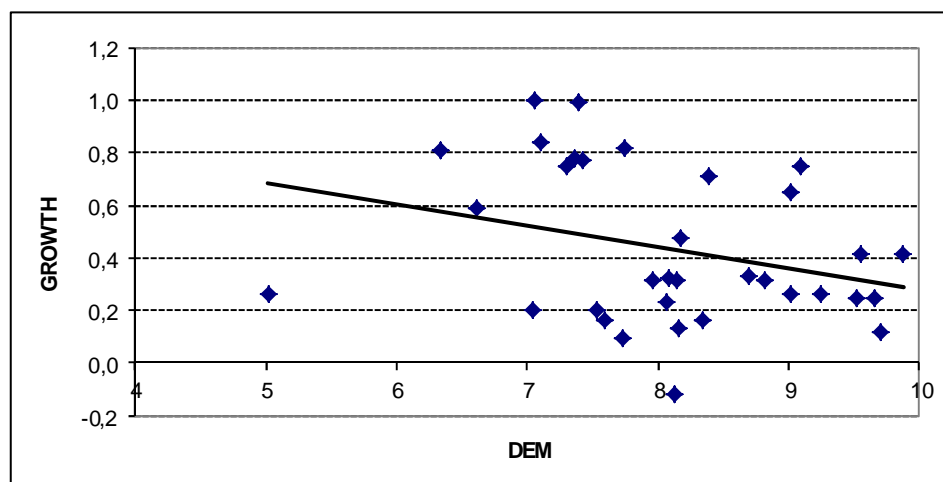
Table 1. Correlation matrix of all variables

	GROWTH	iGDP	OPEN	DEM	PCAP	HCAP	FDI
GROWTH	1	-0.323	0.360	-0.421	-0.166	0.188	0.102
iGDP		1	-0.386	0.154	0.232	0.142	-0.184
OPEN			1	0.112	0.235	0.288	0.770
DEM				1	0.848	0.373	0.238
PCAP					1	0.495	0.236
HCAP						1	0.103
FDI							1

Source: own calculations.

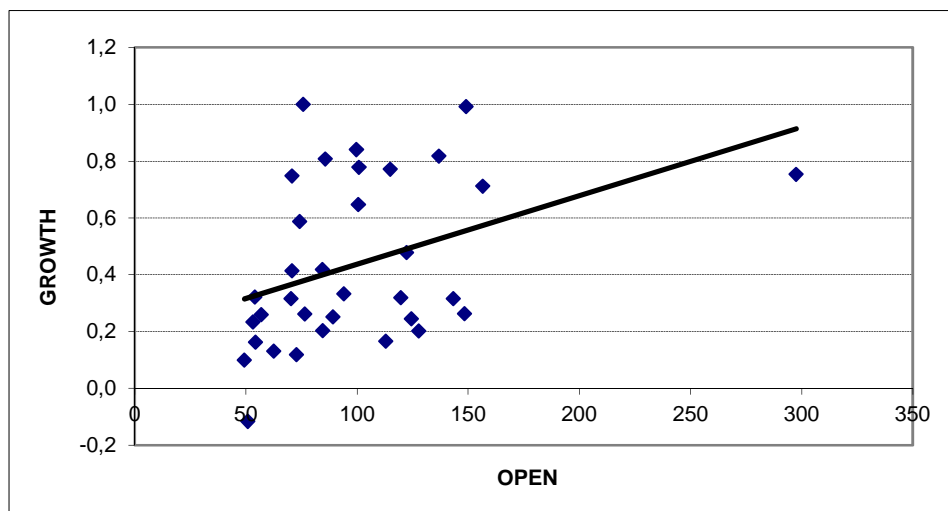**Table 2. The linear model with corrected heteroscedasticity.**

variable	coefficient	st. error	t-value	p-value	significance
const.	1.479	0.467	3.167	0.0040	***
iGDP	-1.562e-07	4.659e-08	-3.353	0.0026	***
OPEN	0.0008	0.0011	0.695	0.4935	
DEM	-0.237	0.0534	-4.436	0.0002	***
PCAP	0.0069	0.0029	2.432	0.0225	**
HCAP	0.0604	0.0209	2.893	0.0078	***
FDI	-0.0005	0.0042	-0.116	0.9086	

Source: own calculations.

Figure 1. The relationship between GDP growth and the democracy index. The "outlier" in the bottom left corner is Russia
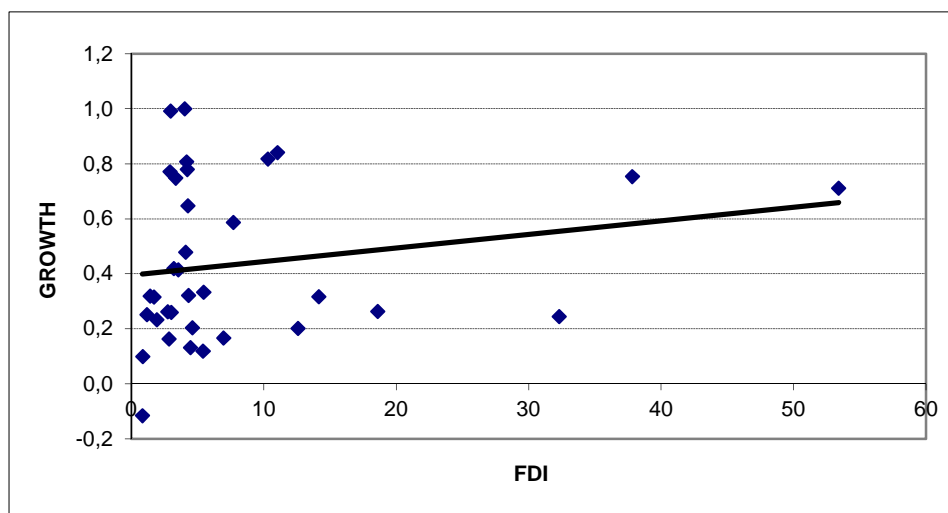
Source: own calculations.

Figure 2. The relationship between GDP growth and openness. The "outlier" in the upper right corner is Luxembourg
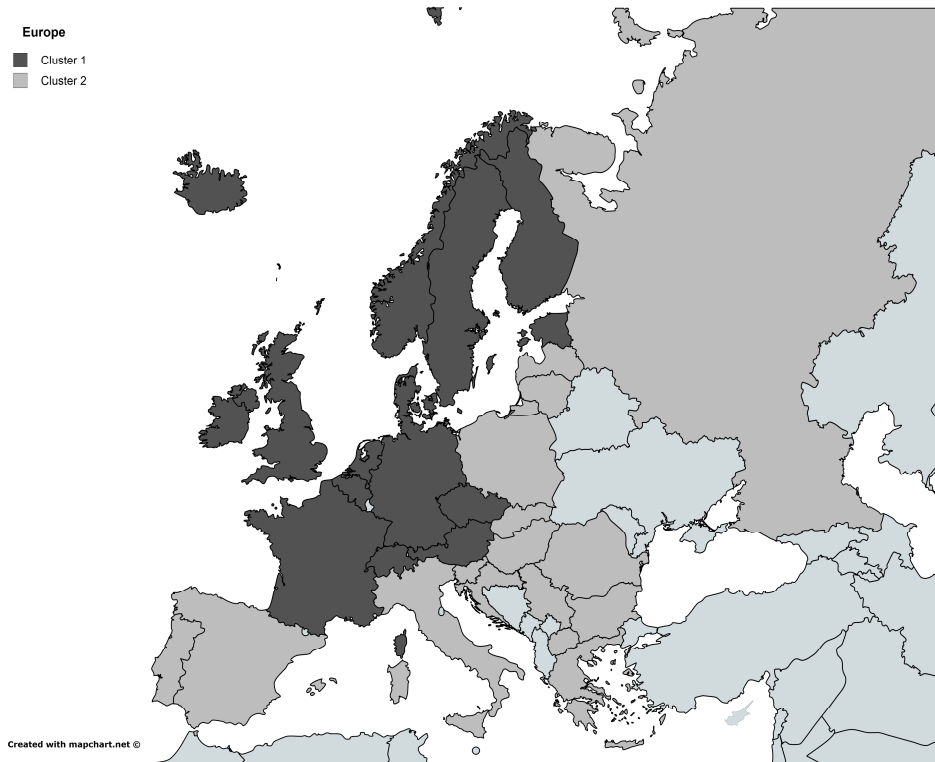

Source: own calculations.

Figure 3. The relationship between GDP growth and FDI. The "outlier" at the right-hand side is Malta

Source: own calculations.

Figure 4. The division of European countries into two groups (clusters) based on the data from Appendix A

Source: own calculations.

4. Conclusions

The aim of this paper was to study the dependence of the GDP growth of 32 European countries during 2005–2015 with regard to six selected socio-economic variables. It was found that the growth was indirectly proportional to the initial level of GDP and the democracy index, and was directly proportional to human and physical capital (all these linear relationships were statistically significant at the 0.01 level). On the other hand, the GDP growth was not affected by countries' openness, which is in accord with the earlier findings of Rodriguez (Rodriguez 2007). Foreign direct investment correlated positively with the growth, but its effect was not statistically significant.

With respect to the perception of an East-West divide in Europe, the results of the cluster analysis indicate that the division is real to a considerable extent, but more precisely, Europe's division today is more about the "rich" Northwest versus the poor "Southeast".

Future studies may focus on a broader set of countries (OECD, etc.), or can employ more socio-economic variables.

Acknowledgments

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APPENDIX A

Data for the linear model (1):

Country	GROWTH	iGDP	OPEN	DEM	PCAP	HCAP	FDI
Austria	0.333	253009	94.16	8.69	55.43	10.1	5.49
Belgium	0.316	311481	143.38	8.15	31.8	10.6	14.19
Bulgaria	0.840	24001	99.87	7.1	5.52	10	11.06
Croatia	0.202	36508	84.73	7.04	18.02	9.7	4.63
Cyprus	0.166	14906	112.92	7.6	26.8	10.7	6.99
Czech Rep.	0.478	109394	122.28	8.17	20.57	13.1	4.12
Denmark	0.251	212907	89.22	9.52	61.52	11.8	1.19
Estonia	0.817	11262	136.92	7.74	43.96	11.9	10.33
Finland	0.261	164387	76.63	9.25	46.13	10.1	2.77
France	0.232	1 771 978.0	53.15	8.07	41.56	10.4	1.95
Germany	0.315	2300860	70.42	8.82	48.46	12.4	1.74
Greece	-0.117	199 242.3	50.9	8.13	8.55	9.8	0.85
Hungary	0.201	90 543.0	127.86	7.53	12.71	11.1	12.60
Iceland	0.118	13 484.6	72.87	9.71	46.28	9.9	5.43
Ireland	0.263	169978	148.46	9.01	45.65	11.4	18.61
Italy	0.098	1 489 725.5	49.39	7.73	26.87	9.5	0.88
Latvia	0.778	13 710.6	100.95	7.37	18.75	10.4	4.25
Lithuania	0.771	21 002.4	115.02	7.43	13.03	11.8	2.94
Luxembourg	0.753	29 733.5	297.56	9.1	62	11	37.85
Macedonia	0.807	5 032.0	85.84	6.33	5.82	8.2	4.21
Netherlands	0.244	545 609.0	124.55	9.66	51.01	11.6	32.33
Norway	0.413	248 332.2	70.85	9.55	55.09	12.7	3.57
Poland	0.748	244 822.0	70.79	7.3	14.34	11.3	3.38
Portugal	0.131	158 652.6	62.57	8.16	13.39	7.1	4.48
Romania	0.999	80 225.6	75.93	7.06	9.66	10.1	4.05
Serbia	0.587	21 103.3	74.28	6.62	5.21	9.4	7.73
Slovakia	0.991	39 219.9	149.17	7.4	23.61	11.6	2.98
Slovenia	0.318	29 235.4	119.8	7.96	32.57	11.4	1.43
Spain	0.162	930 566.0	54.34	8.34	22.25	8.9	2.86
Sweden	0.418	313 218.0	84.57	9.88	68.94	11.6	3.22
Switzerland	0.647	327 755.2	100.62	9.02	73.99	12	4.30
United Kingdom	0.320	1 945 624.5	54.04	8.08	43.85	12.1	4.35

Source: (Worldbank 2016 a,b,c), (Eurostat 2016), (Human Development Reports 2016), (Economist Intelligence Unit 2016).

Streszczenie

O DETERMINANTACH WZROSTU EKONOMICZNEGO KRAJÓW EUROPEJSKICH W LATACH 2005–2015

Celem pracy jest analiza wzrostu gospodarczego 32 krajów europejskich w latach 2005–2015. Okres ten charakteryzował się silnym wzrostem przed rokiem 2009, kiedy to rozpoczęła się Wielka Recesja i trwała do 2012–2013 r. w większości badanych krajów. Wzrost w latach 2005 i 2015 badano w odniesieniu do sześciu wybranych czynników społeczno-ekonomicznych: początkowy poziom PKB, otwartość gospodarcza, wskaźnik demokracji, kapitał ludzki, kapitał fizyczny i bezpośrednie inwestycje zagraniczne. Głównym wnioskiem jest to, że wzrost ten był wprost proporcjonalny do kapitału ludzkiego i fizycznego, i odwrotnie proporcjonalny do początkowego poziomu PKB i wskaźnika demokracji. Ponadto, analiza skupień wykazała, iż historyczny podział Europy na „Zachód" i „Wschód" nadal utrzymuje się w znacznym stopniu.

Słowa kluczowe*: wzrost gospodarczy, otwartość gospodarcza, indeks demokracji, kapitał ludzki, kapitał fizyczny*