REGIONAL CONVERGENCE IN POLAND AND UKRAINE AFTER 2004 – A COMPARATIVE ANALYSIS

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INTRODUCTION

Economic convergence is the process of equalising incomes between countries. Although research on convergence pertains mainly to countries, there are numerous works in the literature that look at the regional level; there the term regional convergence is sometimes used. In economics, research on convergence processes typically indicates there is a divergent nature of changes in a regional cross-section, including changes in the sectors of industry, which leads to an increase in inter-regional disparities [Wong 2006, Cyrek 2009, 2014, Cierniak-Szostak 2012, Jabłoński 2012, Jabłoński et al. 2012, Wosiek 2012, Kosmalski 2016]. The phenomenon of regional convergence has been addressed widely in Poland as a subject of research on European integration, particularly in the works of Jakubowski [2001], Growiec [2005], Geodecki [2006], Markowska-Przybyła [2011], Murzyn [2014]. Less attention in the literature has been devoted to the processes of convergence of regions which are in Europe but remain outside the European Union. This article is an attempt to fill this gap, in particular with regard to the processes of regional convergence in Ukraine.

The following hypothesis has been formulated: the processes of regional convergence in Poland and Ukraine occur in entirely different economic conditions, and therefore differ significantly. The aim of the study is to compare the process of regional convergence in Poland and Ukraine, with a particular emphasis on their direction and dynamics, particularly between 2004 and 2013. The following arguments justify the choice of that particular time horizon:

– The National Statistical Office of Ukraine (NSOU) provides data on Gross Domestic Product (GDP) of the country by region according to a uniform methodology formulated in 2008 for the period from 2004 to 2014 [WWW 2]. However, the data for 2014 are not complete – in particular, the data for two regions (the Autonomous Republic

of Crimea and the city of Sevastopol) are missing, and for another two regions there are reservations about revising announced GDP. There is thus reason to exclude the year 2014 from the analysis until the NSOU provides its final approval and verifies the data.

– In Poland, GDP figures by region are announced with a two-year delay. As of the final writing of this article, there were only preliminary estimates of GDP at current prices for 2014, and, due to the nature of preliminary estimations those are subject to a tendency to approximate the average. Therefore, taking into account the series of data for 2014 would result in strengthening the effect of convergence (or weakening of divergence) and lead to a distortion of the results of the comparative analysis conducted for this article. This constitutes a second reason to exclude the year 2014 from the time horizon.

– The data on per capita GDP in constant prices are announced by Poland's Central Statistical Office (CSOP) in time periods covering the adopted analysis period, i.e. 2004–2013 and are consistent in methodological terms in this time horizon, i.e. based on the principles of Polish national accounts and recommendations of the European System of Accounts (ESA 2010) [WWW 1].

– 2004 was chosen as the first year of the analysis because Poland joined the European Union (EU) in that year, and it should not be without significance for the analysis of convergence processes due to the policy of the European Union aimed at alleviating disparities in regions that are a part of it This factor supports making 2004 the base year for this research.

DEFINING CONVERGENCE AND SELECTED ASPECTS
OF ITS MEASUREMENT

In the literature, convergence is divided into nominal convergence and real convergence [Kossowski 2009]. Nominal convergence is the approximation of economies in terms of certain macroeconomic indicators, among which the indicators included in the Maastricht criteria are enumerated, i.e.: the inflation rate measured by the harmonised index of consumer prices, interest rates, the exchange rate, the ratio of public debt to GDP and the ratio of budget deficit to GDP [Kossowski 2009]. Real convergence pertains to real economic processes that lead to the approximation of economies [Malaga 2004].

Depending on the selected examination method used, four types of real convergence can be distinguished: beta, sigma, gamma [Geodecki 2006, Wolszczak-Derlacz 2007, Kusideł 2013] and stochastic [Kusideł 2013]. Beta convergence occurs when regions with a lower initial income level manifest a higher growth rate. In principle, in the long term this phenomenon should equalise regional development. With beta convergence, poorer countries grow faster based on their access to and use of technologies from richer countries. But the lack of capital preventing the acquisition of technology used by wealthier countries reduces the ability of the developing country to catch up, hence limiting beta convergence.

Convergence understood in this may be unconditional or conditional. Unconditional convergence is also called absolute or complete [Wójcik 2008] and is based on the as-

sumption that there is one state of balance to which all economies aspire, and thus, in the empirical sense, it occurs when the initial conditions and individual characteristics of economies are unimportant for it to occur [Baumol and De Long 1988]. On the other hand, we deal with conditional convergence when it relates to entities (e.g. countries or regions) with similar structural characteristics (e.g. the average level of education, income structure). In the assumption of conditional convergence, entities within the group strive for the same state of equilibrium, but the target state is different for different groups [Barro and Sala-i-Martin 1991, Mankiw et al. 1992]. Such a group is sometimes called a "club". Clubs come into existence when, next to the similarity of structural features, the entities are similar in terms of GDP per capita [Piętak 2014].

To emphasise the specifics of convergence between the countries that make up the club, a separate term – club convergence – is used in the literature [Durlauf and Johnson 1996, Galor 1996, Quah 1995]. It has the nature of conditional convergence – that is, striving of economies with similar structural features for a common point of equilibrium. But the initial state conditions the target equilibrium point which the economies with similar structural features aim at [Durlauf and Johnson 1995, Baumont et al. 2002]. A consequence of conditional convergence would be the approximation of entities within groups with the increasing divergence between groups, because "target" states of individual groups are different.

The empirical verification of the occurrence of beta-convergence boils down to the determination of the regression function of the GDP per capita growth in particular regions in the examined period in relation to the value of the product in these regions in the base year. The linear form of this regression can be written as follows [Próchniak and Rapacki 2007, Kusideł 2013]:

$$\frac{1}{T}\ln\left(\frac{y_{it_0+T}}{y_{it_0}}\right) = a + b\ln\left(y_{it_0}\right) + u_{it_0,t_0+T}$$

where:

y_{it_0+T} – value of the characteristic (GDP per capita) in region i in period t_0;

T　　– number of periods (years);

$$a_i = x_i + \left(1 - e^{-\beta}\right)\ln(y_i^*)$$

x_{it} – value of additional characteristics of economy i in period t.

$$b = -\frac{\left(1 - e^{\beta T}\right)}{T}, \text{ and thus } \beta = \frac{-\ln(1+bT)}{T} \text{ the rate of convergence to equilibrium}$$

y_i^* – in equilibrium;

u_{it_0,t_0+T} – random causes.

Beta-convergence may, but does not have to, lead to sigma-convergence, i.e. the reduction of the diversity of entities (countries or regions) in terms of income This characteristic of estimators of beta-convergence models (indicating convergence in the absence of the reduction of the dispersion of the objects surveyed) has come in for criticism [Friedman 1992, Quah 1996a, b]. Furthermore, in practice it imposes the diagnosis of sigma-

-convergence in the analysis of convergence. In the context of economic convergence it is typically measured by means of changes in the standard deviation of the logarithm of GDP per capita [Barro and Sala-i-Martin 1991, Sala-i-Martin 2003]. Sigma-convergence understood and measured in this way is based on the assumption that the longer the considered time horizon, the more uniform the distribution of income among the entities (countries or regions) will be.

A special type of convergence is the gamma-convergence described by E. de Giorgi [1975]. It enters the picture when the position of objects (countries or regions) changes over time in their rankings in terms of the value of the variable under consideration, and, in the context of economic research, when economies change their position in the rankings of wealth. A measure which allows one to identify the occurrence of gamma-convergence is Kendall's coefficient of concordance [Fiedor and Kociszewski 2010].

THE ECONOMIC GROWTH IN POLAND AND UKRAINE IN THE YEARS 1990–2014 AS A CONTEXT FOR REGIONAL CONVERGENCE PROCESSES

Considering regional convergence, we should recognise that, just like every process, it has its own dynamics, and the dynamics of a process (especially one having a continuous nature) in the period under consideration is determined by the course of this process and its determinants in the period preceding the time horizon being analysed. Therefore, in this part of the study, showing the context of nationwide regional convergence in Poland and Ukraine, the scope of the analysis was extended back to the 1990s.

In the 1990s in Poland, as in Ukraine, there was a thorough socio-economic transformation. A natural consequence of the changes was the start of far-reaching reforms in the economies of both countries, accompanied by transformation recessions. While in Poland the recession was the shortest in the post-socialist countries, and the process of transformation began in 1989, and was on a path of fast growth in 1991, when Ukraine began its transformation. The recession that ensued was, at nearly ten years in length, one of the longest (Fig. 1).

The average annual growth of Poland's real gross domestic product (GDP) in the years 1990–1999 was 3.9%, or nearly 39% in total. In the same period, the economy of Ukraine was "shrinking" by 5.9% per year, as a result of which its total GDP in 1999 accounted for only 41% of its 1990 value. This resulted from the shuttering of entire industrial districts in numerous cities. While a similar situation did occur in Poland, a large share of Polish enterprises were privatised, and quickly began to compete in domestic and international markets [Firszt 2008]. Ukraine's GDP began to grow only in 2000, but by the end of 2014 still had not reached the level of GDP from before the transition period. In the entire 1990–2014 time horizon, the cumulative GDP growth in Ukraine amounted only to 86.2%, which means de facto "contraction" of the economy by 13.6%. At the same time, Poland's economic growth was sustained across the period, contributing to the expansion of GDP by more than 2.5 times, giving the country's economy a cumulative growth rate of 255.1%.

The pace of economic growth in Poland was significantly higher than the average for the countries of Central Europe and the Baltic countries, and also higher than the average
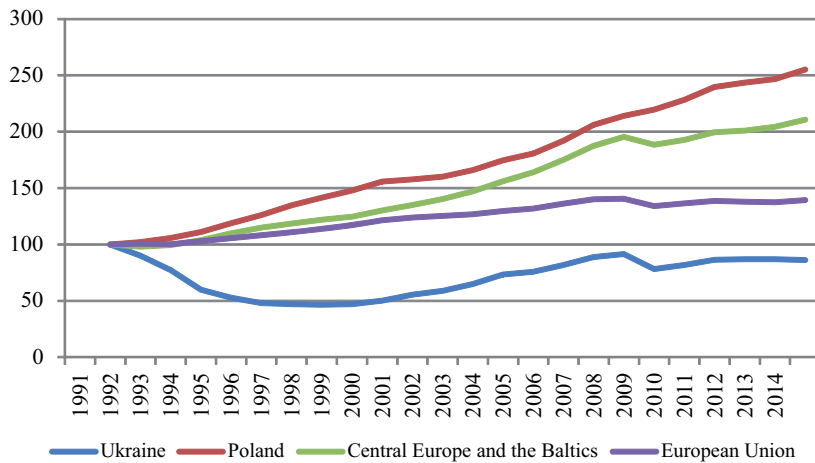
FIG. 1. The cumulative growth rate of gross domestic product in USD (in constant prices) in the years 1990–2014 in relation to 1990

Source: the authors, on the basis of: World DataBank, World Development Indicators [WWW 3].

for the countries of the European Union (Fig. 1). This means that the Polish economy underwent economic convergence, while Ukraine's was "bypassed" [Próchniak and Rapacki 2007][1]. As a result, the development gap in relation to neighbouring countries and in relation to more developed economies of the European Union increased markedly.

Ukraine's GDP per capita indicator in 1990 was 10,490.73 USD (in constant prices of 2011) and accounted for 103.5% of Poland's GDP per capita. In 1998 Ukraine's GDP per capita reached its minimum and amounted only 4,462.79 USD, i.e. 33.6% of Poland's GDP per capita (Fig. 2). Until 2014, in relative terms, the difference between Poland and Ukraine hardly improved at all, while in absolute values the gap between Poland and Ukraine increased substantially – in Poland GDP per capita amounted at the end of 2014 to 23,965.61 USD and was 3 times higher than in Ukraine's 8,267.06 USD. This shows both the size of the step backwards the Ukrainian economy took in the 25 years since 1990, and how much Poland developed.

The two economies' structural transformation, and in particular the nature and pace of the changes, were also significant for the described processes of economic growth in Poland and Ukraine. In Poland the share of individual sectors in the creation of GDP did not change as much as in Ukraine. In the country on the Vistula, the biggest change occurred

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[1] In the results of the research conducted and published by M. Próchniak and R. Rapacki on convergence of post-socialist countries, the cited researchers found that "in the early years of the transformation the deep slump of production meant that despite the subsequent entry on the path of accelerated growth, the economic development gap between the post-socialist countries and the European Union European Union in 2005 was higher than before the political changes. Only Poland managed to reduce the span of the level of development (GDP per capita according to purchasing power parity) in relation to the EU-15 countries [Próchniak and Rapacki 2007].
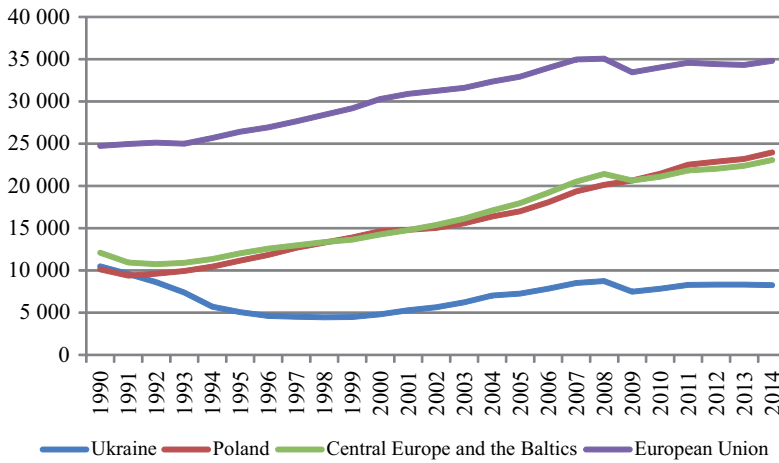
FIG. 2. Gross domestic product per capita in USD (in constant prices of 2005) in the years 1990–
–2014

Source: the authors, on the basis of World DataBank, World Development Indicators [WWW 3].

in 1991, when the share of industry in GDP declined markedly, giving way to the serv-
ice sector. In contrast, in the period after 1991, the share of agriculture in GDP declined
from 6.3 to 3.9% in 2014, the share of industry decreased in the same period from 37.9%
to 32.6%, and the importance of services for domestic product increased from 55.8 to
64.0%. In the corresponding period (i.e. after 1991) in Ukraine, the share of agriculture in
GDP declined from 20.4 to 11.8%, industry from 50.6 to 25.4% while the services sector
rose more than twofold, from 28.7 to 62.8% (Fig. 3).

   In both countries the direction of structural changes was similar; however, in Ukraine
a much larger restructuring of the entire productive system took place and, as the previ-
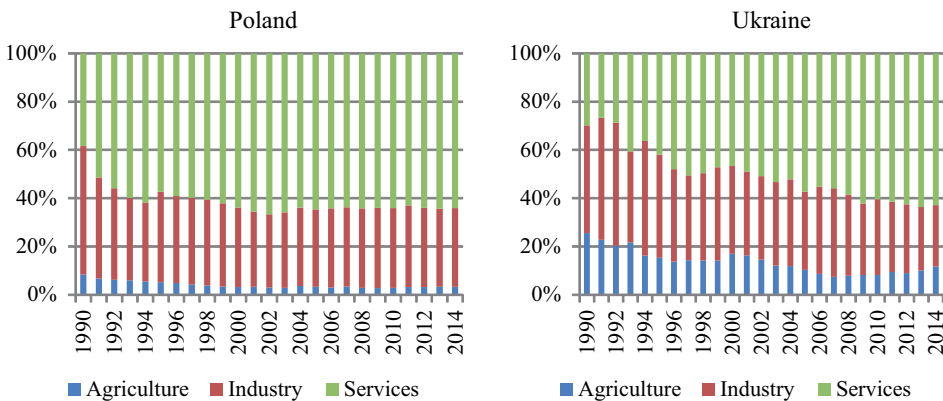

FIG. 3. The structure of GDP of Ukraine and Poland by economic sector in the years 1990–2014

Source: the authors, on the basis of World DataBank, World Development Indicators [WWW 3]; the years
1990–1994 for Poland on the basis of Zajdel [2011].

ously cited data on GDP growth show, these changes have taken their toll on Ukraine. Comparison of the structure of employment in the two countries further bears this argument out (Fig. 4).
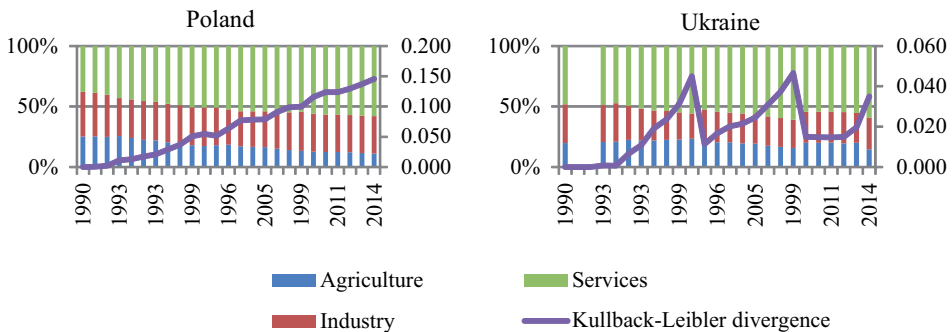

FIG. 4. The structure of employment and the degree of changes in this structure (expressed by the Kullback-Leibler divergence) in Ukraine and Poland by economic sectors in the years 1990–2014

In Poland, in relative terms, employment in services increased (from 37.8 to 58%), while industry (from 37 to 30.8%) and agriculture (from 25 to 11.2%) saw their role diminished in job creation. In Ukraine, the share of the service sector in job creation increased from 48.2 to 59.1% (i.e. only by 10.9 percentage points, while in Poland it increased by 15.1 percentage points). The industrial sector dropped from 32.0 to 26.1% (or 4.4 percentage points, decidedly more than the 0.7 percentage points industry lost in Poland's employment structure). Elsewhere, the agricultural sector fell from 19.8 to 14.8% (i.e. only by 5.9 percentage points, while in Poland the share of agriculture in the creation of jobs decreased by 14.4 percentage points).

Paradoxically, although the changes in the structure of employment took place both in Ukraine and Poland, those in Ukraine were slightly smaller and more "chaotic" – that is, they were subject to greater fluctuations, as indicated by the indicator of the level of relative entropy called the Kullback-Leibler divergence[2] [1951]. In Poland, this divergence grew steadily, while in Ukraine it clearly fluctuated. The structural changes that occurred in both economies are typical of developing countries – the importance of the service sector increased, while the significance of the industry and the agriculture sectors fell. However, comparison of the changes in the structure of GDP creation with the changes in the employment structure shows that in Poland the decline in employment in agriculture was significantly compensated by a relative increase in labour productivity in this sector.

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[2] The relative entropy called the Kullback-Leibler divergence (D_{KL}) belongs to the Csiszár class measure of discrepancy between two structures S_t^n and S_τ^n, changing over time. The structure S_τ^n from the period τ is a basic structure. $D_{KL} \left(S_t^n, S_\tau^n \right) = \sum_{i=1}^{n} \omega_{it} \log_2 \frac{\omega_{it}}{\omega_{i\tau}}$, where ω_{it} is the i-th element of the structure, S_t^n n – the number of the elements of the structure. The indicator ranges from 0 to infinity, where 0 means the total convergence of these structures [Wędrowska and Wojciechowska 2015].

This phenomenon did not take place at all in Ukraine. However, in Ukraine the relative productivity in the service sector increased significantly compared to Poland, though in absolute terms it dropped. As a result, Ukraine's economy failed to match the GDP it had been producing 25 previously, before its transition began. The process of growth is not evenly distributed in space, and regions have their own specificity (with different exposure of individual economic sectors in their economic meso-systems). It may therefore be asked whether in Poland and Ukraine, whose economies are characterised by totally different dynamics and growth characteristics, the processes of regional convergence occur and whether or not their nature and pace are similar.

ECONOMIC GROWTH IN POLAND AND UKRAINE
IN REGIONAL CROSS-SECTION

The above-described economic growth in Poland and Ukraine is not evenly distributed in the regional cross-section. In 2004–2013, the Polish economy recorded continued growth, totalling 40.8%. It was much larger than in Ukraine, which also increased its GDP in those years, but was more ravaged by the global economic crisis in 2009, driving the increase down to 13.8%.

Four provinces drove Poland's economy: Mazowieckie, Śląskie, Łódzkie and Dolnośląskie, where the individual growth was faster than that of the national economy. Their growth rates came in at 152.5, 145.9, 144.4 and 143.8%, respectively. In Ukraine, more than half of the country's oblasts (14) outperformed the national economy. The leaders were the oblasts of Ternopil (143.1%), Cherkasy (135.3%), the city of Kiev (132.4%), Zhytomyr (131.7%), Vinnytsia (131.4%), Kirovohrad (130.1%) and Kiev (128.7%). In Poland, three out of the four of the aforementioned provinces were the provinces which are the most important for Polish economy. In turn, in Ukraine the fastest growth characterised only 2 oblasts from among those driving national GDP growth.

Figures 5 and 6 depict the importance of individual regions for the national economy evaluated through the prism of their participation in the creation of GDP in Poland and Ukraine, which differ considerably.

In Poland, the share of individual provinces in the creation of GDP in 2004 ranged from 2.3% (Podlaskie) to 20.3% (Mazowieckie), while in 2013 it ranged from 2.1% in Opolskie to 22.1% in Mazowieckie, home to the capital Warsaw. On the other hand, in Ukraine in 2004 the lowest gross regional product (the city of Sevastopol) accounted for 0.6% of the national GDP, and the highest was 17.8% (the city of Kiev), while in 2013 the regions of Ukraine produced from 0.6% (again Sevastopol) to 20.5% (Kiev) of GDP. The range of the distribution of the share of individual regions in GDP creation in both countries is therefore very large and growing – in Poland it changed from 17.9 percentage points in 2004 to 20.0 percentage points in 2013, while in Ukraine it increased from 17.1 percentage points to 19.8 percentage points. This means that the diversity of importance of individual regions for the economy in Poland and Ukraine was not only considerable, but increased. In both countries the differences in the structure of GDP by region increased, while the cumulative degree of structural changes in 2004–2013 should have been, in fact, considered negligible, as confirmed by the Kullback-Leibler divergence (Fig. 7).
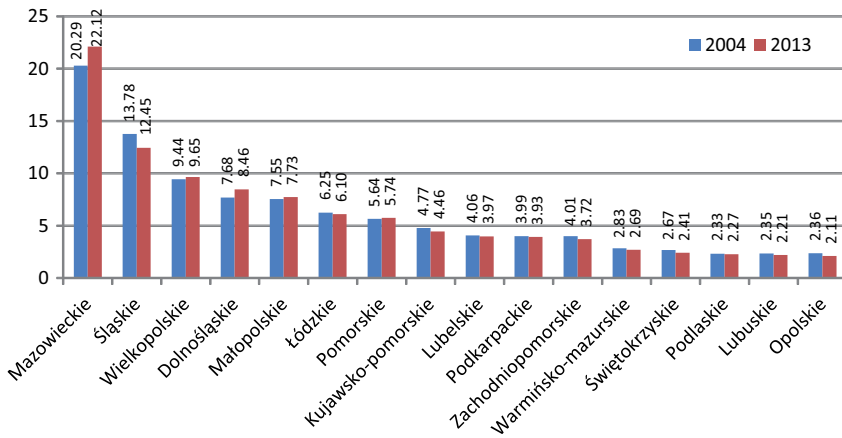
FIG. 5. The share of individual provinces in the creation of Poland's GDP in 2004 and 2013 (%)

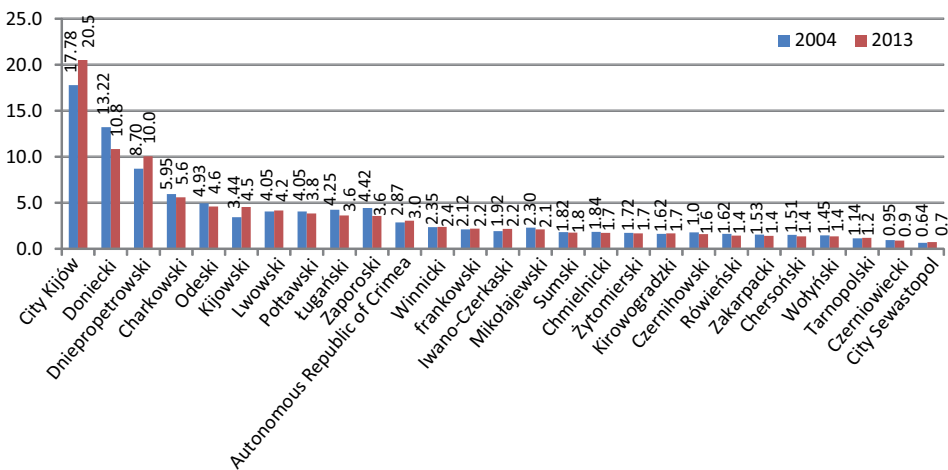Source: the authors, on the basis of CSOP data [WWW 1].

FIG. 6. The share of individual oblasts in the creation of Ukraine's GDP in 2004 and 2013 (%)

Source: the authors, on the basis of NSOU data [WWW 2].

The calculated Kullback-Leibler divergence of structural changes of GDP by region in the analysed period was 0.00364 for Poland and 0.00230 for Ukraine. It is worth noting, however, that in Poland this divergence decreased only in 2008, while in Ukraine it fell in the years 2006, 2010, and 2013, which suggests that this indicator is less prone to growth for this economy than in Poland.

The role of the "capital" regions in both countries increased in particular, so these regions are the most important districts in the production systems of their economies. Given the difference in the number of regions in Poland and Ukraine, it can be concluded that
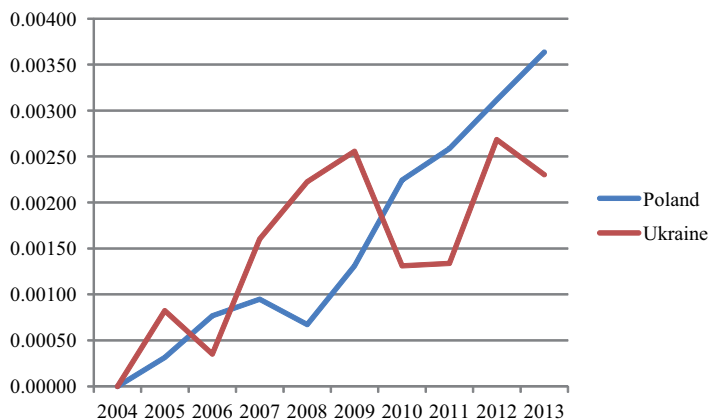
FIG. 7. The Kullback-Leibler divergence expressing the degree of structural changes of GDP by region in Poland and Ukraine in 2004–2013

Source: the authors, on the basis of CSOP data [WWW 1] and NSOU [WWW 2].

the capital city of Kiev is, however, a more important economic centre for Ukraine than Mazowieckie is for Poland. This is evidenced, for instance, by the fact that the ratio of the share of Mazowieckie in Polish GDP in relation to the share of the province with the least importance for Polish GDP in 2013 amounted to 10.5 (and in 2004 it was 8.7), while the ratio of the share of the city in Kiev in Ukrainian GDP in relation to the share of the region with the least importance for Ukraine's GDP amounted to 28.2 (compared to 27.7 in 2004). It is worth noting that a fourth of all Polish regions – that is, the four provinces of Mazowieckie, Śląskie, Wielkopolskie and Dolnośląskie – which are the largest contributors to Polish GDP, produced in 2004 in total more than half of domestic production, i.e. 51.18% and, in 2013, 1.5 percentage points more, or 52.68%. Similarly, a fourth of Ukrainian oblasts of key importance for the economy (the city of Kiev, Donetsk, Dnipropetrovsk, Kharkiv, Odessa, Kiev, and Lviv oblasts) produced in 2004 58.1% of the country's GDP, and in 2013 2.2 percentage points more, or 60.3%. According to these data, regions which are important for the economy in both countries for the most part gained in importance, while others lost, but in Ukraine this phenomenon is much more pronounced.

In both countries the coefficient of variation of GDP in the regions increased – in Poland in 2013 the variation coefficient of the mentioned characteristics amounted to 83.3% compared to 77.9% in 2004. In Ukraine, meanwhile, the figure amounted to 112.8% in 2013, compared to 105.0% in 2004. This leads to the conclusion that the differentiation of the GDP value in individual Polish regions in 2004–2013 was sizable, but still much lower than in Ukraine.

Though it has come in for criticism, GDP per capita is commonly used to measure economic development on both a macro and meso-scale [Talberth et al. 2007, Stiglitz et al. 2012, Szarfenberg 2012, UNDP 2012, Kubiczek 2014]. The coefficient of variation of GDP per capita in the period was lower in Poland, but grew more (from 21.4 to 25.3%), demonstrating that more systematic growth occurred there than in Ukraine (from 58.1 to 61.2%) – Figure 8. In Poland the growth was 3.9% while Ukraine saw 3.1% growth.
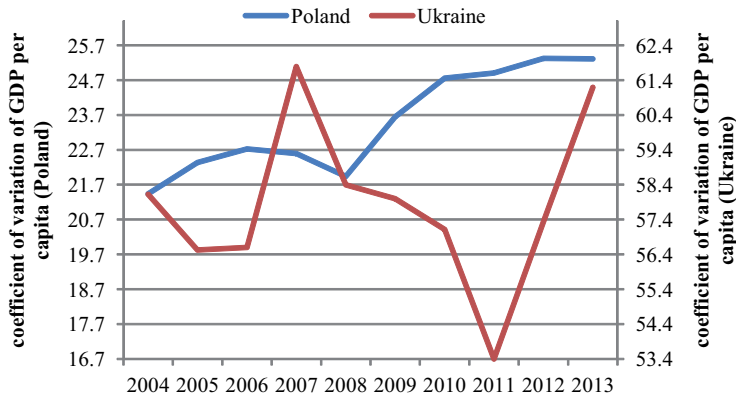
FIG. 8. The analysis of sigma-convergence based on the coefficient of variation of GDP per capita in Poland and Ukraine in the years 2004–2013

Source: the authors, on the basis of CSOP data [WWW 1] and NSOU [WWW 2].

It can therefore be stated that regions in Ukraine were and are more diverse in terms of GDP per capita than in Poland, but in Poland in the years 2004–2013 there was a greater increase in regional disparities. The analysis of the variation coefficient suggests that it is not sigma-convergence that is at work here, but its opposite, sigma-divergence, which characterised both countries, though it was more pronounced in Poland. It is worth noting, however, that in 2007–2011 the variation coefficient in Ukraine fell strongly, which again indicates the occurrence of sigma-convergence during this period.

REGIONAL CONVEREGENCE IN POLAND AND IN UKRAINE IN THE YEARS 2004–2013

In order to verify if, throughout the analysed time horizon – that is 2004–2013 – divergence occurred in Poland, and sigma-convergence in Ukraine, the standard deviation of the logarithm of GDP per capita of regions (in constant prices) was calculated for both countries at the beginning and end of the period. It amounted to 0.1928 in 2004 and 0.2196 in 2013 in Poland and, respectively, 0.3799 and 0.3671 in Ukraine. This means that while in Poland the condition for sigma-convergence was not fulfilled (this condition is a drop of the estimated standard deviation) [Sala-i-Martin 1996, Quah 1996c, Markowska-Przybyła 2010], the calculation results for Ukraine fulfilled this condition.

Next, the regression equation of the standard deviation of the natural logarithm of GDP per capita over time was estimated for Poland and Ukraine[3] (Figs 9 and 10). The determination coefficients and the significance of parameters of the obtained equations were specified through the prism of Student's t-statistics (Figs 9 and 10). For Poland, the

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[3] $sd(lnPKBpc(t)) = \alpha_0 + \alpha_1 t + \xi$, where $sd(lnPKBpc(t))$ – the standard deviation of the natural logarithm of GDP per capita in the year t. The negative parameter α_1 means the occurrence of sigma-convergence [Markowska-Przybyła 2010].

slope of the estimated regression function was 0.0042. That means it was positive with a very high determination coefficient (0.9524) denoting a very strong correlation of the standard deviation of the logarithm of GDP of Polish regions over time. For Ukraine, however, the estimated regression function had a negative slope value of –0.0029 and a determination coefficient of 0.2907, which was lower than Poland's. The results confirmed the significance of the estimated parameters of the equation, which, in turn, indicated the occurrence of sigma-convergence in Ukraine and clear regional divergence of this type in Poland during the period. Thus, disparities in regional development increased in Poland, and decreased in Ukraine.
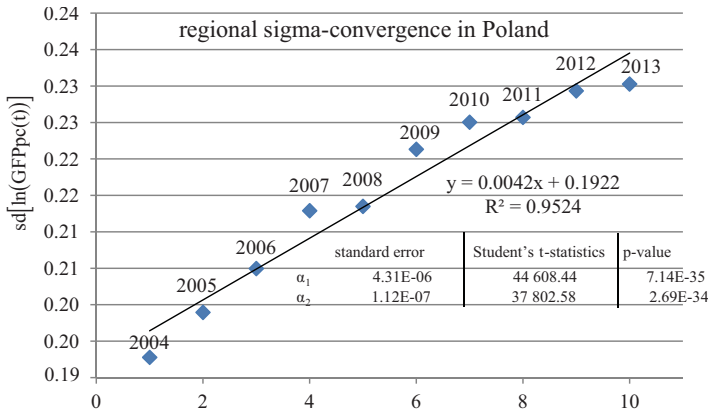

FIG. 9. Regional sigma-convergence in Poland in the years 2004–2013

Source: the authors, on the basis of CSOP data [WWW 1].
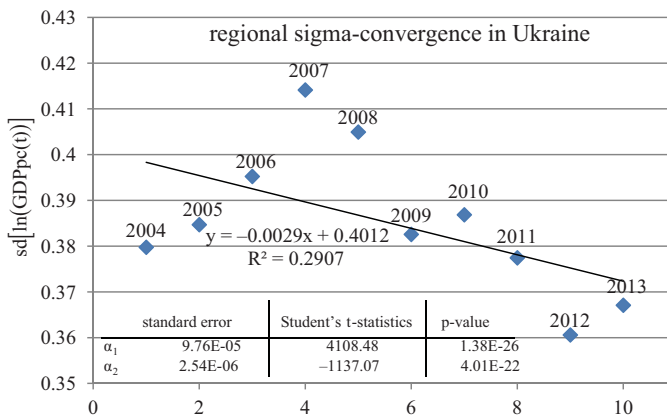

FIG. 10. Regional sigma-convergence in Ukraine in the years 2004–2013

Source: the authors, on the basis of NSOU data [WWW 2].

The occurrence of sigma-convergence implies the presence of beta-convergence, the latter being a prerequisite for the occurrence of the former. It can therefore be firmly concluded that in Ukraine, where the appearance of sigma-convergence was proved, beta--convergence is also present. On the other hand, it was theoretically possible that beta-convergence also took place in Poland, as the absence of sigma-convergence does not condition the lack of absolute convergence. To determine whether beta-convergence occurred there in 2004–2013 we estimated the regression equation of the natural logarithm of GDP per capita divided by the number of years in the time horizon (vertical axis) and the initial logarithm of GDP per capita (horizontal axis). Hence we examined the relationship between the average rate of growth of individual regions and their initial income (Fig. 11).

In the estimated equation, the coefficients are statistically significant, including the slope parameter of 0.0188 (Student's t-statistics had a value of −29.03, thus the p-value was only $6.57 \cdot 10^{-14}$). Its positive value confirms the final recognition of the lack of absolute convergence and of the occurrence of divergence between regions in Poland in 2004–2013. The calculated value of the slope in the designated regression function provided the basis for the calculation of the rate of the diagnosed process of convergence to equilibrium. The dynamics of this process in Poland amounted to −0.01736. The negative value of this indicator confirms the divergence of Polish provinces from equilibrium.

Similar calculations were also made for Ukraine, in particular to determine and compare the direction and dynamics of changes in regional disparities in both countries
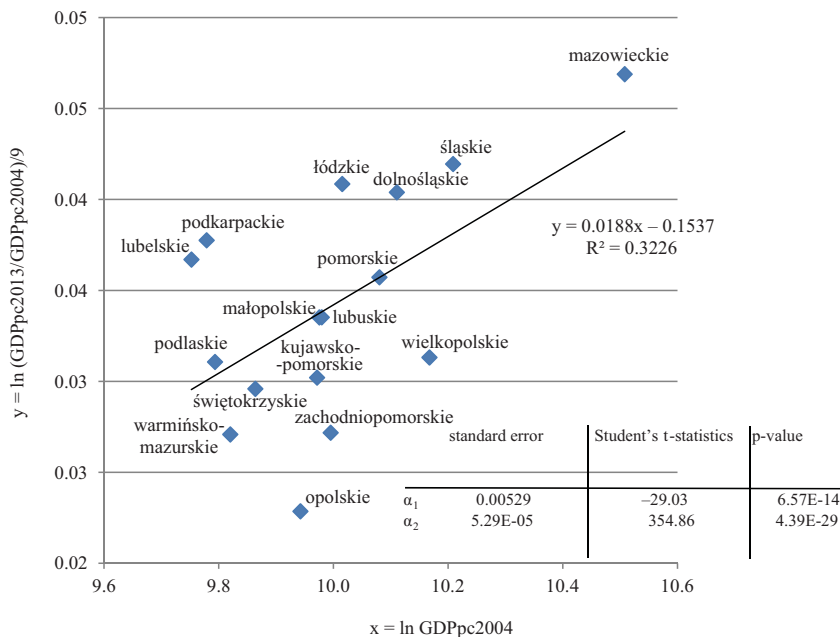

FIG. 11. The classical analysis of regional convergence in Poland on the basis of beta-convergence of GDP per capita (in constant prices of 2004) in the years 2004–2013

Source: the authors, on the basis of CSOP data [WWW 1].

(Fig. 12). The estimation of the regression equation of the logarithm of the average GDP growth per capita of Ukraine's regions and their initial income confirms the occurrence of beta-convergence in the country. At –0.0083, the slope of the equation is in fact negative, and is statistically significant (Student's t-statistic amounted to 30.51, and the p-value was $2.65 \cdot 10^{-21}$). The pace of convergence to equilibrium is very small: a mere 0.00858.
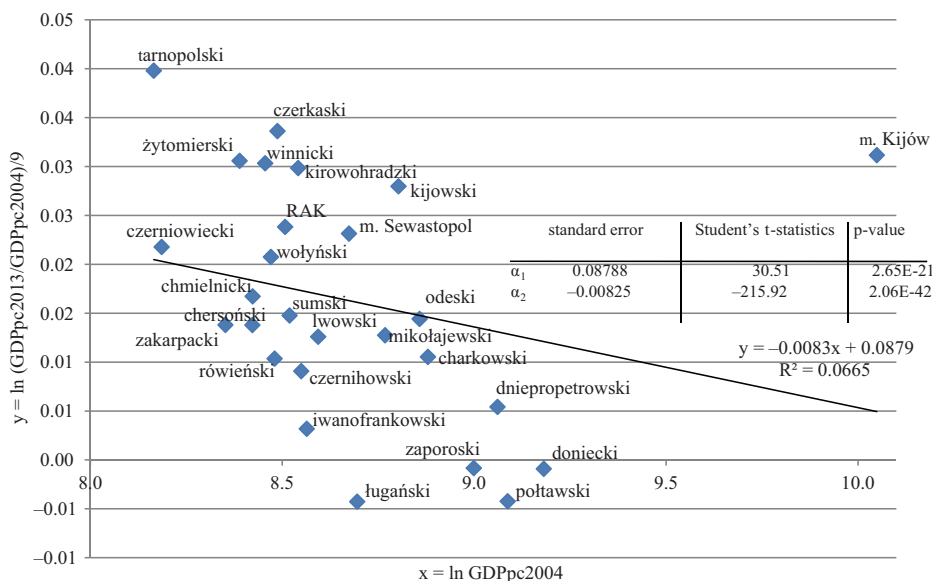

FIG. 12. The classical analysis of regional convergence in Ukraine on the basis of beta-convergence of GDP per capita (in constant prices of 2004) in the years 2004–2013

Source: the authors, on the basis of NSOU data [WWW 2].

When it is compared with the result obtained for Polish regions, it becomes clear that the convergence processes in Poland and Ukraine are moving in different directions, and moreover the growth pace of divergence of Polish regions is greater than the pace of convergence to equilibrium of Ukraine's regions.

CONCLUSIONS

The processes of regional convergence/divergence taking place in Poland and Ukraine in 2004–2013 were directed in quite different conditions of economic growth in the years leading up to 2004. After a brief post transformation recession, the Polish economy quickly embarked upon a growth path and was subjected to slow but systematic structural changes, which in effect led to profound changes in the country's manufacturing arm. In Ukraine, on the other hand, the post transformation recession was long and lasted nearly a decade, while the country's economy was affected by dynamic structural changes which

de facto did not lead to such profound changes in the manufacturing system as those which occurred in Poland. Poland (its entire economy) was covered by the process of economic convergence, while this process "bypassed" Ukraine's economy.

After 2004, Poland's economy was the much faster-growing of the two, though regional economic growth was not evenly distributed in either country while the diversity of importance of individual regions for the economy in Poland and Ukraine was not only significant, but even increased.

The analyses we have conducted show that regions which are important for the economy both in Poland and Ukraine for the most part gain in importance, while others lose. In Ukraine, this phenomenon is much more pronounced. In both countries the role of the "capital" regions, which are the most important districts in the production systems of their economies, increased. The capital city of Kiev is a more important economic centre for Ukraine than Mazowieckie is for Poland.

In the course of this analysis, it was observed that the diversity of GDP values in individual Polish regions in 2004–2013 was large, but still much lower than in Ukraine. On the other hand, regions in Ukraine have been and are more diverse in terms of GDP per capita than in Poland, though in the years 2004–2013 that country did observe an increase in regional disparities, while in Ukraine such differences decreased. In Poland sigma- and beta-convergence occurred during the period. In Ukraine, on the other hand, sigma-convergence occurred and absolute convergence conditioned it. The convergence process in Poland and Ukraine is moving in a different direction, and the pace at which Polish regions are diverging is growing faster than Ukraine's regions are converging to equilibrium.

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Summary. The aim of the paper is to compare the process of regional convergence in Poland
and Ukraine, with special regard to its direction and dynamics. Regional convergence is
widely discussed in the literature, and has gained in importance in the context of European
integration, especially in the past decade. Less attention is devoted to the process of
convergence of regions of European states which are not associated with the European
Union. The authors attempt to fill this gap, in particular to the extent to which they devote
attention to the processes of regional convergence in Ukraine. In the study the authors put
forward the hypotheses that the processes of regional convergence in Poland and in Ukraine
occur in entirely different economic conditions, and therefore their direction and dynamics
differ significantly. The target period of the analysis covered the years 2004–2013, while

the scope of this research was extended into the 1990s and described in the section of the article which presents the specifics of economic growth and changes in the three-sector structures, providing the context for regional convergence in comparable countries.

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