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Structural Funds and Convergence in Poland*

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Abstract

This study aimed to investigate whether cohesion policy funds affected economic growth and resulted in a convergence process across NUTS 2 regions in Poland. The study examined a balanced panel of data from 16 Polish regions between 2004 and 2016 and applied different estimations procedures, including the fixed effects estimator –as the main estimator– and the GMM estimator. The empirical analysis revealed that cohesion policy funds had a positive impact on regional economic growth. However, the influence of structural funds on convergence was shown to be weak in Poland. The results were robust to various estimation methods.

Keywords: Cohesion policy funds, regional convergence, Poland.

JEL Classification: C23, R11, R58.

1. Introduction

Regional disparities represent a serious problem for the European Union (EU). The European Commission's seventh report on economic, social and territorial cohesion underlines that, in 2015, 27% of the EU's residents lived in NUTS 2-level regions which were defined as 'less developed' or Objective 1 regions[1]. Objective 1 regions have a GDP per capita, in PPS terms, of less than 75% of the EU average (European Commission, 2017).

The economic divergence between regions in the European Community (as it was known at the time) increased in the 1980s, with the addition of countries such as Greece, Portugal and Spain. Shortly after this, in the late 1980s, the EU decided to allocate significant support to regional policy; it was agreed that spending in this area would constitute one-third of the

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EU budget allocation for subsequent financial years. In 2004, Poland joined the EU, together with nine other central and eastern European countries, which led to further intra-EU disparities. At the time, the GDP per capita (PPS) of Poland's poorest region, Lubelskie, was 35% of the EU average, while the GDP per capita of the most developed Inner London-West region was 554% of the average. Comparing these two regions, Inner London-West was 15.8 times richer than Lubelskie (Eurostat, 2019). The accession of Bulgaria and Romania in 2007 brought about a further increase in regional development gap within the EU. In 2016, the GDP per capita of the least developed EU region, the Bulgarian region of Severozapaden, was 29% of the EU average, meaning that it was 22 times poorer than the Inner London-West region (611%) (Eurostat, 2019).

In 2004, Polish regions were characterised by low levels of socio-economic development. No region exceeded the threshold of 75% of the average EU GDP per capita and, accordingly, all regions in the country were categorised as less developed. Furthermore, four of the five least developed EU regions were located in Poland (Lubelskie, 35% of the average EU GDP; Podkarpackie, 36%; Podlaskie, 37%; and Warminsko-Mazurskie, 38%). Nevertheless, in the following years, the Polish economy developed faster than other EU countries, demonstrating the process of economic convergence. In the financial forecast for the years 2014–2020, the Mazowieckie region, in which the Polish capital Warsaw is located, was classified as a more developed region and, according to data provided by Eurostat, in 2016, three Polish regions reached a GDP per capita above 75% of the EU average: Mazowieckie (109%), Dolnosląskie (76%) and Wielkopolskie (76%) (see Appendix: Map A.1).

Poland, as a relatively large EU country with a low level of socio-economic development, is eligible for extensive support from cohesion policy funds. Moreover, the constant growth of structural aid is a distinctive feature of the Polish economy. In the financial forecasts for 2007-2013 and 2014-2020, the support allocated to Polish regions amounted to EUR 67.2 billion and EUR 77.6 billion, respectively. Funds provided under the EU's cohesion policy have supported the transformation of the Polish economy, making it more competitive and innovative. The effects of structural funds can be observed in the number of expressways and motorways, the citizens' level of education and the increase in investment expenditure. In addition, structural funds have constituted the main financial instruments of national regional policy. In this context, it is legitimate to evaluate the extent to which cohesion policy funds have influenced regional economic growth and accelerated the convergence process.

Against this background, the study focuses on the impact of structural funds on both economic growth and convergence at the NUTS 2 level in Poland. The study examined a panel of data from 16 Polish regions between 2004 and 2016. The time frame was selected based on Poland's 2004 accession to the EU, as well as the availability of data at the regional level. Using the fixed effects estimator and GMM estimator, it was proved that structural funds had a positive on regional economic growth. However, the role of cohesion policy in convergence in Poland was shown to be very weak. Few econometric studies have assessed the role of cohesion policy and structural funds in the equalisation of economic development (that is, convergence) across Polish regions, and this study contributes to filling that gap in the literature.

The paper is organised as follows. Section II presents the literature review and, in section III, there is an empirical and statistical analysis of regional disparities and convergence in Poland. Section IV describes the methodology applied and the results of the empirical analysis. Section V summarises the findings and implications of the analysis and identifies limitations and possible areas for future research.

2. Literature review

Many papers have examined the effectiveness of the EU's cohesion policy. However, the existing research has shown mixed, if not contradictory, results. Some works have highlighted the positive and statistically significant impact of the policy (e. g. Becker *et al.*, 2010; Beugelsdijk and Eijffinger, 2005; Cappellen *et al*., 2003; Loddo, 2006; Lolos, 2009; Maynou *et al*., 2014; Mohl and Hagen, 2010; Ramajo *et al*., 2008; Tomova *et al*., 2013), others a positive but very small or not statistically significant impact (e. g. De la Fuente and Vives, 1995; Esposti and Bussoletti, 2008; Rodríguez-Pose and Fratesi, 2004; Rodríguez-Pose and Novak, 2013), while others have found an insignificant or negative impact (e. g. Bähr, 2008; Boldrin and Canova, 2001; Breidenbach *et al*., 2016; Dall'Erba and Le Gallo, 2008; Ederveen *et al*., 2006; Le Gallo *et al*., 2011).

Some authors in the field of cohesion policy have focused on the divergent results of empirical studies. Pieńkowski and Berkowitz (2015) highlighted that empirical studies have differed in their estimations method, sample size, financial perspective or type of funds, which in turn led to their different conclusions on the effectiveness of cohesion policy. Marzinotto (2012) concluded that a study's assessment of the impact of regional funds depends on the methodology applied. Similar conclusions were drawn in other studies.

For example, Hagen and Hohl (2009) identified several limitations to existing econometric studies, including the omission of variables such as a possible spill-over effect, in which a region may be affected by the receipt of cohesion policy funds of a neighbouring region. The authors also suggested other factors that may have complicated past econometric analyses. These included the inappropriateness of using a fixed-effect model to assess the dynamic relationship between cohesion policy and growth, as well as possible measurement errors, because many variables are observed only at a national level and studies have typically examined the effectiveness of cohesion policy funds at the regional level. Dall'Erba and Fang (2015) proved that the influence of cohesion policy is more significant for Objective 1 regions and for more recent data samples. According to Percoco (2016), the impact of cohesion policy is stronger in regions with less-developed service sectors. Gagliardi and Percoco (2017) found that cohesion policy enhances regional growth more significantly in rural regions that are close to a city. Crescenzi and Giua (2017) underlined the difficulties in assessing the impact of structural funds. These include the fact that cohesion policy operates in heterogeneous regional economies, with several projects underway at the same time. There is also a data problem, due to the lack of data on variables such as degree of decentralisation, level of corruption or openness of economies, and interaction between cohesion policy and national polices. These drawbacks have made it difficult for empirical studies to draw conclusive findings on the effectiveness of cohesion policy funds.

Notwithstanding these difficulties, there is an extensive body of literature exploring the impact of cohesion policy at both the national and regional levels. Surubaru (2016) examined the examples of Romania and Bulgaria, which have been members of the EU since 2007. The paper drew on both qualitative interviews and quantitative questionnaires and showed that Bulgaria's higher administrative meant that it made better use of the funds. Cardenate *et al*. (2014), applying a dynamic general equilibrium model, presented two scenarios: an optimistic scenario, which assumed that Andalusia (a region in southern Spain) would receive the same level of funds in 2014-2020 that it had received in 2007-2013, and a realistic scenario, which assumed a reduction in funds for the region. The results confirmed that Andalusia's GDP growth rate would be 0.15% higher in 2014-2020 under the first scenario. Fortuna *et al*. (2016), using a dynamic, multisector, computable general equilibrium model, showed that the elimination of EU funds in the Portuguese region of Azores would be harmful to its GDP and level of consumption. Giua (2017), using a regression-discontinuity design model, found that cohesion policy had a positive impact on employment levels in Italian Objective 1 regions. Di Cataldo (2017) considered two of the UK's most subsidised regions, Cornwall and South Yorkshire, and assessed the consequences of the interruption of EU financial support as a result of the UK leaving the EU (a process known as 'Brexit'). Counterfactual methodologies assessing the regions' labour markets and economic performance provided evidence that cohesion policy has a positive impact. Lastly, García Nicolás and Cantos (2018) examined the issue of the crowding out of local funds by structural aid from the EU. The authors, using a panel data analysis, found that 1% of the EU's support reduces domestic public investment by around 0.09%.

As was emphasised by Fratesi and Wishlade (2017), recent studies have moved away from attempting to assess the total impact of cohesion policy towards emphasising the conditioning factors that explain the policy's (in)effectiveness. Rodríguez-Pose and Garcilazo (2015) stressed the impact of the quality of governments on the effectiveness of cohesion policy. Becker *et al.*, (2013) revealed that human capital and strong institutions were important conditions for effective policy. Fratesi and Perucca (2014) stated that the level of capital in the regions in question strengthened the influence of cohesion policy.

In the case of Poland, studies have confirmed the limited impact of cohesion policy on regional development. The study by Misiąg *et al*. (2013) pointed out that cohesion policy funds did not significantly affect regional economic growth between 2004 and 2011, and the preference since 2007 to allocate structural support to regions in eastern Poland has not accelerated the convergence process. Similarly, Kozak (2014) underlined the lack of a positive relationship between cohesion policy and regional convergence in Poland. Lewandowska *et al*. (2015) explored the impact of structural funds on the development of small –and medium– sized enterprises in eastern Poland. The analysis, which was based on computer-assisted telephone interviews, confirmed that structural funds do not have a significant role in corporations' willingness to invest in the regions. In the context of regional competitiveness, Gorzelak (2014) found that eastern Polish regions are less attractive to investors due to their limited ability to improve their economic institutions. Recently, Czudec *et al*. (2019) published a paper assessing the impact of structural funds in Poland. The authors considered six development gaps in eastern Poland between 2004 and 2015. They suggested, using dynamic panel data analysis, that cohesion policy funds had both a positive impact by reducing the regional transport accessibility gap and a negative impact by widening the innovation gap.

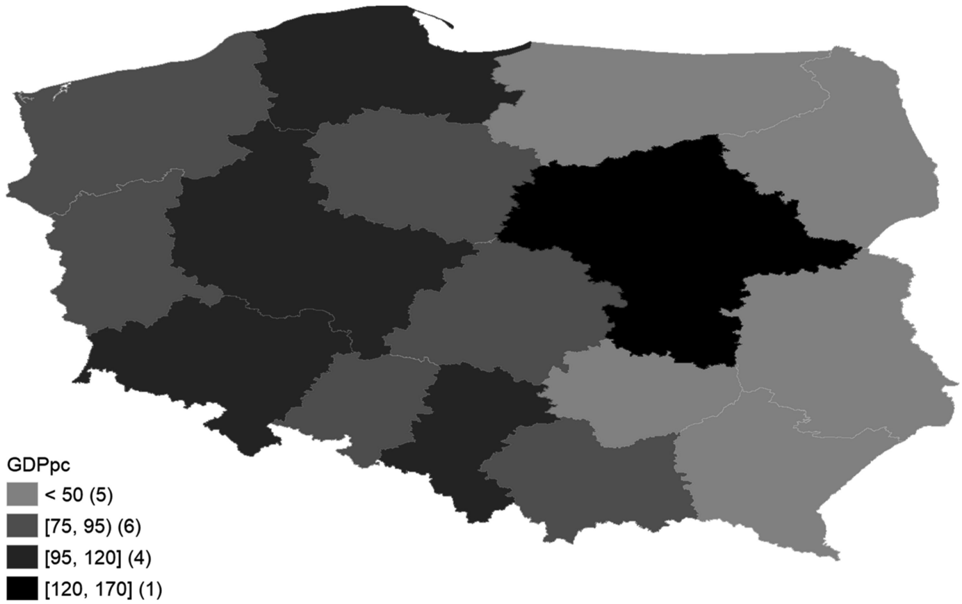
Three main macroeconometric models are used to assess the effectiveness of cohesion policy in Poland at a national level: Hermin, EUImpactMod and MaMoR3. When presenting their results, researchers compare two scenarios: the actual results of the Polish economy and 'without funds' simulations, which assume an absence of cohesion policy funds. Estimations covering the period from 2004 to 2010, based on the three mentioned models, reveal that, in the absence of the structural funds, the GDP per capita annual growth rate would have been lower: Hermin (–3.1%); MaMoR (–3.2%) and EUImpactM (–3.0%) (Bukowski *et al*., 2009; Kaczor *et al*., 2009; Zaleski *et al*., 2009). All estimations also confirm the positive impact of structural funds on the share of employment in industry and services and the employment rate of the population aged 25-64.

3. Regional disparities and convergence in Poland

Poland is a country that successfully transitioned from a centrally planned to a free-market economy. The administrative reform of 1999, following the establishment of a non-communist government, created 16 *voivodeships* (NUTS 2 regions) that are termed regions in this study (see Map 1). The reform also established 380 *powiats* (counties), including 65 cities with *powiat* status and about 2,500 *gminas* (communes), as the basic units of local government. For the purposes of EU statistics, Poland is also divided into 66 NUTS 3 sub-regions, but these are not used as official administrative divisions within the country. In 2018, the Mazowieckie region, which has the highest per capita income in the country, was divided into the Warszawski Stoleczny and Mazowiecki Regionalny regions. Accordingly, since that time, Poland has consisted of 17 NUTS 2 regions.

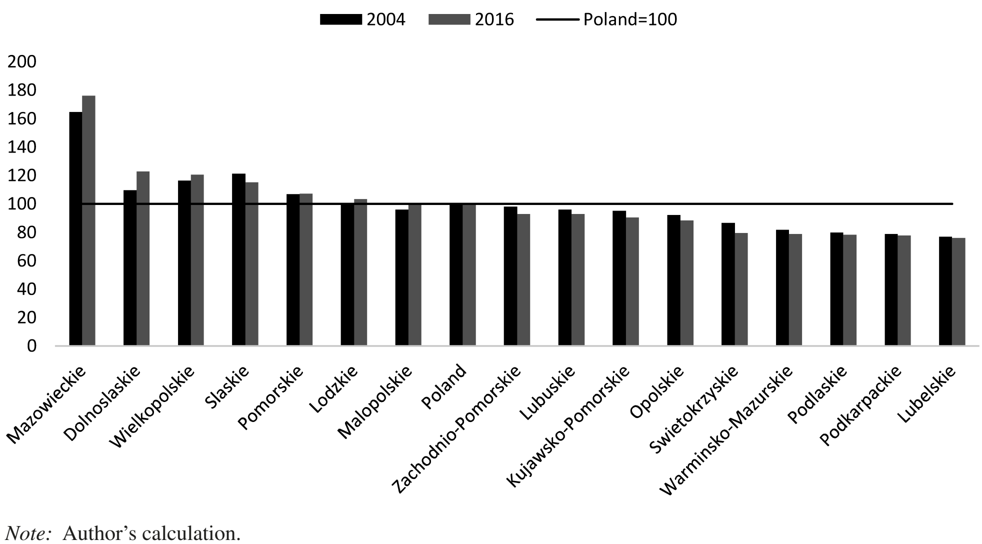
Map 1 illustrates both the administrative division of Poland at the NUTS 2 level and the existing GDP per capita gap. Some patterns can be observed from this geographical distribution. The five poorest regions, with an income below 75% of the national average, are all situated in eastern Poland. They are referred to as the 'poor eastern wall' in this study. This pattern resembles the concentration of poor regions in the south of both Spain (Andalusia) and Italy (Mezzogiorno). In turn, the five most developed regions constitute the foundations for the growth of the national economy, confirming the core-periphery pattern of development. The richest Mazowieckie region reached a GDP per capita of more than 160% of the national average. However, it should be emphasised that a high proportion of the income of Mazowieckie flows from the above-average level of development of Warsaw. In 2018, Mazowieckie was divided into two regions: Warszawski Stołeczny and Mazowiecki Regionalny. After the division, Warszawski Stołeczny, which includes Warsaw and nine adjacent powiats, remained the richest region of Poland with a GDP per capita of 219% of the national average, whereas Mazowiecki Regionalny was somewhat lower at 85%.

Map 1
ADMINISTRATIVE DIVISION OF POLAND INTO VOIVODESHIPS (REGIONS)



Source: GDP per capita in 2016, Poland = 100. Geoda software was used to prepare all maps presented in the study. The graphic file of Poland was taken from www.gadm.org.

Figure 1
GDP PER CAPITA IN POLISH REGIONS



Note: Author's calculation.

The statistical analysis of data confirms the increasing regional disparities in Poland –that is, the richest regions became richer and the poorest ones became relatively poorer. Figure 1 depicts the GDP per capita in Poland on a regional level in 2004 and 2016. Regions are listed in descending order of income as of 2016. The most developed regions, with the exception of the Slaskie region, all increased their level of GDP per capita relative to the national average: Mazowieckie from 164.4% to 176.1%; Dolnosląskie from 109.6% to 122.7%; Wielkopolskie from 116.4% to 120.6%; Pomorskie from 106.7% to 107.1%; Lodzkie from 100.0% to 103.3%; and Malopolskie from 96.6% to 100.6%. Only in the Slaskie region was there a reduction of GDP per capita from 121.2% to 114.7% of the national average. In turn, the nine poorest regions worsened their economic situations. The income of the least developed region, Lubelskie, decreased from 76.9% to 76.1% of the national average. A similar situation occurred in Podkarpackie (from 78.8% to 77.7%), Podlaskie (from 79.8% to 78.3%) and Warminsko-Mazurskie (from 81.7% to 78.8%).

The concepts of beta and sigma convergence to empirically assess whether regional disparities had increased and whether the regions' economic growth had been impacted by their initial levels of GDP per capita were used. Beta convergence refers to the idea that poor regions tend to grow faster than richer ones and therefore catch up to the latter's level of development. The formula used to measure beta convergence generally involves the estimation of a growth equation in the following form:

$$logy_{i,t} - logy_{i,t-1} = a + blogy_{i,t-1} + u_{i,t} \quad (1)$$

where $y_{i,t}$ is the level of GDP per capita in region i at time t and $u_{i,t}$ is the standard error term. The negative and statistically significant value of the b parameter confirms that convergence occurred across the analysed regional economies.

The second concept of convergence, called sigma convergence, simply refers to a reduction of disparities between regions over time. The formula most frequently used to test sigma convergence is the coefficient of variation. The variance is computed as:

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(y_{i,t} - \bar{y}_t)^2 \quad (2)$$

where $y_{i,t}$ is the variable and $\bar{y}$ is the simple arithmetic average. The decreasing value of the measure signifies the reduction of dispersion around the average value.

Figure A.1 (see Appendix) depicts two versions of the regional coefficient of variation (sigma convergence) for the Polish regions. One includes all 16 regions and the other excludes the Mazowieckie region. By comparing the two versions, it was found that the inclusion of the Mazowieckie region significantly increased the level of disparity observed in the analysis. In addition, the regional disparities in GDP per capita have been gradually increasing since 2008, confirming that a process of divergence is underway across Polish regions.

Figure A.2. (see Appendix) presents beta convergence in Poland, with the logarithmic value of the initial level of GDP per capita on the x-axis and the annual growth rate of GDP per capita in 2000-2016 on the y-axis. The value of the convergence parameter (0.11) was positive and statistically significant, confirming regional divergence. Taking into account that the Mazowieckie region influences regional disparities, an additional estimation of Equation (1) based on a sample of only 15 regions (i.e. excluding Mazowieckie) was run. The regression confirmed the positive impact (0.01) of the initial value of GDP per capita on economic growth, but this relationship was statistically insignificant. Hence, it cannot be stated that divergence was observed in the 15-region sample.

The growing regional disparities translated into each region's contributions to the national economy. The richest regions improved their proportions of the total scores for the basic macroeconomic indicators (i.e. national GDP, employment and population), whereas the poorest regions either worsened or remained unchanged. Table A.1 (see Appendix) presents the share of each region for these indicators between 2004 and 2016. The richest regions of Poland, like Mazowieckie, Dolnosląskie or Wielkopolskie, increased their contribution to the national GDP and population. The Mazowieckie, Pomorskie and Dolnosląskie regions were among the areas with the highest increase in employment. Among the richest regions, only the Slaskie region decreased its share of national GDP, employment and population. In contrast, Lubelskie, Podkarpackie, Swietokrzyskie and Podlaskie all decreased their share of all analysed macroeconomic indicators.

Summing up, in 2004, Poland's five most developed regions (Mazowieckie, Dolnosląskie, Wielkopolskie, Slaskie and Pomorskie) produced 57% of the national GDP, were home to 48% of the country's total population and comprised 47% of employment. Twelve years later, their combined relative contributions had increased to 59%, 49% and 50%, respectively. In turn, the importance of the 'poor eastern wall' regions was limited. Between 2004 and 2016, their share of the national GDP reduced from 16% to 15%, whereas their contributions to the national population (22%) and employment (21%) remained the same.

This empirical analysis confirmed that a process of economic divergence took place in Poland between 2004 and 2016, with rich regions developing more than poorer ones. The statistical analysis of data also showed the growing economic polarisation in Poland, which is reflected in the expanding importance of rich areas to the national economy. These findings are in line with various studies dealing with the problems of convergence and regional disparities in the EU. Longhi and Musolesi (2007) underlined that regional disparities are stable or increasing within individual economies, although a convergence process between countries is occurring. Funke and Strulik (1999) pointed out an increasing divergence between regions (Länder) in Germany since 1990. Terrasi (1999) drew similar conclusions, showing growing regional divergence within Italy since 1975. Finally, a recent study concerning Poland also highlighted divergence across NUTS 2 regions (Czudec *et al.*, 2019).

4. Empirical analysis

4.1. Structural funds in Polish regions

Poland joined the EU in 2004 and partly participated in the 2000-2006 EU budget process. Between 2004 and 2006, Poland received EUR 8.6 billion in structural funds and EUR

4.1 billion from the Cohesion Fund (see Appendix: Table A.2). In the 2007-2013 and 2014-2020 EU budgets, Poland was the largest beneficiary of cohesion policy funding, with payments of EUR 67.2 billion and EUR 77.6 billion, respectively (Wajda, 2016). Between 2004 and 2020, almost EUR 158 billion was allocated to Poland under the EU's cohesion policy. It should be emphasised, however, that Poland has received the most funds only in absolute (rather than per capita) terms. In the ongoing 2014-2020 budget, Poland (EUR 291) occupies the sixth position in terms of structural support per capita. Estonia (EUR 390), Slovakia (EUR 369) and Lithuania (EUR 331) have all received more funds per capita during this budget cycle. However, this support is heavily weighted towards new EU members; among countries that joined the EU before 2004, only Portugal (EUR 294) and Greece (EUR 203) received support exceeding EUR 100 per inhabitant.

Cohesion policy aims to strengthen economic and social cohesion within the EU by supporting less-developed regions. Thus, my analysis of the effectiveness of cohesion policy explored the distribution of structural funds. To assess whether the allocation of Cohesion Policy funds has been egalitarian, linear regression is applied:

$$SFpc_i = a + bGDPpc_i + u_i \tag{3}$$

where $GDPpc_i$ is GDP per capita in i region in 2004 and $SFpc_i$ is the value of structural funds per capita allocated to the same i region from 2004 through 2016. The estimate of equation (3) showed a negative value of b parameter (–0.01), meaning that a 1% increase in GDP per capita resulted in a reduction in structural funds of 0.01%. However, the b parameter was statistically insignificant, meaning there was no significant relationship between the level of regional development and the support provided under the cohesion policy. Additional estimates, based on the period from 2007 to 2013, also showed inequality in the distribution of structural funds in the NUTS 2 regions.

Table 1 presents the distribution of structural funds in Poland in the years 2007-2013 and 2004-2020, ordered by the highest level of financial support per capita (T/pc) in 2004-2020. Across all the years of Poland's participation in cohesion policy, the most subsidised regions have included both poor and rich regions, which may confirm the inequality in the funds' distribution. For example, Warminsko-Mazurskie (EUR 449 per capita) and Podkarpackie (EUR 361) belong to the 'poor eastern wall', while Mazowieckie (EUR 343) is the richest region of Poland. The least subsidised regions included Kujawsko-Pomorskie (EUR 264), Wielkopolskie (EUR 249) and Slaskie (EUR 235). However, if the financial resources of the Cohesion Fund are omitted from the analysis, the five biggest beneficiaries of structural funds all come from the 'poor eastern wall' –Warminsko-Mazurskie (EUR 284), Podlaskie (EUR 259), Swietokrzyskie (EUR 247), Podkarpackie (EUR 243) and Lubelskie (EUR 226)– with Mazowieckie (EUR 151) occupying the penultimate position. This indicates that the financial resources of the Cohesion Fund have mainly been allocated to developed regions. For example, funding from the Cohesion Fund represents half of all structural funds received by the Mazowieckie region.

Table 1 also presents the financial support received by Polish regions in absolute values (€ billion). Between 2004 and 2020, Mazowieckie was the most subsidised region, receiving a total of EUR 22.0 billion. During the same period, over EUR 10 billion in structural funds was allocated to Slaskie (EUR 13.3 billion), Malopolskie (EUR 10.8 billion), Dolnosląskie (EUR 10.5 billion), Wielkopolskie (EUR 10.5 billion) and Lodzkie (EUR 10.0 billion). The lowest level of structural aid, EUR 3.5 billion, was granted to Opolskie.

Table 1
DISTRIBUTION OF STRUCTURAL FUNDS IN POLISH REGIONS (EUR BILLION)

Regions	2007-2013					2004-2020					
	ERDF	ESF	CF	Total	T/pc	ERDF	ESF	EAGGF	CF	Total	T/pc
Warminsko-Mazurskie	2.8	0.8	2.9	6.4	463	3.9	1.0	0.08	2.9	7.9	449
Podkarpackie	3.3	1.1	3.3	7.7	414	5.0	1.2	0.04	3.0	9.3	361
Lubuskie	1.0	0.3	1.4	2.7	380	1.8	0.5	0.03	2.1	4.4	354
Mazowieckie	3.0	0.9	2.3	6.1	350	7.8	1.7	0.18	12.3	22.0	343
Zachodniopomorskie	1.7	0.6	1.8	4.0	337	3.0	0.9	0.11	3.0	7.0	338
Pomorskie	3.0	0.7	2.1	5.8	338	4.1	1.1	0.13	4.0	9.2	338
Lubelskie	0.9	0.3	0.7	1.9	178	4.7	1.2	0.11	2.6	8.6	322
Lodzkie	1.7	0.6	1.6	4.0	364	5.0	1.1	0.08	3.8	10.0	320
Podlaskie	2.0	0.6	2.7	5.3	332	3.1	0.6	0.08	0.9	4.6	319
Swietokrzyskie	2.2	0.7	1.8	4.6	323	2.9	0.9	0.05	0.8	4.7	299
Dolnoslaskie	3.0	0.7	2.7	6.5	288	5.2	1.1	0.05	4.1	10.5	295
Opolskie	1.8	0.5	0.6	2.9	272	1.8	0.5	0.03	1.1	3.5	282
Malopolskie	2.6	0.7	1.3	4.6	280	5.2	1.4	0.07	4.1	10.8	267
Kujawsko-Pomorskie	2.8	0.7	2.5	6.0	275	3.3	1.0	0.09	2.4	6.7	264
Wielkopolskie	1.8	0.4	0.5	2.7	256	5.2	1.4	0.15	3.7	10.5	249
Slaskie	5.1	1.2	6.5	12.8	240	6.0	1.8	0.03	5.5	13.3	235

Note: Author's calculation based on data from www.mapadotacji.pl. ERDF-European Regional Development Fund; ESF-European Social Fund; CF-Cohesion Fund, EAGGF denotes the amount of European Agriculture Guidance and Guarantee Funds-Section Orientation and Finance Instrument for Fisheries Guidance; T/pc-Structural funds per capita (€ per capita).

This empirical analysis of data shows the unequal distribution of cohesion funds in Poland. A low level of regional economic development has not translated into a higher investment of structural funds overall. However, when cohesion funds are excluded from the analysis, the five most subsidised regions are located in eastern Poland and the richest Mazowieckie region ranked the penultimate place. This finding is confirmed by several studies. Churski (2008) underlined that in the first years of Poland's participation in EU cohesion policy, more funds were allocated to developed regions, which did not have a positive impact on convergence. Analysis conducted by Misiąg *et al.* (2013) also proved that the increase in funding allocated to regions in eastern Poland only began in 2009. The explanation of this change in allocation may be that some operational programmes under cohesion policy operate at the national level, and the less-developed regions could not effectively compete for structural support in the first years of Poland's membership in the EU.

4.2. Empirical model and estimation methods

The starting points for the empirical analysis were the neoclassical models of economic growth, which adopt production functions with positive and diminishing marginal products of each input. According to these models, regions with a lower level of capital per capita achieve higher economic growth (otherwise known as convergence). This study applied the human-capital-augmented Solow model to evaluate the impact of structural funds on convergence in Poland (Mankiw *et al*., 1992). The Mankiw-Romer-Weil (MRW) model not only considers the impact of physical capital and labour force in the production process but also takes into account human capital as a factor contributing to growth. Given that the structural funds co-finance projects promoting the development of human capital, the convergence of this production factor may be crucial to the equalisation of economic development across NUTS 2 regions.

The production function of the model is written as

$$Y = K^{\alpha} H^{\lambda} (AL)^{1-\alpha-\gamma} \quad \text{with} \quad \alpha + \lambda \in (0;1) \tag{4}$$

where Y is the output flow, K is the stock of physical capital, H is human capital, L is the labour force and A is the effectiveness of labour. The function is characterised by a positive and diminishing marginal product for each input, as well as constant returns to scale.

The production function in intensive form is

$$y = k^{\alpha} h^{\lambda} \tag{5}$$

where $y = Y/AL$, $k= K/AL$, $h = H/AL$ are units per effective unit of labour.

Changes in capital stock K and human capital H are given by

$$\dot{K} = s_K Y - \delta K \tag{6}$$

$$\dot{H} = s_H Y - \delta H \tag{7}$$

where s_K and $s_H \in (0;1)$ denote the fraction of income invested in physical capital and human capital, respectively, and $\delta \in (0;1)$ is the depreciation rate of capital.

By dividing both sides of equations (6) and (7) by the unit of effective labour AL, the dynamics of physical and human capital stock can be calculated,

$$\dot{k} = s_K y - (n + \delta + g)k \tag{8}$$

$$\dot{h} = s_H y - (n + \delta + g)h \tag{9}$$

where n is the population growth rate and g is the exogenous technology growth rate.

The steady-state value of physical capital, k^*, and human capital, h^*, is determined by

$$k^* = \left(\frac{s_K^{1-\lambda}\, s_H^{\lambda}}{n+\delta+g}\right)^{\frac{1}{1\text{-}\alpha\text{-}\lambda}} \tag{10}$$

$$h^* = \left(\frac{s_K^{\alpha}\, s_H^{1\text{-}\alpha}}{n+\delta+g}\right)^{\frac{1}{1\text{-}\alpha\text{-}\lambda}} \tag{11}$$

applying equations (10) and (11) to equation (5), giving the GDP per effective labour at the steady state.

$$y^* = \left(\frac{s_K^{1-\lambda}\, s_H^{\lambda}}{n+\delta+g}\right)^{\frac{\alpha}{1\text{-}\alpha\text{-}\lambda}} \left(\frac{s_K^{\alpha}\, s_H^{1\text{-}\alpha}}{n+\delta+g}\right)^{\frac{\lambda}{1\text{-}\alpha\text{-}\lambda}} \tag{12}$$

The speed of convergence can be obtained using the following formula:

$$\dot{y}/y = \beta^*[ln(y^*) - ln(y(t))] \tag{13}$$

where $\beta = (n + \delta + g)(1 - \alpha - \beta)$.

Solving the differential equation (13) yields

$$ln(y(t)) = (1 - e^{-\beta t})\, ln(y^*) + e^{-\beta t}\, ln(y(t-1)) \tag{14}$$

where $y(t-1)$ is the value of y at some initial date. Equation (14) can be written as

$$ln(y(t)) - ln(y(t-1)) = (1 - e^{-\beta t})\, ln(y^*) - (1 - e^{-\beta t})\, ln(y(t-1)) \tag{15}$$

Using equation (12) to substitute for $ln(y^*)$ yields

$$\begin{aligned} ln(y(t)) - ln(y(t-1)) &= (1 - e^{-\beta t})\frac{\alpha}{1-\alpha-\lambda}ln(s_K) \\ &+(1 - e^{-\beta t})\frac{\lambda}{1-\alpha-\lambda}ln(s_H) \\ &-(1 - e^{-\beta t})\frac{\alpha+\lambda}{1-\alpha-\lambda}ln(n+\delta+g) - (1 - e^{-\beta t})\, ln(y(t-1)) \end{aligned} \tag{16}$$

Relationships given by equation (16) can be estimated using

$$ln(y(t)) - ln(y(t-1)) = b_0 + b_1\, ln(s_K) + b_2\, ln(s_H) + b_3\, ln(n+\delta+g) + \varepsilon_{0,t} \tag{17}$$

The steady-state level of GDP per capita for i-th region can be substituted for convergence regressions, which were estimated in this study

$$\begin{aligned} lny_{i,t} - lny_{i,t-1} &= b_o + b_1 y_{i,t-1} + b_2\, ln(s_{K_{i,t}}) + b_3\, ln(s_{H_{i,t}}) \\ &+b_4\, ln(n_{i,t} + \delta_{i,t} + g_{i,t}) + \ln(X_{i,t}) + \eta_i + \varepsilon_{i,t} \end{aligned} \tag{18}$$

$$\Delta lny_{i,t} = (1+b)\Delta lnb_1 y_{i,t-1} + \Delta b_2\, ln(s_{K_{i,t}}) + \Delta b_3\, ln(s_{H_{i,t}}) + \Delta b_4\, ln(n_{i,t} + \delta_{i,t} + g_{i,t}) + \Delta \ln(X_{i,t}) + \Delta\varepsilon_{i,t} \quad (19)$$

where $i = 1,...N$ denotes a region and $t = 1,...T$ is time, with t and $t - 1$ being one year apart. The variable $y_{i,t}$ is the logarithm of the GDP per capita in (PPS), $X_{i,t}$ is the matrix of control variables, η_i is the individual effect for the i-th region, $e_{i,t}$ is the error term. The growth of GDP per capita in each region between $t - 1$ and t is given by the left-hand side of Equation (18), where $X_{i,t}$ is the set of explanatory variables that are significant to explain the GDP per capita in regions, such as structural funds. Equation (19) is the first differences version of equation (18).

The specifications of the empirical models were based on the neoclassical model of economic growth (see Sala-i-Martin, 2000). The model assumes that the economy tends to a steady state. During the transition, the explanatory variables impact economic growth. When the economy achieves the level of output per capita that corresponds to a steady state, the explanatory variables no longer impact economic growth. However, the transition to a steady state can be protracted and, therefore, the changes in explanatory variables can affect economic growth over a long period.

As to the estimation method, the presence of a lagged dependent variable in equation (18) indicates that the OLS estimator is biased and inefficient. Furthermore, the OLS estimator does not take into account the country-specific effect and suffers from omitted variable bias. Equation (19), the first differenced version of equation (18), was estimated using the GMM estimator (see Arellano and Bond, 1991; Blundell and Bond, 1998). The GMM estimator takes into account lagged dependent variables and omitted variable bias. Moreover, there is no individual effect, η_i, in equation (19). However, the GMM estimator is most suitable for panel data composed of many individuals and a short time period. In this case, the analysis examined only 16 regions. For these reasons, the fixed effects estimator was applied to estimate equation (18). In turn, the GMM estimator was used to test the results of the estimates for robustness. To assess the consistency of the GMM estimator, the Sargan test for the validity of instruments and the AR2 test for autocorrelation were conducted.

4.3. Data

Annual data on Polish NUTS 2 regions were taken from the databases of Eurostat and the Polish Central Statistical Office (GUS). The value of structural funds allocated to Poland was taken from the website of Ministry of Development Funds and Regional Policy. In the empirical analysis, the dependent variables were the annual growth rates of economic growth ($\Delta y_{i,t}$) and labour productivity ($\Delta prod_{i,t}$) of region i at time t. The regional GDP per capita ($y_{i,t}$) and labour productivity per worker ($prod_{i,t}$) (euros in PPS) were expressed in the logarithmic value. The human capital ($Human$) was proxied by the percentage of the active population with tertiary education. The investment ($Invest$) was a relation of gross fixed capital formation and GDP. The depreciation rate of capital and technology growth rate was fixed at the same level in all regions ($\delta + g = 0.05$). The population growth rate (n) was calculated according to data provided by GUS.

The structural funds variable (*Fpc*) expressed the annual average value of structural support per capita. Also, in the empirical analysis, the value of structural funds were divided into the four regressors: European Regional Development Fund per capita (*ERDFpc*); European Social Fund per capita (*ESFpc*); European Agriculture Guidance and Guarantee Funds-Section Orientation and Finance Instrument for Fisheries Guidance per capita (*EAGGFpc*); Cohesion Fund per capita (*CFpc*). Other explanatory variables affecting economic growth taken into consideration were expenditure on research and development as a percentage of GDP, the share of agriculture in regional gross value added (GVA), unemployment rate and population density. However, these variables were all omitted from the final analysis due to either collinearity or a lack of statistical significance.

Table A.3 (see Appendix) presents descriptive statistics of the data set. The correlation matrix between variables is reported in Table A.4 (see Appendix). A negative correlation coefficient (–0.12) between the level of GDP per capita and the structural funds per capita showed that more developed regions received less support from cohesion policy funds. The correlation coefficient between the GDP per capita growth rate and the funding stream per capita was positive but statistically insignificant (0.01). The absence of a statistically significant correlation may indicate the low influence of structural aid on growth. Also, the relationship between GDP per capita and economic growth rate was negative but statistically insignificant (–0.03). Hence, neither convergence nor divergence was observed. To test for multicollinearity, the variance inflation factor was calculated. As all values were lower than 10, multicollinearity was not a concern.

4.4. Results

Table A.5 (see Appendix) reports the parameter estimates of equation (18) using the fixed effects estimator. The analysis covered the years 2004-2016, and the results showed a positive impact of structural funds on growth. The variable *Fpc* was positive and at least statistically significant at the 5% significance level. The results presented in columns 3-7 again confirm a positive and statistically significant relationship between cohesion policy funds and growth.

However, the estimations reveal the insignificant role of structural funds in convergence across Polish regions. In column 1, the negative and statistically significant value of $y_{i,t-1}$ confirms the presence of a convergence process. The value of $y_{i,t-1}$ changed significantly after controlling for several regressors (column 2), such as human capital (*Human*), investment (*Invest*) and combined effect $n+\delta+g$, which indicates these variables have a significant impact on convergence. Adding variables representing structural funds (columns 3-7), the value of $y_{i,t-1}$ did not change considerably. This suggests that cohesion policy funds do not influence convergence.

Next, to capture which regions leverage structural funds most effectively, the dummy variable (*dummy*Fpc*) was introduced. The variable *Fpc* was multiplied by 1 for regions situated in the 'poor eastern wall' and by 0 for other regions. There was a positive and statistically significant value for the dummy variable, showing that cohesion policy funds are better used in regions situated in eastern Poland.

The estimations also confirmed that economic growth depends on both human capital endowment and the stock of physical capital. The negative value for the population growth rate indicates its negative impact on economic growth. The speed of convergence β was very high; for example, it was 40.2% per annum for estimates reported in column 2. However, convergence rates can be seriously overstated. The lagged GDP per capita shown in the panel data analysis did not represent convergence speed in the long term but rather the adjustment speed of the short-run deviation for the long-run equilibrium path.

Table A.6 (see Appendix) depicts the estimations of equation (18) using the fixed effects estimator, examining the period from 2007 to 2013. The relationship between cohesion policy and growth was positive and statistically significant. However, similar to the results for the period from 2004 to 2016, controlling for the structural fund variables did not significantly affect the value of $y_{i,t-1}$, which indicates that structural funds had an insignificant impact on convergence. Regions were also distinguished by the dummy variable. Nevertheless, due to its statistically insignificant value, this result does not necessarily indicate that eastern Polish regions used structural funds more effectively.

Adopting a Hermin macroeconometric model assumes that cohesion policy funds affect supply and demand within the national economy through three transmission channels: direct investment in physical infrastructure, direct investment in human resources and expenditure on investment aid to the private sector. For the empirical analysis, investments co-financed by structural funds were divided into these three channels. Regarding the dummy variable, investment in each channel was multiplied by 1 for regions from the 'poor eastern wall' and by 0 for other regions. Table A.7 (see Appendix) depicts the estimations of equation (18) after applying the fixed effects estimator. The results show that the structural funds positively influenced economic growth across all channels. However, the role of cohesion policy funds in achieving regional convergence was again insignificant. Due to the lack of statistical significance of the dummy variable, it cannot be stated that regions of eastern Poland used the structural funds they received more effectively.

Next, all regressors covered by the transmission channels were considered separately to confirm which investments supported by cohesion policy, if any, had a positive and statistically significant impact on regional growth. The private sector channel included only the 'Development in enterprises' variable; this variable's impact on growth is reported in Table A.5 (columns 8 and 9; see Appendix). Table A.8 (see Appendix) shows the relevant parameter estimates of equation (18) using the fixed effects estimator. Only statistically significant variables are reported. The results suggest that investment in the sectors within the physical infrastructure and human resources channels, such as transport, environmental protection, R&D and security, had a positive impact on regional growth. However, all estimations revealed that the examined investments had an insignificant role in convergence.

At the next stage of the empirical analysis, the impact of structural funds on labour productivity convergence in 2004-2016 was verified. Table A.9 (see Appendix) presents the estimations of equation (18) using the fixed effects estimator. The dependent variable was the growth in labour productivity. For this step in the analysis, the variable of structural funds per capita was replaced with the variable of structural funds per worker. Other regressors remained unchanged. All structural funds variables were statistically insignificant, indicating that cohesion policy had an insignificant impact on regional labour productivity convergence.

The study also assessed the impact of structural funds on labour productivity convergence between 2007 and 2013. Table A.10 (see Appendix) depicts the estimates of equation (18) using the fixed effects estimator. The analysis found a positive relationship between cohesion policy funds and labour productivity growth. Nevertheless, the value of labour productivity variable $prod_{i,t-1}$ did not change noticeably after considering the structural funds variable, which indicates that structural funds did not have a significant impact on labour productivity convergence across Polish regions during this period.

4.5. Robustness of results

To test the robustness of these results, equation (19) was calculated by applying the GMM estimator (see Table A.11). The results again confirmed the positive impact of structural funds –namely Fpc, $ERDFpc$, $EFSpc$, $EAGGFpc$ and $CFpc$– on growth, and their insignificant impact on convergence between 2007 and 2013. These estimates confirm the results obtained using the fixed effects estimator. Regarding labour productivity, the results indicated a stronger influence of the structural funds on convergence than the previous analysis.

Table A.12 (see Appendix) depicts the estimations of equation (18) using the fixed effects estimator. The set of explanatory variables was changed to check the sensitivity of the results obtained. The regressors of investment ($Invest$), human capital ($Human$) and structural funds per capita (Fpc) were replaced by investment calculated as a gross fixed capital formation per capita ($Invest1$); human capital calculated as tertiary-educated persons who are employed in science and technology ($Human1$); and structural funds calculated as a ratio of structural funds and GDP ($Fpc\%$). The estimations again confirmed the positive impact of cohesion policy on growth and its insignificant impact on convergence.

Finally, a quadratic relationship between structural funds and economic growth was explored. The results of that analysis are not reported in this study, but they confirmed that cohesion policy funds have an insignificant role in achieving regional convergence.

5. Conclusion

This study aimed to assess the impact of cohesion policy funds on growth and convergence across Polish regions. The methodological framework was based on the neoclassical models of economic growth. A panel data analysis was applied to the empirical evidence, using mainly a fixed effects estimator. The results revealed that structural funds had a positive impact on regional economic growth. Nevertheless, the impact of cohesion policy on regional convergence was very weak. This study went a step further than previous studies, which have given little consideration to the effectiveness of cohesion policy in the context of regional convergence.

Although the study's results show that cohesion policy does not have a significant role in encouraging convergence, such results should not be used to conclude that cohesion policy is ineffective in Poland. Cohesion policy constitutes an important element of Poland's development and brings many advantages to Polish regions. The impact of structural funds is visible in, for example, Poland's transport industry, environmental infrastructure, labour market growth and research and development sector. Cohesion policy funds also foster the transformation of rural areas and support the growth of local businesses. However, the most highly developed Polish regions are characterised by the phenomenon of 'metropolisation', and regional economic growth is concentrated in the largest cities, such as Warsaw, Krakow and Wroclaw. Cohesion policy cannot replace endogenous factors of growth and should be seen as an additional means of support to counteract regional differences.

Several factors contribute to the unsatisfactory effect of cohesion policy on convergence in Poland. First, the impact of structural funds in regions may be delayed. Investments supported by cohesion policy need time to bring about the kinds of structural change that could reverse the negative trend of polarisation. Second, as this research highlights, convergence did not occur across Polish regions during the period examined. Richer areas developed faster than poorer ones. The top-down regional policy was ultimately too weak to overcome the polarisation process at a regional level. Third, the analysis of the regional allocation of structural funds showed that developed regions are among the largest beneficiaries. Such inequality in the allocation of funds may hinder regional convergence. Fourth, only a relatively small share (about 20%) of EU aid was allocated to direct support for the manufacturing sector. The investment that could potentially have a direct effect on supply was therefore relatively small and did not translate into an increase in regional production. Thus, in macroeconomic terms, the supply effect of structural funds was not noticeable.

Several policy implications can be drawn from this analysis. Cohesion policy aims to achieve socio-economic cohesion within the EU in the medium to long term. The estimations of this study were based on a one-year panel data analysis, identifying short-term effects. The recommendation for policymakers arising from this study is that the support of structural funds should be recognised as an important factor affecting regional economic growth in the short term.

The study's statistical analysis of the allocation of structural funds showed that the most subsidised regions are situated in eastern Poland. However, the differences were not significant, and the richest Mazowieckie region stood out as one of the most highly subsidised. Furthermore, the econometric analysis found that distribution of structural funds was not egalitarian across regions. The concentration of funds in more developed regions does not enable convergence. The practical conclusion stemming from this study is that the distribution of EU aid should be further concentrated in poorer areas.

As discussed above, the results showed a weak impact of cohesion policy funds on convergence in Poland. However, additional estimations, which were not reported in the study, showed that the convergence parameter would have changed significantly if the value of structural funds had been three times bigger. This indicates that the effectiveness of cohesion policy funds, in the context of convergence, is linked to the scale of support; that is, insufficient aid cannot bring about optimal results.

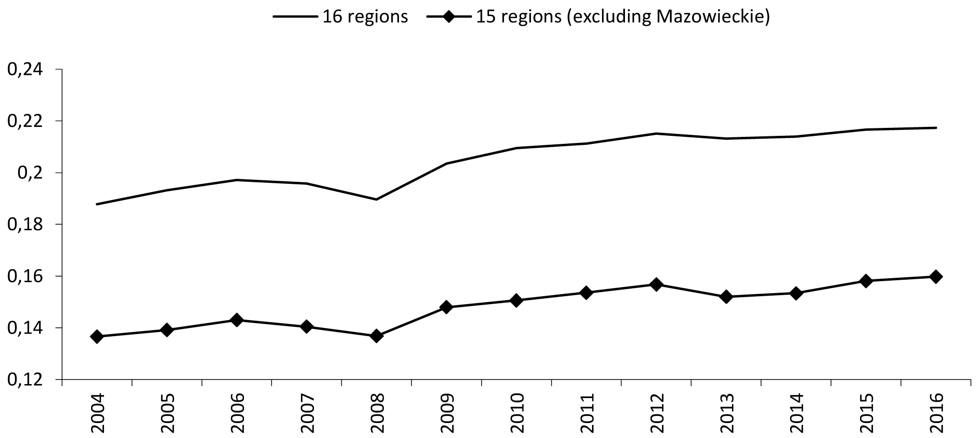
In 2016, three Polish regions achieved a GDP per capita of more than 75% of the EU average. In subsequent years, the Slaskie and Lodzkie regions may also exceed this threshold. This means that in the next EU budget, they will be classified as 'transition' regions and will receive only limited cohesion policy support. Moreover, the deteriorating condition of regions located in countries severely affected by the global financial crisis (e.g. Portugal or Greece) may mean that Poland will no longer be the most subsidised country in the EU. In this context, Poland's central government should enable sustainable economic growth by investing in national programs with a regional dimension.

There are some limitations to the results of this study. The main problem lies in data availability, and in particular the lack of statistically significant variables at the regional level. Various political or structural regional factors such as the degrees of decentralisation, openness or corruption may impact on the effectiveness of cohesion policy. Data for many of these variables are not publicly available. Excluding such variables from the analysis may have led to omitted variable bias. The impacts of the omitted variables were then attributed to the included variables, which may have caused the parameter estimates to be biased. Moreover, growth in GDP per capita is not the only goal of cohesion policy. Programmes funded under the policy also seek to preserve the environment, enhance urban development and promote social inclusion. This kind of support may not always be reflected in econometric analyses.

Regarding further research, first, it will be important to explore whether cohesion policy is more effective if it is complemented by funding under the EU's Common Agricultural Policy (CAP). Empirical research could be conducted in this domain from the perspective of regions situated in eastern Poland because they are characterised by above-national-average shares of agriculture in their regional GDP. Second, future research should consider the impact of cohesion policy funds on NUTS 3 regions. This will be a difficult task, due to the data limitations at this level. However, the allocation of funds to NUTS 3 Polish regions is recorded by national statistics, and thus such research is possible. Third, it is necessary to shed light on the role of the management and effective application of structural funds. A comparative analysis of the management approaches of several countries could indicate more effective ways to use such funds.

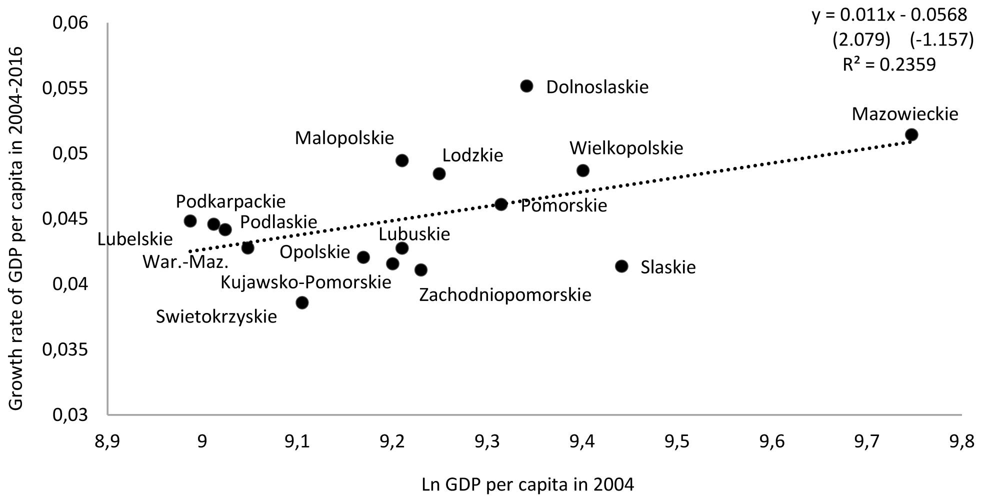
Appendix

Figure A.1
SIGMA CONVERGENCE IN POLAND 2004-2016



Note: Author's calculation.

Figure A.2
BETA CONVERGENCE IN POLAND 2004-2016



Note: Author's calculation.

Table A.1
SHARE OF REGIONS OF GDP, EMPLOYMENT AND POPULATION IN POLAND, 2004-2016

Regions	GDP			Employment			Population		
	2004	2016		2004	2016		2004	2016	
Lodzkie	6.24	6.05	–0.20	7.77	6.81	–0.96	6.80	6.53	–0.27
Mazowieckie	20.35	22.19	1.84	13.93	15.15	1.22	13.45	14.02	0.57
Malopolskie	7.55	7.97	0.42	8.73	8.68	–0.05	8.52	8.77	0.25
Slaskie	13.75	12.32	–1.43	12.10	11.55	–0.55	12.35	11.91	–0.44
Lubelskie	4.06	3.83	–0.22	6.41	5.35	–1.06	5.74	5.58	–0.16
Podkarpackie	3.99	3.90	–0.09	5.22	5.12	–0.09	5.49	5.49	0.00
Swietokrzyskie	2.69	2.34	–0.35	3.51	3.16	–0.35	3.38	3.27	–0.11
Podlaskie	2.33	2.19	–0.13	3.10	2.97	–0.13	3.16	3.05	–0.10
Wielkopolskie	9.42	9.88	0.46	9.56	9.59	0.03	8.80	9.09	0.29
Zachodniopomorskie	4.01	3.73	–0.28	3.94	4.15	0.22	4.44	4.44	–0.01
Lubuskie	2.34	2.22	–0.12	2.76	2.64	–0.12	2.64	2.65	0.01
Dolnoslaskie	7.67	8.38	0.70	6.87	7.65	0.78	7.59	7.54	–0.04
Opolskie	2.36	2.07	–0.29	2.29	2.45	0.16	2.76	2.51	–0.26
Kujawsko-Pomorskie	4.77	4.43	–0.33	5.71	5.27	–0.44	5.42	5.43	0.02
Warminsko-Mazurskie	2.83	2.67	–0.16	3.17	3.38	0.20	3.74	3.73	–0.02
Pomorskie	5.64	5.82	0.19	4.94	6.09	1.14	5.73	6.00	0.27
Poland	100	100		100	100		100	100	

Note: Author's calculation based on Eurostat.

Table A.2
STRUCTURAL FUNDS AND COHESION FUND IN THE YEARS 2000-2020 (EUR MILLION)

Country	2000-2006				2007-2013				2014-2020			
	Sf	CF	Total	Total/pc	Sf	CF	Total	Total/pc	Sf	CF	Total	Total/pc
Austria	2.008	0	2.008	35	1.204	0.000	1.204	21	1.236	0.000	1.236	21
Belgium	2.257	0	2.257	31	2.064	0.000	2.064	28	2.284	0.000	2.284	29
Denmark	0.909	0	0.909	24	0.510	0.000	0.510	13	0.553	0.000	0.553	14
Finland	2.304	0	2.304	63	1.596	0.000	1.596	43	1.466	0.000	1.466	38
France	17.192	0	17.192	39	13.449	0.000	13.449	30	15.853	0.000	15.853	34
Germany	32.765	0	32.765	57	25.489	0.000	25.489	44	19.235	0.000	19.235	34
Greece	24.095	3.388	27.483	359	16.513	3.697	20.210	262	12.272	3.250	15.522	203
Ireland	3.993	0.184	4.177	148	0.751	0.000	0.751	25	1.189	0.000	1.189	37
Italy	32.707	0	32.707	81	27.958	0.000	27.958	69	32.823	0.000	32.823	77
Luxembourg	0.103	0	0.103	32	0.050	0.000	0.050	15	0.060	0.000	0.060	16
Netherlands	3.615	0	3.615	32	1.660	0.000	1.660	14	1.404	0.000	1.404	12
Portugal	21.751	3.388	25.139	343	18.352	3.060	21.412	290	18.603	2.862	21.465	294
Spain	49.711	12.357	62.068	208	34.658	0.000	34.658	111	28.560	0.000	28.560	88
Sweden	2.396	0	2.396	38	1.626	0.000	1.626	25	2.106	0.000	2.106	31
UK	18.209	0	18.209	44	9.891	0.000	9.891	23	11.840	0.000	11.840	26
Cyprus	56	54	110	22	0.399	0.213	0.612	115	0.466	0.270	0.736	122
Czech Republic	1.685	936	2.621	37	17.707	8.819	26.526	370	15.724	6.259	21.983	299
Estonia	386	309	695	73	1.298	2.106	3.403	362	2.517	1.073	3.590	390
Hungary	2.095	1.113	3.208	45	20.268	4.653	24.921	354	15.881	6.025	21.906	317
Latvia	649	515	1.162	73	2.991	1.540	4.530	293	3.162	1.349	4.512	322
Lithuania	930	608	1.538	65	4.470	2.305	6.775	298	4.774	2.049	6.823	331
Malta	67	21.94	88.94	32	0.556	0.284	0.840	30	0.507	0.218	0.725	24
Poland	8.631	4.179	12.81	48	44.798	22.387	67.186	252	54.359	23.208	77.567	291
Slovakia	1.187	571	1.758	47	7.600	3.899	11.498	306	9.823	4.168	13.992	369
Slovenia	1.595	0.849	2.445	175	2.689	1.412	4.101	291	2.179	0.895	3.075	213
Romania	N/A	N/A	N/A	N/A	12.691	6.522	19.213	130	16.059	6.935	22.994	165
Bulgaria	N/A	N/A	N/A	N/A	4.391	2.283	6.674	126	5.310	2.278	7.588	150
Croatia	N/A	N/A	N/A	N/A	0.577	0.281	0.858	28	6.050	2.560	8.609	290

Note: Author's calculations based on data from the European Commission. Sf-structural funds; CF-Cohesion Fund, Total/pc-structural funds per capita (annual average).

Table A.3
DESCRIPTIVE STATISTIC OF THE DATA SET

Variables	Mean	Median	S.D.	Min.	Max.
$y_{i,t-1}$	9.538	9.510	0.2714	8.987	10.36
$prod_{i,t-1}$	10.48	10.48	0.2547	9.879	11.15
$Invest$	0.2019	0.2003	0.0280	0.1465	0.2997
$Human$	24.28	24.20	5.580	13.80	41.80
$n+\delta+g$	0.0489	0.0496	0.0066	–0.0075	0.0569
Fpc	314.7	318.5	50.70	230.2	452.3
$ERDFpc$	155.9	146.6	33.03	103.7	223.4
$ESFpc$	39.87	39.35	8.103	26.43	58.27
$EAGGFpc$	3.149	2.995	1.427	0.599	5.958
$CFpc$	115.7	108.8	37.97	51.43	195.4

Sources: Eurostat; Polish Central Statistical Office (GUS); mapadotacji.pl. Number of observations included: 112.

Table A.4
CORRELATIONS MATRIX

Variable	$\Delta y_{i,t}$	$y_{i,t-1}$	$Human$	$Invest$	$n+\delta+g$	Fpc
$\Delta y_{i,t}$	X					
$y_{i,t-1}$	–0.03	X				
$Human$	0.06	0.71	X			
$Invest$	0.33	–0.09	0.03	X		
$n+\delta+g$	–0.04	0.16	0.17	0.16	X	
Fpc	0.01	–0.12	0.00	0.31	0.08	X

Note: See the note for Table A.3.

Table A.5
FIXED EFFECTS ESTIMATIONS OF EQUATION (18), GDP PER CAPITA CONVERGENCE 2004-2016

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const	0.7876***	2.8606***	2.7285***	2.6882***	2.6925***	2.7629***	2.7905***	2.7261***
	(0.0494)	(0.3227)	(0.3328)	(0.3381)	(0.3411)	(0.3202)	(0.3271)	(0.3479)
$y_{i,t-1}$	–0.0780***	–0.3309***	–0.3231***	–0.3202***	–0.3208***	–0.3257***	–0.3271***	–0.3234***
	(0.0051)	(0.0398)	(0.0404)	(0.0410)	(0.0414)	(0.0396)	(0.0398)	(0.0421)
Human		0.0083***	0.0084***	0.0083***	0.0083***	0.0084***	0.0084***	0.0083***
		(0.0016)	(0.0016)	(0.0017)	(0.0017)	(0.0016)	(0.0016)	(0.0017)
Invest		0.2089***	0.2160***	0.2219***	0.2220***	0.2158***	0.2095***	0.2245***
		(0.0653)	(0.0676)	(0.0691)	(0.0688)	(0.0670)	(0.0661)	(0.0682)
$n+\delta+g$		–0.0418***	–0.0406***	–0.0406***	–0.0405***	–0.0411***	–0.0409***	–0.0416***
		(0.0116)	(0.0113)	(0.0115)	(0.0114)	(0.0115)	(0.0112)	(0.0122)
Fpc			0.0007**					0.0001*
			(0.0001)					(0.0001)
FEDERpc				0.0001**				
				(0.0001)				
ESFpc					0.0007**			
					(0.0002)			
FEOGApc						0.0056**		
						(0.0021)		
CFpc							0.0001*	
							(0.0001)	
dummy								0.0001*
								(0.0001)
N	192	192	192	192	192	192	192	192
Regions	16	16	16	16	16	16	16	16
R squared	0.19	0.37	38	0.38	0.38	0.38	0.38	0.38
F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	2.16	2.18	2.17	2.17	2.18	2.17	2.17	2.18
Doornik-Hansen	0.2125	0.4540	0.5912	0.5780	0.5633	0.5556	0.5732	0.4665
b (%)	8.1	40.2	39.0	38.6	38.7	39.4	39.6	39.1

Note: The dependent variable is Δy_t. *p<.10. **p<.05. ***p<.01. Standard errors are clustered in parentheses. D-W test and F test denote Durbin-Watson test and Fisher-Snedecor test, respectively. The annual convergence speed is calculated according to the formula: $b = -\frac{ln(1+n\beta)}{n}$.

Table A.6
FIXED EFFECTS ESTIMATIONS OF EQUATION (18), GDP PER CAPITA CONVERGENCE 2007-2013

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
const	1.0883***	3.1885***	3.0553***	3.0569***	3.1130***	3.0358***	3.0489***
	(0.1626)	(0.5156)	(0.5170)	(0.5179)	(0.5109)	(0.5223)	(0.5992)
$y_{i,t-1}$	–0.1098***	–0.3939***	–0.4103***	–0.4078***	–0.4044***	–0.4152***	–0.4078***
	(0.0170)	(0.0635)	(0.0585)	(0.0593)	(0.0611)	(0.0565)	(0.0576)
Human		0.0093***	0.0097***	0.0096***	0.0095***	0.0098***	0.0098***
		(0.0025)	(0.0025)	(0.0025)	(0.0025)	(0.0024)	(0.0024)
Invest		0.4267***	0.4140***	0.4136***	0.4169***	0.4142***	0.4149***
		(0.1325)	(0.1337)	(0.1330)	(0.1333)	(0.1346)	(0.1335)
$n + \delta + g$		–0.0268***	–0.0346***	–0.0345***	–0.0327***	–0.0349***	–0.0349***
		(0.0057)	(0.0114)	(0.0123)	(0.0113)	(0.0102)	(0.0099)
Fpc			0.0011*				0.0014*
			(0.0004)				(0.0006)
FEDERpc				0.0021*			
				(0.0012)			
ESFpc					0.0056*		
					(0.0034)		
CFpc						0.0036**	
						(0.0015)	
*dummy*Fpc*							–0.0031
							(0.0037)
N	112	112	112	112	112	112	112
Regions	16	16	16	16	16	16	16
R squared	0.11	0.34	0.34	0.34	0.34	0.33	0.34
F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	1.99	2.02	2.00	1.99	1.99	2.01	1.98
Doornik-Hansen	0.0048	0.0653	0.1650	0.1527	0.1542	0.1685	0.1481
b (%)	11.6	50.1	52.8	52.4	51.8	53.6	52.4

Note: See the note for Table A.5.

Table A.7

FIXED EFFECTS ESTIMATIONS OF EQUATION (18), GDP PER CAPITA CONVERGENCE 2007-2013, TRANSITIONS CHANNELS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
const	1.0883***	3.1885***	3.0553***	3.0926***	3.1130***	3.1854***	3.3854***	3.1471***	3.3832***
	(0.1626)	(0.5156)	(0.5170)	(0.5600)	(0.5109)	(0.5432)	(0.5359)	(0.5596)	(0.5261)
$y_{i,t-1}$	–0.1098***	–0.3939***	–0.4103***	–0.4089***	–0.4047***	–0.4072***	–0.4034***	–0.4060***	–0.4044***
	(0.0170)	(0.0635)	(0.0585)	(0.0585)	(0.0582)	(0.0614)	(0.0616)	(0.0601)	(0.0586)
Human		0.0093***	0.0097***	0.0096***	0.0121***	0.0117***	0.0119***	0.0116***	0.0121***
		(0.0025)	(0.0025)	(0.0025)	(0.0017)	(0.0020)	(0.0018)	(0.0020)	(0.0017)
Invest		0.4267***	0.4140***	0.4179***	0.4180***	0.4132***	0.4137***	0.4145***	0.4163***
		(0.1325)	(0.1337)	(0.1311)	(0.1323)	(0.1110)	(0.1208)	(0.1109)	(0.1196)
$n+\delta+g$		–0.0268***	–0.0346***	–0.0351***	–0.0360***	–0.0350***	–0.0358***	–0.0361***	–0.0362***
		(0.0057)	(0.0114)	(0.0084)	(0.0085)	(0.0082)	(0.0083)	(0.0083)	(0.0086)
Fpc			0.0011*						
			(0.0004)						
Infra				0.0013*	0.0017**				
				(0.0007)	(0.0007)				
*dummy*Infra*					–0.0045				
					(0.0049)				
Humancap						0.0029**	0.0035***		
						(0.0012)	(0.0013)		
*dummy*Human*							–0.0095		
							(0.0114)		
Enterprise								0.0066*	0.0094**
								(0.0037)	(0.0039)
*dummy*Enterprise*									–0.0255
									(0.0217)
N	112	112	112	112	112	112	112	112	112
Regions	16	16	16	16	16	16	16	16	16
R squared	0.11	0.34	0.34	0.34	0.34	0.33	0.34	0.34	0.34
F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	1.99	2.02	2.00	2.11	2.08	2.10	2.10	2.10	2.11
b (%)	11.6	50.1	52.8	52.6	51.9	52.3	51.7	52.1	51.8

Note: See the note for Table A.5. The physical infrastructure channel (*Infra*) covers structural funds allocated to science and education, energy, transport, tourism, telecommunications, administration, revitalisation and environment protection. The human resources channel (*Humancap*) covers structural funds allocated to security, R&D, arts and culture, health care, employment and social integration. The private sector channel (*Enterprise*) expresses the value of structural funds allocated to the development of enterprises.

Table A.8
FIXED EFFECTS ESTIMATIONS OF EQUATION (18), GDP PER CAPITA CONVERGENCE 2007-2013, INVESTMENT UNDER TRANSMISSION CHANNELS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
const	3.1885***	3.0257***	3.2118***	3.1048***	3.1921***	3.1971***	3.3355***	3.1379***	3.1462***
	(0.5156)	(0.5678)	(0.5514)	(0.5443)	(0.5486)	(0.5395)	(0.5628)	(0.5569)	(0.5446)
$y_{i,t-1}$	–0.3939***	–0.4125***	–0.4033***	–0.4132***	–0.4046***	–0.4098***	–0.4048***	–0.4064***	–0.4107***
	(0.0635)	(0.0564)	(0.0616)	(0.0552)	(0.0621)	(0.0610)	(0.0639)	(0.0604)	(0.0584)
Human	0.0093***	0.0119***	0.0116***	0.0119***	0.0116***	0.0117***	0.0116***	0.0117***	0.0118***
	(0.0025)	(0.0019)	(0.0022)	(0.0019)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0017)
Invest	0.4267***	0.4750***	0.4873***	0.4848***	0.4855***	0.4807***	0.4890***	0.4837***	0.4801***
	(0.1325)	(0.1109)	(0.1126)	(0.1102)	(0.1111)	(0.1110)	(0.1122)	(0.1104)	(0.1116)
$n+\delta+g$	–0.0268***	–0.0346***	–0.0364***	–0.0343***	–0.0361***	–0.0341***	–0.0349***	–0.0358***	–0.0342***
	(0.0057)	(0.0084)	(0.0087)	(0.0088)	(0.0082)	(0.0083)	(0.0090)	(0.0082)	(0.0090)
Transport		0.0036*							
		(0.0019)							
Environment prot.			0.0083**						
			(0.0037)						
Revitalization				0.0810**					
				(0.0397)					
Science and edu.					0.0130*				
					(0.0067)				
R&D						0.0180***			
						(0.0066)			
Security							0.0300***		
							(0.0087)		
Employ, soc. prot.								0.0173*	
								(0.0010)	
Culture and art									0.0820**
									(0.0317)
N	112	112	112	112	112	112	112	112	112
Regions	16	16	16	16	16	16	16	16	16
R squared	0.34	0.36	0.34	0.36	0.34	0.35	0.35	0.34	0.34
F	0.0000	0.0005	0.0006	0.0000	0.0006	0.0006	0.0006	0.0006	0.0005
b (%)	50.1	52.8	52.1	52.6	51.9	52.3	51.7	52.1	51.8

Note: See the notes for Tables A.5 and A.7.

Table A.9
FIXED EFFECTS ESTIMATIONS OF EQUATION (18). LABOUR PRODUCTIVITY CONVERGENCE, 2004-2016

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const	0.9045***	3.6638***	3.3807***	3.4241***	3.4336***	3.6198***	3.3697***	3.3098***
	(0.2751)	(0.7499)	(0.8320)	(0.8459)	(0.8419)	(0.8037)	(0.8072)	(0.8310)
$prod_{i,t-1}$	–0.0834***	–0.3874***	–0.3894***	–0.3846***	–0.3857***	–0.3816***	–0.3890***	–0.3800***
	(0.0262)	(0.0793)	(0.0903)	(0.0915)	(0.0917)	(0.0863)	(0.0864)	(0.0896)
Human		0.0089***	0.0073**	0.0075**	0.0075**	0.0086**	0.0072**	0.0069*
		(0.0029)	(0.0034)	(0.0034)	(0.0034)	(0.0032)	(0.0032)	(0.0033)
Invest		0.4994***	0.4862***	0.4832***	0.4838***	0.4972***	0.4943***	0.4800***
		(0.1122)	(0.1126)	(0.1165)	(0.1186)	(0.1149)	(0.1088)	(0.1184)
$n+\delta+g$		–0.0477***	–0.0471**	–0.0469**	–0.0471**	–0.0475***	–0.0474***	–0.0461***
		(0.0201)	(0.0194)	(0.0197)	(0.0197)	(0.0199)	(0.0190)	(0.0199)
Fpc			–0.0001					–0.0001
			(0.0001)					(0.0003)
FEDERpc				–0.0001				
				(0.0002)				
ESFpc					–0.0006			
					(0.0011)			
FEOGApc						–0.0012		
						(0.0137)		
CFpc							–0.0002	
							(0.0003)	
*dummy*Fpc*								–0.0001
								(0.0001)
N	192	192	192	192	192	192	192	192
Regions	16	16	16	16	16	16	17	17
R squared	0.06	0.24	0.24	0.24	0.24	0.24	0.24	0.24
F	0.0062	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	1.66	1.71	1.71	1.71	1.71	1.71	1.72	1.73
Doornik-Hansen	0.0018	0.0203	0.0150	0.0161	0.0170	0.0199	0.0137	0.0123
b (%)	8.7	49.0	49.3	48.5	48.7	48.1	49.2	47.8

Note: See the note for Table A.5. The dependent variable is $\Delta prod_{i,t}$.

Table A.10
FIXED EFFECTS ESTIMATIONS OF EQUATION (18). LABOUR PRODUCTIVITY CONVERGENCE 2007-2013

	(1)	(2)	(3)	(4)	(5)	(7)	(8)
const	1.2262***	3.8205***	3.3132***	3.3016***	3.4863***	3.2817***	3.0612***
	(0.2674)	(0.5918)	(0.6058)	(0.5835)	(0.5590)	(0.6530)	(0.5943)
$prod_{i,t-1}$	–0.1134***	–0.4058***	–0.4409***	–0.4429***	–0.4328***	–0.4400***	–0.4475***
	(0.0255)	(0.0609)	(0.0604)	(0.0628)	(0.0617)	(0.0569)	(0.0674)
Human		0.0131***	0.0141***	0.0140***	0.0138***	0.0143***	0.0139***
		(0.0038)	(0.0037)	(0.0037)	(0.0037)	(0.0037)	(0.0036)
Invest		0.7202***	0.6756***	0.6723***	0.6799***	0.6802***	0.6618***
		(0.1986)	(0.1864)	(0.1858)	(0.1896)	(0.1861)	(0.1828)
$n+\delta+g$		–0.0343	–0.034	–0.0270	–0.0298	–0.0293	–0.0256
		(0.0219)	(0.0391)	(0.0272)	(0.0277)	(0.0275)	(0.0305)
Fpc			0.0027*				0.0023*
			(0.0015)				(0.0012)
FEDERpc				0.0060**			
				(0.0032)			
ESFpc					0.0148*		
					(0.0082)		
CFpc						0.0067*	
						(0.0040)	
*dummy*Fpc*							0.0040
							(0.0057)
N	112	112	112	112	112	112	112
Regions	16	16	16	16	16	17	17
R squared	0.07	0.34	0.35	0.35	0.35	0.35	0.36
F	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	1.82	1.93	1.98	1.98	1.96	1.98	1.99
Doornik-Hansen	0.2840	0.2426	0.4249	0.4356	0.4026	0.4075	0.4403
b (%)	12.0	52.1	58.1	58.5	56.7	57.9	59.3

Note: See the note for Table A.5.

Table A.11
ROBUSTNESS CHECK. GMM ESTIMATIONS OF EQUATION (19). GDP PER CAPITA CONVERGENCE, 2007-2013

	Per capita GDP					Labor productivity				
$y_{i,t-1}/prod_{i,t-1}$	0.5469***	0.5104***	0.5050***	0.5246***	0.5091***	0.3733**	0.2728**	0.2577**	0.2654***	0.3165***
	(0.1235)	(0.0900)	(0.0943)	(0.0972)	(0.0792)	(0.1772)	(0.1072)	(0.1110)	(0.1020)	(0.1057)
Human	0.0140***	0.0135***	0.0133***	0.0133***	0.0136***	0.0254***	0.0237***	0.0234***	0.0240***	0.0231***
	(0.0050)	(0.0034)	(0.0034)	(0.0037)	(0.0033)	(0.0077)	(0.0044)	(0.0044)	(0.0045)	(0.0050)
Invest	0.1738***	0.1547***	0.1599***	0.1543***	0.1593***	0.1700*	0.1552***	0.1608***	0.1614***	0.1540***
	(0.0425)	(0.0271)	(0.0292)	(0.0334)	(0.0241)	(0.0998)	(0.0542)	(0.0604)	(0.0613)	(0.0384)
$n+\delta+g$	–0.0096	–0.0041	–0.0057	0.0025	0.0041	–0.0742	–0.0068	–0.0063	–0.0039	–0.0179
	(0.0271)	(0.0192)	(0.0200)	(0.0213)	(0.0175)	(0.0856)	(0.0338)	(0.0367)	(0.0396)	(0.0358)
Fpc/Fpw		0.0004***					0.0015***			
		(0.0001)					(0.0001)			
FEDEpc			0.0009**					0.0033***		
			(0.0003)					(0.0004)		
ESFpc				0.0029*					0.0110***	
				(0.0016)					(0.0017)	
CFpc					0.0010***					0.0037***
					(0.0002)					(0.0004)
N	80	80	80	80	80	80	80	80	80	80
Regions	16	16	16	16	16	16	16	16	16	16
Instruments	18	19	19	19	19	18	19	19	19	19
AR(1)	0.0913	0.0542	0.0781	0.0630	0.0437	0.2099	0.2020	0.3605	0.2881	0.0997
AR(2)	0.1342	0.3893	0.3617	0.2799	0.4938	0.0988	0.4066	0.3178	0.2210	0.7247
Sargan	0.3460	0.4810	0.5175	0.4468	0.4608	0.3204	0.3359	0.3508	0.3332	0.3583
Wald	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
b (%)	60.3	67.3	68.3	64.5	67.5	98.5	129.9	148.9	132.7	115.0

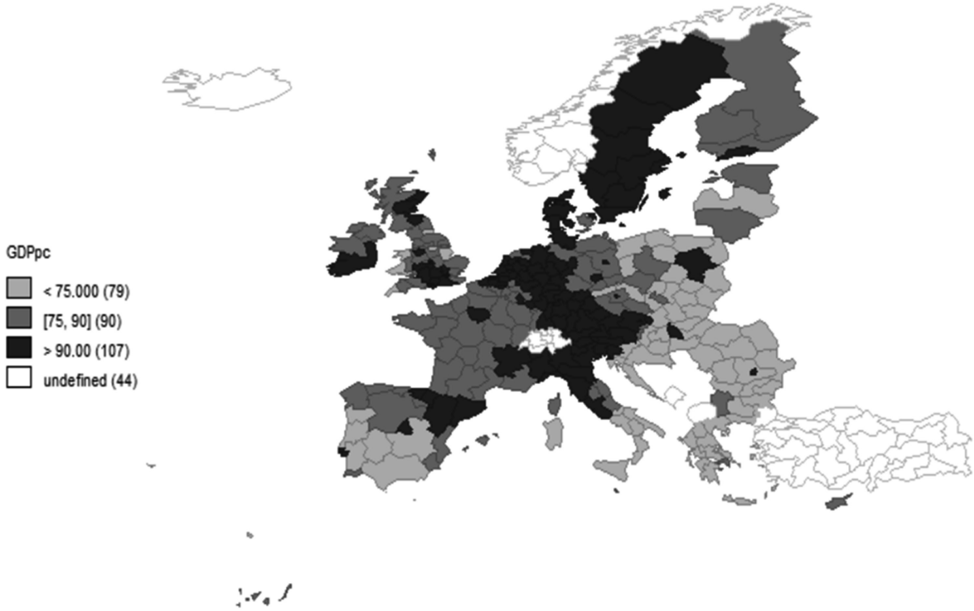
Note: Two-step FDGMM estimates with the Windmeijer (2005) correction. Period dummies were not included. AR(1) and AR(2) denote the p-value of the first –and second– order serial correlations, respectively. In relation to the dependent variable $prod_{i,t-1}$, the structural funds were divided per worker (*Fpw*).

Table A.12
ROBUSTNESS CHECK. NEW SET OF REGRESSORS. FIXED EFFECTS ESTIMATIONS OF EQUATION (18). GDP PER CAPITA CONVERGENCE, 2007-2013

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
const	1.0883***	2.4455***	2.5481***	2.5505***	2.5464***	2.5416***	2.5806***
	(0.1626)	(0.3407)	(0.3445)	(0.3514)	(0.3502)	(0.3372)	(0.4012)
$y_{i,t-1}$	–0.1098***	–0.2730***	–0.3014***	–0.3021***	–0.3031***	–0.2989***	–0.3052***
	(0.0170)	(0.0382)	(0.0405)	(0.0417)	(0.0413)	(0.0394)	(0.0460)
Human1		0.0146***	0.0176***	0.0175***	0.0179***	0.0175***	0.0177***
		(0.0044)	(0.0049)	(0.0049)	(0.0051)	(0.0049)	(0.0051)
Invest1		0.4949***	0.5080***	0.5143***	0.5156***	0.4999***	0.5121***
		(0.1155)	(0.1154)	(0.1160)	(0.1151)	(0.1153)	(0.1145)
$n+\delta+g$		–0.0528***	–0.0505***	–0.0574***	–0.0571***	–0.0572***	–0.0575**
		(0.0075)	(0.0073)	(0.0070)	(0.0071)	(0.0069)	(0.0070)
Fpc(%)			0.0001*				0.0001*
			(0.0001)				(0.0001)
FEDERpc(%)				0.0001**			
				(0.0001)			
ESFpc(%)					0.0001*		
					(0.0001)		
CFpc(%)						0.0001*	
						(0.0001)	
*dummy*Fpc*							0.0001
							(0.0001)
N	112	112	112	112	112	112	112
Regions	16	16	16	16	16	16	16
R squared	0.11	0.31	0.33	0.33	0.33	0.33	0.33
F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
D-W	1.99	2.09	2.11	2.10	2.11	2.11	2.09
Doornik-Hansen	0.0048	0.0511	0.0872	0.0820	0.0825	0.0830	0.0772
b (%)	11.6	31.9	35.9	36.0	36.1	35.6	36.4

Note: See the note for Table A.5.

Map A.1
GDP PER CAPITA IN NUTS 2 REGIONS IN 2016, EU-27 = 100



Note: See note for Map 1. The graphic file of the EU was downloaded from www.eurostat.com..

Note

1. NUTS is a geographical nomenclature subdividing the territory of the European Union (EU) into regions at three different levels (NUTS 1, 2 and 3, respectively, moving from larger to smaller territorial units). Above NUTS 1 is the 'national' level of the Member State. NUTS areas aim to provide a single and coherent territorial breakdown for the compilation of EU regional statistics.

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Resumen

Este estudio analiza si los fondos de la política de cohesión afectan al crecimiento económico y si dan lugar a un proceso de convergencia entre las regiones de Polonia (NUTS 2). Se estima un modelo con distintos procedimientos de estimación, incluido el estimador de efectos fijos –como estimador principal– y el estimador GMM, a un panel equilibrado de datos de 16 regiones polacas en el periodo (2004-2016). El análisis empírico revela que los fondos de cohesión tuvieron un impacto positivo en el crecimiento económico regional. Sin embargo, la influencia de los fondos estructurales en el proceso de convergencia es débil. Los resultados son robustos con independencia del método de estimación.

Palabras clave: Fondos de la política de cohesión, convergencia regional, Polonia.

Clasificación JEL: C23, R11, R58.