

THE CONTRIBUTION OF COHESION POLICY TO THE DEVELOPMENT AND CONVERGENCE OF THE REGIONS OF THE EUROPEAN UNION

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Abstract

The Cohesion Policy's (CP) contribution to the development and convergence of EU regions is examined by utilizing the most complete historical data about CP payments regionally. Through the implementation of the neoclassical econometric model, the positive contribution, with a room of improvement, of CP to development and convergence of EU regions is substantiated. Moreover, the contribution of the secondary sector is emerging as the most critical. It is argued that the provision of reliable data of the implementation of CP contributes decisively towards reducing the complexity and heterogeneity of results. Also increases their potential to be utilized in assessment and design programs.

Keywords: Cohesion Policy of the European Union, Regional development and convergence, Econometric model, Data reliability and representativeness, Secondary sector

JEL classification: R11, R58, R15

1. Introduction

The Cohesion Policy (CP), (Piattoni and Polverari, 2016), is one of the most important EU policies, since it was established, to contribute to the harmonious development of regions, and reduce any lag exists in the most disadvantageous areas (European Union, 2016). At the same time, to reach this highly ambitious, twin (growth and convergence), yet controversial goal set that is in line with theories of economic growth, it is supported through five funds, European Social Fund (ESF), European Agricultural Fund for Rural Development (EAFRD), European Regional Development Fund (ERDF), Cohesion Fund (CF), and European Maritime and Fisheries Fund (EMFF), and its substantial resources amounting to 30% of EU budget.

The establishment of the CP was prompted by the need to counterbalance the negative effects that would result from the operation of the single market in 1989 (Delors, 1989, cited in Boldrin and Canova, 2001). Furthermore, it was believed that the free movement of capital and human resources would unleash centripetal forces, accumulating more benefits at the core of the EU, and raising social and economic disparities to unaccepted levels, at the same time (Rodriguez-Pose and Fratesi, 2004). However, the effort to substantiate the need for the CP based on the theories of economic growth leads to different and contradictory conclusions. In detail, the neoclassical development theory (Solow-Swan, 1956) posits that the operations of the single market ensure a uniform allocation of the factors of production, and due to their diminishing returns, in the long run, economies converge to equilibrium and therefore, the CP is unnecessary. On the other hand, the endogenous development theory (Romer, 1986), followed by the new economic geography theory (Krugman, 1991), posits that the two goals of the CP (development and convergence) cannot be met simultaneously. More precisely, it is argued that regional disparities increase at times of growth and decrease or remain constant at times of recession, due to the economies of scales and rising returns of the factors, which

result from their accumulation in the developed regions. As Guastella and Timpano (2010) mention “the debate on the role of external economies on convergence is still open”.

A milestone during the implementation of the CP is marked by the year 1988, when its radical review and transformation occur through a set of fragmented interventions within a comprehensive operation program, spanning over many years, with specific resources and targets, and participatory planning, monitoring and evaluation procedures (Manzell and Mendez, 2009).

According to Becker et al. (2010), the interest in the evaluation of the CP, i.e., in the evaluation of the impact from its implementation on the development and convergence of the EU regions, has the report of Sala-i-Martin (1996) as its starting point. In more detail, in this report, the failure of the CP is noted, estimating that development and convergence in the EU were not different from other areas, where similar programs were not implemented.

Currently, after about 25 years of significant research efforts, neither the scientific community nor the policymakers have managed to reach a common conclusion about the competition of the objectives of the CP. On the other hand, they have mainly managed to identify the factors that have a major impact on this accomplishment (Bachtrogler et al., 2020). A characteristic report is that of Berkowitz et al. (2020) who, following the research on the impact assessment methods applied to the CP, conclude that the functioning of CP remains a “black box” in the analysis, highlighting, at the same time, that the presence of representative and reliable data within the appropriate scope and territory level is critical.

Furthermore, it is argued by Fratesi and Wislade (2017) that the overall impact assessment of the CP is very difficult, since several parameters affect the analyses, and the researcher’s interest should be focused on investing the determinants that have an impact on its effectiveness. As a result, a failure to reach consistent conclusions about the benefits of the CP leads, among other things, was a growing questioning of the added value of the CP, as it characteristically emerges from the analysis of nine surveys in the paper of Crescenzi et al. (2020).

As illustrated in the following section, the heterogeneity, even contradiction of the results of the surveys are not the only critical issues, since the assumptions, conditionalities and case studies that introduced and examined by each one of them, also significant limitations to their utilization in planning future programs. Reference made by Pieńkowski and Berkowitz (2015) on the need for collaboration to be encouraged among academics, econometric analyst, and policymakers, at all levels, to develop synergies and establish a common understanding about how research results can be utilized. The following recognized in the literature as the causes of a lack of clarity in research. The range and variety of interventions within the CP and the various effects that they have on development, the different period and scope that are covered by the research and the analysis method applied. However, almost all the researchers report the limited availability of representative and reliable data as the cause of lack of clarity in analyses, both for simulation of the CP and any additional explanatory variables that should be taken under consideration in analysing, as specified in regional development theories and literature. To further elaborate, although it is accepted (Berkowitz et al., 2020; Ederveen et al., 2003; Fiaschi et al., 2018; Mohl and Hagen, 2010; Rodriguez-Pose and Fratesi, 2004) that the evaluation of the CP should take place after considering the actual payments of funds, as they distributed in the appropriate scope, intervention sector, and time of implementation, the studies that utilize the relevant data are limited. Characteristically reported that Dall’erba and Fang (2017) after reviewing 17 econometric studies which were taken from the years 1996 to 2013, included in their analysis only those studies that received actual amounts of funds for the simulation of the CP, excluding those that use proxy or dummy variables.

This paper aspires to further contribute to research, since it takes advantage of some of the most complete and accurate set of historical data published by the European Commission in April 2018 (European Commission, 2018), regarding CP payments. So far, these data have not been utilized by any research, as far as the authors of the paper at hand are concerned. Moreover, it covers the highest number of regions that can be found in literature, i.e., 237 out of 272, and expands the period of analysis up to 2016, from 2013 that it has been so far. Furthermore, it provides clear and quantified results that are based on the most parsimonious econometric model, which has a high explanatory capacity and meets the goodness of fit tests.

Therefore, it can be used for the forecast of impact during the design and evaluation of CP programs.

The study is structured around 5 sections, including the 1st section and the 5th section that refer to the introduction and the conclusions, respectively. In the 2nd section, a presentation of literature takes place and the contribution of the report to research is determined, while in the 3rd section, an analysis is conducted on the evaluation method used for the CP and the relevant data that are taken into account. This is followed by the 4th section, where a presentation of the results derived from the implementation of the neoclassical econometric model, takes place, as well as their discussion, referring mostly to the contribution of the CP to the development and convergence of the EU regions.

2. Literature review

The evaluation of the CP has been a topic of main research interest over the years. In a recent study by Butkus et al. (2019), the key features (researchers, period, the scope of analysis, method, results, and conditions for their application) of 42 papers published from 2001 to 2018, are summarized towards the evaluation of the CP. Moreover, Alexiadis (2020) recognizes that the convergence of EU regions is one of the most controversial issues in regional science. Earlier, it was reported by Dall'erba et al. (2006) that more than 100 studies investigate the impact of EU regional development policies. An analysis of only 11 of them took place, since, as it is reported by the authors, they are the only ones that are based on reliable data. This is followed by systematic summaries of research studies by Mohl and Hagen (2010) and Pinho et al. (2015). On top of that, Dall'erba and Fang (2017) gathered and evaluated 323 analyses from 17 econometric studies that were prepared from 1966 to 2013, while Pienkowski and Berkowitz (2015) also include a comprehensive literature analysis about the contribution of econometric analyses to the evaluation of CP, putting forward suggestions about how the reliability and usefulness of analyses can be enhanced.

As it emerges from literature, so far, the scientific community and policymakers have failed to agree on the impact of the CP on the development and convergence of the EU regions. Research results lead not only to different, but also conflicting results in many cases, identifying and analysing numerous sources of research heterogeneity and diversification.

However, the scientific debate is often focused on the lack of representative and reliable data for simulation of the CP, as is extensively described in the paper of Ederveen et al. (2003) for the first time. The authors point out that econometric analyses have several flaws due to the absence of data about funds allocation from the CP, especially at a regional level. Concluding that the researchers use either proxy or dummy variables, and this assumption does not contribute to reaching firm and reliable conclusions. They also refer to efforts made by the EU towards to development of a CP payments database, estimating that it will be made available soon.

Subsequently, the report of Rodriguez-Pose and Fratesi (2004) is the first comprehensive effort to address the issue of the lack of data about the allocation of resources from the CP at a regional level. The authors discuss the problems that they encountered and the efforts that they made to establish sufficient and reliable data for the simulation of the CP. They refer to the absence of a database about CP payments and the criticism that the EU has received from the European Court of Auditors for this, stressing the need to also consider the time lag that exists between the annual funding commitments and the actual payments that take place during the implementation of the CP. To cover this gap, primary data and data from annual implementation reports of the CP were processed by the researchers, highlighting, in many cases, the complete lack of data about the regional allocation of funds.

Later, comprehensive data about the allocation of resources from the CP at a regional level included in the study of Esposti and Bussoletti (2008). Precisely, the researchers report that to cover the gap from the absence of a central database about CP payments made at a regional level, data retrieved from the annual reports of CP payments made both regional and sectoral programs. Although they cover the ERDF, the ESF, the EAFRD and the EMFF, their analysis is limited to the Convergence regions (i.e., regions with Gross Domestic Product (GDP) per capita (p.c.) in Purchasing power standard (PPS) that is less than 75% of the EU regions

average, i.e., 47 to 48 regions, and only for the 1989-1999 period. Also, does not include resources from the CF.

Moreover, Mohl and Hagen (2010) include a comprehensive review of how a series of econometric studies simulate the funds of the CP. They highlight the failure to distribute regionally the funds of the sectoral programs that included in the annual reports of the EU. They also note that the allocation of funds that included in them differs significantly from the actual allocation of funds from the CP to the regions. They also stress the need for the actual payments to be considered rather than the annual funding commitments, reporting that, due to the time lag, there can be major differences in the results. The above two issues (regional dimension and actual annual payments of CP funds) are the main flaws in a group of surveys (Bouayad-Agha et al., 2013; Dall'èrba et al., 2009; Dall'èrba and Le Gallo, 2008; Fayolle and Lecuyer, 2000; Le Gallo et al., 2011; Puigcerver-Peñalver, 2007; Rodríguez-Pose and Garcilazo, 2015; Rodríguez-Pose and Novak, 2013), where it is reported that the funds of the CP were taken from official publications or they were made available to them by the EU, listing, however, limited information, or no information at all, about the amount of the funds that were included in the analysis, and their distribution in space and time.

After, Fratesi and Perucca (2014) evaluated the CP in regions of various countries in Central and Eastern Europe, taking into consideration only payments by the ERDF and the CF from the database of the SWECO (2008), allocated to four areas of intervention and only for the 2004-2006 period. The same database was also used by Butkus et al. (2019) to assess the impact of the CP on EU regions for the 2000-2006 period. Also, Çolac (2015) includes in his article a rich literature on the study of the convergence, absolute, conditional β -convergence and σ -convergence of 33 states of the Central and Eastern European (CEE) and South Eastern European. What is more, Fiaschi et al. (2018) characteristically report that the use of actual payments is the most accurate variable for the simulation of the CP. However, due to the limited availability of data, and to expand the period time of their analysis beyond the 2000-2006 period, they developed a complex methodology about the distribution of actual payments to the regions, according to the GDP p.c. upon commencement of the programming period, assuming that the level of support remains constant over time.

In more recent literature, research that is based on the counterfactual method, and more specifically, on the regression discontinuity technique (Lemieux, 2010) can be found more and more often (Becker et al., 2010, 2013, 2018; Cerqua and Pellegrini, 2018; Crescenzi and Giua, 2020; Gagliardi and Percoco, 2017; Pellegrini et al., 2013; Percoco, 2017). In these research studies, the CP is simulated by using dummy variable, and takes binary values “0” and “1” depending on whether the region under investigation belongs, or not, to regions that are eligible to receive support from the CP. Therefore, it emerges that the CP is evaluated indirectly, through the benchmarking of “similar” regions “with and without the intervention”. The reason of using the binary dummy variable “0-non beneficiary” and “1-beneficiary” regions for the simulation of the CP is also followed by a group of researchers (Boldrin and Canova, 2001; De Dominicis, 2014; Falk and Franz, 2008; LeSage and Fischer, 2008; Ramajo et al., 2008), and although they are based on the neoclassical model of development, they do not take the allocation of CP resources into account.

The most recent research paper that uses actual payments for the simulation of the CP is the paper of Cerqua and Pellegrini (2018). In specific, by modifying the regression discontinuity method and introducing the variable of level of support, they estimate that the CP has a positive impact on the economic development of the EU regions. They report, without providing a more detailed reference, that, a result of data that were made available to them by the EU and external consultants, payments through operational programs by all five funds of the CP were distributed regionally for each year of the 1994-1999 and 2000-2006 programming periods, allowing thus an analysis that expands across 208 regions to be conducted with accuracy, which was not possible in the past.

3. Method and data

The estimation of the contribution of the CP to the development and convergence of the EU regions is made through the implementation of an econometric model that is founded on the neoclassical growth theory of Solow-Swan (1956) and is described in detail in the papers of Barro and Sala-Martin (1991, 1992), Sala-Martin (1996). Without underestimating the

flaws of the model, as they have been highlighted by several researchers (Durlauf, 2009; Quah, 1993; Rodrik, 2012), it is selected to be used in this paper, in order to enable the benchmarking of results, since it is used by the overwhelming majority of empirical analyses that can be found in the literature. The alternative option that refers to the application of the counterfactual method does not qualify, since it evaluated the CP indirectly, without taking into account the key variable that refers to the application of the CP, i.e., the level of support that is expressed by the allocation of funds. Furthermore, the limitation that applies to the application of the counterfactual method for “similar” regions that were either “beneficiaries” or “non-beneficiaries” of the CP, is extremely difficult to be met. In more detail, in the neoclassical growth model, development is expressed by the rate of change of the GDP p.c. in PPS, and represents the dependent variable of the model, whereas its mathematical formulation in the case of a panel data layout, i.e., combination of cross-sectional that correspond to regions and time series, is the following (Alexiadis et al., 2010; Maynou et al. 2016; Mohl and Hagen, 2010):

$$\frac{GDPPC_{i,t} - GDPPC_{i,t-1}}{GDPPC_{i,t-1}} = \beta_0 + \beta_1 \ln(GDPPC_{i,t-1}) + \beta_2 \ln(EUSF_{i,t}) + \beta_j \ln(X_{i,t}) + \mu_i + \lambda_t + u_{i,t} \quad (1)$$

where index i denotes the region ($i=1, \dots, N$), t the year ($t=2000, \dots, 2016$), $\beta_0, \beta_1, \beta_2$ and β_j the unknown coefficients that are determined by linear regression analysis. As independent variables are regarded the GDP p.c. in PPS with a time lag ($GDPPC_{i,t-1}$), the payments ($EUSF_{i,t}$) of the CP in €, which is also the key variable for the application of the CP, the contribution of which to development is investigated, and $X_{i,t}$ as independent variables that affect the conditions of development and convergence of regions, and may refer to the composition of the economy, employment, demographics, research and innovation, living conditions, etc.

In the literature (Bouayad-Agha et al., 2013; Esposti and Bussoletti, 2008; Islam, 2003), it is also recommended to use the constants μ_i and λ_t to take space and time heterogeneity into account. In specific, constant μ_i determines the non-measurable impact that the unique characteristics of each region that are constant in terms of time can have on the dependent variable. These characteristics can be associated with both inherent comparative advantages, or limitations, due to its geographical location and special structural and institutional characteristics that are identified on a national level, and which provide a different degree of freedom to each region that should be taken into consideration in the analysis. The disturbance term $u_{i,t}$ is also included, which follows a normal distribution with a mean value of zero and constant standard deviation $N(0, \sigma^2)$, and which is the remainder stochastic disturbance term of the sample, such as the omitted of independent variables that affect the dependent variable, measurement errors, and other random factors that are ignored in the mathematical expression of the model.

Convergence can be achieved if coefficient β_1 takes negative and statistically significant value during the evaluation of the model. The case, which is classified as b-convergence case, describes the process, during which, the poorer regions develop faster than the richer ones, reaching a common equilibrium in the long run, and resulting in a decrease in inequality. Additionally, the σ -convergence assumption can be identified as a process of decrease over time, of the dispersion of the GDP p.c. in the economies under investigation. The coefficient of variance (CV) is taken as a measure dispersion, which is defined as the ratio of standard deviation over the arithmetic mean. The two forms of convergence are considered as complementary, and in literature, it is recommended that they are examined simultaneously, since b-convergence provides the necessary, but not sufficient, condition for σ -convergence (Batabyal, 2017; Ederveen et al., 2003; Koudoumakis et al., 2019).

Regarding the data of this research, in order to cover the gap that was identified in the literature concerning the actual allocation of CP funds at a regional level, the details of payments that were announced by the EU on the 30th anniversary of its realization were selected to be used (European Commission, 2018). In more detail, in April 2018 the EU published, Table 1, the most complete historical data about payments from its budget made by the ERDF, the ESF the EAFRD, and the CF to 272 regions (NUTS 2) (Eurostat, 2018),

covering the 1986-2016 time period. In the publication, the distribution method of the CP funds on a regional level is described in detail, as well as an estimation of the actual annual allocation of payments, taking into account the time lag that exists between the payments that are made by the EU to member states and the actual payments that are made by member states during the implementation of the CP.

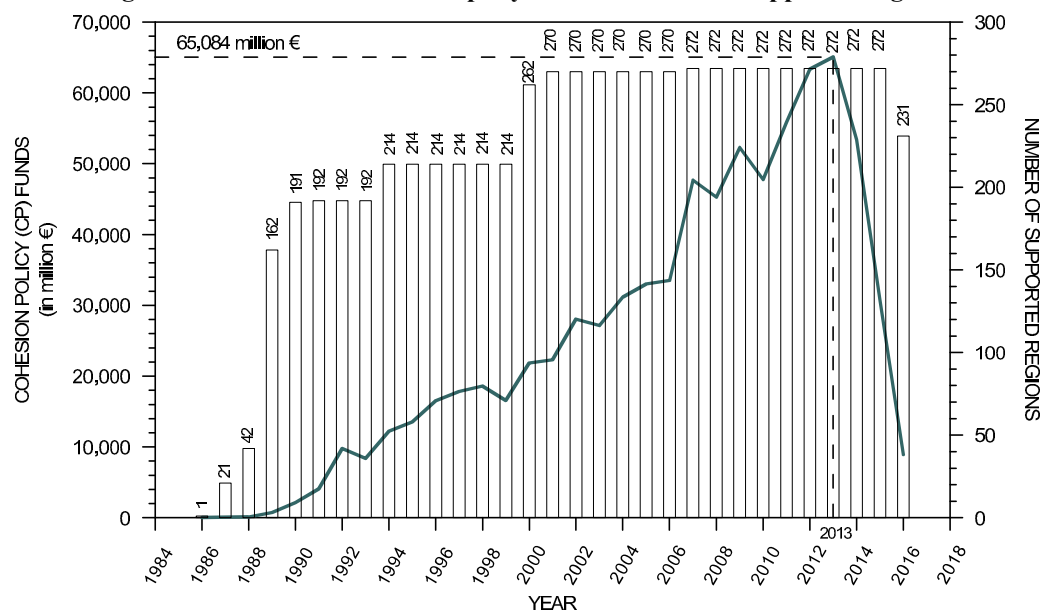
Table 1: Descriptive statistics measures of the CP funds over the 1986-2016 period

	Total funds	European Regional Development Fund	European Social Fund	European Agricultural Fund for Rural Development	Cohesion Fund
		(ERDF)	(ESF)	(EAFRD)	(CF)
Number of regions (N)	272	272	272	270	99
Sum	€787,946,112,663	€408,926,769,721	€137,003,749,868	€127,132,222,322	€114,883,370,752
Mean	€2,896,860,708	€1,503,407,242	€503,690,257	€470,860,083	€1,160,438,088
Median	€1,443,816,908	€686,711,593	€363,224,121	€267,222,882	€1,007,153,874
Max	€32,912,765,186 (ES61-Andalucía)	€21,999,684,856 (ES61-Andalucía)	€4,366,513,656 (ES61-Andalucía)	€4,092,010,590 (ES61-Andalucía)	€5,136,904,526 (PL12-Mazowieckie)
Min	€57,367,518 (FI20-Aland)	€10,748,849 (FI20-Aland)	€24,560,238 (FI20-Aland)	€1,419,704 (CZ01-Praha)	€62,533,046 (ES63-Ciudad Autónoma de Ceuta)
Standard deviation (σ_{n-1})	€3,809,937,084	€2,404,810,938	€505,278,748	€587,636,094	€911,201,504
Coefficient of variation (CV)	1.315	1.600	1.003	1.248	0.785
Max/Min	574	2.047	178	2.882	82

Source: European Commission (2018) and own processing.

Besides, from the progress in the allocation of the CP funds over time, Figure 1, it emerges that the first allocation of funds is recorded in 1986, and subsequently, especially from 1989 onwards, when the commencement of the first programming period (1989-1993) took place, with a growing rate of resources and several supported regions, the payments reach their maximum annual value in 2013, amounting to €65.1bn and 272 beneficiary regions. The declining trend is recorded from 2013 to 2016 and is due to the transition from the completion of the fourth programming period (2007-2013) to the commencement of the fifth on (2014-2020), the data of which have not been integrated yet.

Figure 1: Allocation of CP funds per year and number of supported regions.



Source: European Commission (2018) and own processing.

The remaining data that are input during the application of the econometric model, and refer to both the GDP p.c. in PPS and the independent variables $X_{i,t}$ are taken from the database of the Eurostat. The data were developed in the form of a panel, the growing use of which is due, inter alia, to their ability to reduce the problem of multicollinearity, i.e., the correlation on independent variables, as well as overcome the problem of heteroscedasticity that refers to a non-constant variance of the disturbance term in the linear model (Baltagi, 2005).

Prior to the application of the econometric model, and in order to address the strong heterogeneity of the EU regions, they are classified into three groups, according to the mean value of the GDP p.c. in PPS over the 2000-2017 period. The results of clustering the 272 regions are presented in Appendix A, Table A.1 while the descriptive statistics measures for the resources of the CP per group of regions are presented in Table 2.

Table 2: Descriptive statistics measures of the CP funds per group of regions

	GROUP (A) GDP p.c. in PPS<75%	GROUP (B) 75<GDP p.c. in PPS<90%	GROUP (C) GDP p.c. in PPS>90%	REGIONS OUTSIDE CLUSTERING
Number of regions (N)	65	51	121	35
Sum	€368,212,212,221	€180,367,182,016	€144,530,476,822	€94,836,241,604
Mean	€5,664,803,265	€3,536,611,412	€1,194,466,751	€2,709,606,903
Median	€4,167,849,709	€1,818,194,508	€694,038,893	€2,110,664,677
Max	€32,912,765,186 (ES61-Andalucia)	€14,138,130,664 (ES11-Galicia)	€9,392,688,857 (PT17-Lisboa)	€12,783,154,630 (EL30-Attiki)
Min	€302,393,879 (HR03-Jadranska Hrvatska)	€207,617,636 (BE34-Prov. Luxembourg)	€185,887,709 (BE10-Région de Bruxelles- Capitale)	€57,367,518 (FI20-Åland)
Standard deviation (σ_{n-1})	€5,358,701,364	€3,866,404,567	€1,194,466,751	€2,684,147,588
Coefficient of variation (CV)	0.946	1.093	1.166	0.991
Max/Min	109	68	51	223

Source: European Commission (2018) and own processing.

Therefore, the current research covers 237 regions or 87% of the EU regions, to which €693.110bn or 88% of the total funds are allocated, of which the 46.7% in Group A, the 22.9% in Group B and the 18.4% in Group C. The mean annual level of support is estimated at €202, €100, and €27 per citizen, which is equal to 1.63%, 0.63%, and 0.12% of the GDP, for Groups A, B and C, respectively. Moreover, the maximum annual support is €1,250 per citizen or 10.4% of the GDP for Group A, €1,060 per citizen or 6.8% of the GDP for Group B, and €439 per citizen or 2.3% of the GDP for Group C.

Much lower amounts of resources can be found in the literature. As indicated by Butkus et al. (2019) report payments of €149.8bn, Fratesi and Perucca (2014) €21.106bn, whereas Becker et al. (2010, 2013, 2018) report that the annual allocation of resources per programming period range from €10.3bn to €15.7bn. Besides, Pinho et al. (2015) report that payments amount to €28 per citizen or 1.41% of the GDP. Mohl and Hagen (2010) report payments ranging from €5.4 to €264.4 per citizen, while in the study of Esposti and Bussoletti (2008), they range from €148.9 to €443.2 per citizen. Further to that, Rodriguez-Pose and Fratesi (2004) indicate that funds are as high as 1.74% of the GDP for the Convergence regions, 0.94% of which were allocated from regional programs, and the remaining 0.84% from sectoral programs. It should be noted that 35 regions, to which €94.536bn or 12% of the total funds are allocated, are not classified into any group and are not part of the analysis, since they either present limited data or outlier residual values of the disturbance term upon implementation of the econometric model. It is characteristically reported that the following are not included in the analysis: all eight regions of Romania (RO), three out eight regions of Sweden (SE), some regions that include an entire member state, e.g. Estonia (EE00), Malta (MT00), Latvia (LV00), and also regions with special features, such as, for example, the region of Groningen (NL11) in the Netherlands, the special behaviour of which, due to exploitation of natural gas, has also been highlighted in other reports (Ederveen et al., 2003).

4. Results

The results from the application and test of goodness of fit of the econometric model for the assessment of the impact of the CP on the development and convergence of the EU regions are presented for Groups A, B and C in Table 3. Two cases can be identified, according to the number of independent variables that are included in the model: a) the basic model, which only includes as independent variables as the GDP p.c. in PPS with a time lag ($GDPPC_{i,t-1}$) and the CP payments in € ($EUSF_{i,t}$), as well as b) the modified model, which includes additional independent variables ($X_{i,t}$) that affect significantly the conditions for the development and convergence of the regions.

Table 3: Results and tests of goodness of fit of the model

	Basic model			Modified model		
Dependent variable	Annual rate of change of the GDP p.c. in PPS, $(GDPPC_{i,t}-GDPPC_{i,t-1})/GDPPC_{i,t-1}$					
Period of analysis	2000-2016					
Years, (t)	16					
Group of regions	A	B	C	A	B	C
Number of regions, (i)	65	51	121	65	51	121
Observations, (N)	1,026	812	1,904	1,017	812	1,904
Results						
Constant, β_0	0.466972***	0.815512***	1.119735***	0.667860***	1.256714***	1.165258***
Convergence, $\ln(GDPPC_{i,t-1})$, β_1	-0.057941***	-0.089318***	-0.106358***	-0.134659***	-0.176562***	-0.146355***
Speed of convergence				0.90%	1.21%	0.99%
Half time life ¹⁴				77 years	57 years	70 years
EU funds, (€), $\ln(EUSF)$, β_2	0.006311***	0.005085***	-0.000375	0.003470***	0.004460***	0.000214
Participation of secondary sector in GVA, (%), $\ln(GVAB)$, β_3				0.174608***	0.136294***	0.109927***
Goodness of fit tests						
1. Normality of residuals of disturbance term	NO	YES	YES	YES	YES	YES
Jarque Bera – JB statistics	63 (p=0%)	0.89 (p=64%)	1.7 (p=43%)	2.83 (p=24%)	0.84 (p=66%)	2.6 (p=28%)
2. Coefficient of determination, R^2	0.563356	0.663681	0.695341	0.625363	0.699741	0.724797
3. Akaike Information Criterion - AIC	-4.050578	-4.777151	-4.929839	-4.234655	-4.888104	-5.030471
4. Schwarz Criterion - SC	-3.656288	-4.383597	-4.527456	-3.832745	-4.488762	-4.625172
5. Hannan and Quinn Criterion - HQ	-3.900907	-4.626071	-4.781724	-4.082026	-4.734802	-4.881283
6. Absence of autocorrelation of residuals	YES	YES	YES	YES	YES	YES
Correlation coefficient of residuals, $r_{u(t), u(t-1)}$	0.138	0.177	0.094	0.128	0.180	0.070
7. Absence of multicollinearity	YES	YES	YES	YES	YES	YES
Variance Inflation Factor, (VIF)	2.29<10	2.97<10	3.28<10	2.67<10	3.33<10	3.63<10
Independent variables correlation coefficient	-	-	-	$r_{EUSF, GVAB}=-0.03$	$r_{EUSF, GVAB}=0.27$	$r_{EUSF, GVAB}=-0.02$
8. Absence of endogeneity	YES	YES	YES	YES	YES	YES
Correlation of independent variables and residuals of disturbance term	$r_{EUSF, u(t)}=-0.034$	$r_{EUSF, u(t)}=0.024$	$r_{EUSF, u(t)}=0.015$	$r_{EUSF, u(t)}=0.042$	$r_{EUSF, u(t)}=0.013$	$r_{EUSF, u(t)}=-0.009$
	$r_{GVAB, u(t)}=0.006$	$r_{GVAB, u(t)}=0.008$	$r_{GVAB, u(t)}=0.011$			

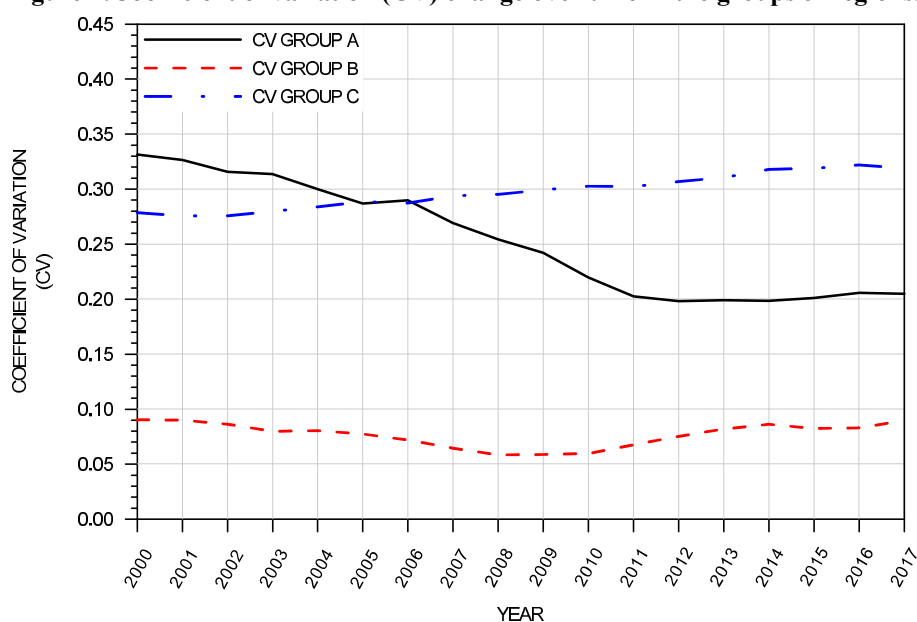
Statistical significance level, p: *** < 1%, ** < 5% και * < 10%

Source: Own processing.

According to the results of the basic model, for Group A, the assumption of normal distribution of residuals of the disturbance term is violated, as it is estimated through the statistical calculations of Jarque-Bera (1980). It is pointed out that the normality of the residuals of the disturbance term is an essential condition for the validity and reliability of the method of least squares, where the solution that is provided by the model is based (Arbia et al., 2005, Baltagi, 2005, Islam, 2003; Maynou et al., 2016). At the same time, the need is demonstrated to examine the possibility of increasing the explanatory capacity of the model, which is 56.3%, 66.4% and 69.5% for Groups A, B and C, respectively, as it emerges from the coefficient of determination R^2 . In this context, the explanatory capacity and goodness of fit of the modified model are examined through the addition of independent variables that are associated with the: a) economy, such as the percentage of participation in establishing the Gross Value Added (GVA) of the primary, secondary, and tertiary sectors, and the number of overnight stays of tourists, b) employment, such as the employment to population ratio, both overall and for employees with a tertiary education, in specific, and c) living conditions and demographics, such as population density, growth, life expectancy at birth, child mortality, and ageing index. From more than thirty alternative models that were examined in addition to the basic model, both individually and in combination with the above independent variables, it emerges that only the addition of the rate of participation of the secondary sector (GVAB) to the establishment of the GVA contributes to the satisfaction of the assumption of the normal distribution of residuals of the disturbance term throughout Groups. Also, the

explanatory potential of the modified model increases sufficiently, and amounts to 62.5%, 70% and 72.5% for Groups A, B and C, respectively, as it is presented in Table 3. It should be noted that the contribution of the manufacturing sector to development, also identifying it as the driving force behind it, has already been acknowledged from an early stage (Kaldor, 1967), while, nowadays, it plays a key role in regional development, mainly through the Strategy of Smart Specialization (Foray and Goenaga, 2013; Midelfart-Knarvik and Overman, 2002; Percoco, 2017). In terms of the effect that the sectoral composition of the economy has on development, it is reported that the negative impact of the service sector, especially in the cases where it grows disproportionately to the other two sectors of the economy, is described, and documented in the paper of Percoco (2017). At the same time, the development lag of regions that rely mainly on the primary sector is acknowledged by several researchers (Bussoletti and Esposti, 2004; Deller et al., 2003), and is attributed to the low level of technological development that can be utilized by the primary sector. Improvement is also shown by the criteria, that are used to test the model in terms of goodness of fit, providing evidence that the GVAB was fairly introduced as a new independent variable. The modified model also satisfies the following: a) the test of the absence of autocorrelation of the residuals of the disturbance term concerning the correlation of two successive values u_t and u_{t-1} , b) absence of multicollinearity test, i.e., the linear relationship between independent variables, and c) test of the absence of endogeneity for the model, i.e., the non-correlation of independent variables with the residuals of the disturbance term. In addition, the assumption of σ -convergence was examined for the three groups of regions, Figure 2, taking into account the progress of the CV over time. It emerges that there is a decrease in the dispersion of the development level of Group A, i.e., σ -convergence and a constant progress to slight increase in the dispersion of the development level of Groups B and C. It should be noted that the formulas for calculating the speed of convergence and the half-life time are described in detail by Arbia (2006).

Figure 2: Coefficient of variation (CV) change over time in the groups of regions.



Source: Own processing

5. Conclusion

The literature review revealed that, so far, the CP is evaluated by nearly the entire body of research, without reliable and representative data resulting from its implementation. This gap is attempted to be addressed by this paper, by utilizing for the first time, the most complete and accurate historical data that were published by the EU in April 2018, regarding payments by the CP funds made to 272 regions, spanning over the 1986-2016 period. In addition to covering the four main funds of the CP, these data address the two main disadvantages of the data that have been made available so far, since they include the regional dimension of

resources from sectoral programs and take into consideration in the establishment of the annual allocation of payments, the time lag that exists between the payments by the EU to member states and the actual payments made by the member states during the implementation of the CP interventions.

The actual allocation of CP funds at a regional level, along with the participation of the secondary sector, shaped up the econometric model of the neoclassical theory of development with a high explanatory capacity and the ability to satisfy goodness of fit testing and the simplicity principle. Therefore, the estimated coefficients of the econometric model are best, linear, and unbiased estimators that can be used to conclude and to forecast. This can also serve as the basis for expanding research and applying a more in-depth research approach within specific scopes, as well as evaluating the CP funds.

From the implementation of the econometric model, it was possible to calculate the positive and statistically significant contribution of CP funds to the development and convergence of regions with a GDP p.c. lower than 75% and 90% of the EU regions, i.e., Groups A and B, respectively, while for regions with GDP p.c. higher than 90% of the EU average, i.e., Group C, the contribution of the CP was estimated as positive but not statistically significant. It should be noted that the participation of the secondary sector is positive and statistically significant for the development and convergence of all the three groups of EU regions. Moreover, all the three groups of regions converge (β -convergence) during the period under investigation (2000-2016). The regions of Group B converge faster than the regions of Group C and Group A. However, in all the cases, the corresponding rate is lower than 2% to 7%, as it can be bound in the literature (Badinger et al., 2004). More specific, the rate of convergence of regions in Group B is 1.21% while it is 0.99% in Group C, and 0.90% in Group A, in general, in accordance with the results reported by Karras (2010) for regions of Europe. This conclusion gives weight to the view of several researchers (Becker et al., 2013; Ederveen et al., 2003; Rodriguez-Pose and Garcilazo, 2015) that regions with developed institutional and administrative capacity, at it, applies, in regions on Group B, make more efficient use of CP funds. It is also in concordance with what is reported by Crescenzi (2009) and Bondonio and Greenbaum (2006), that regions with a relatively higher level of development, CP programs are more effective, leading to the paradoxical conclusion that the CP achieves less where more is needed, i.e., in less developed regions.

It is also emerging that there is a decrease in the dispersion of the development level of Group A, which implies σ -convergence, is interrupted after 2011. However, this is in fact what is believed to be the results of the economic crisis of 2009. At the same, it is found out that there is a stable to a slight increase in the dispersion of the development level of Groups B and C, confirming that β -convergence is a necessary, but not sufficient condition to also satisfy σ -convergence. The low rate of convergence and low positive contribution of CP resources indicate that there is much more room for improvement when it comes to the effectiveness of the CP.

It can be understood that the provision of reliable and representative data from the application of the CP is in everyone's interest, and mostly the EU's since it can evaluate and communicate the significant benefits of its policy on a well-grounded basis, improving the design of new programs with the CP, as well.

6. References

- Alexiadis, Stylianos., Ladias, Christos Ap. and Polo, Antoneta. (2010) 'Converging and Diverging Regions in the EU: Implications for Regional Policy', *Regional Science Inquiry*, Vol. II, (2), pp. 55–70.
- Alexiadis, Stylianos (2020) 'Regional Convergence: Theory and Empirics', *Regional Science Inquiry*, Vol. XII, (1), pp. 245–252.
- Arbia, G. (2006) *Spatial Econometrics, Statistical Foundations and Applications to Regional Convergence*. 1st edn. Berlin Heidelberg: Springer-Verlag. doi: 10.1007/3-540-32305-8.
- Arbia, G., Basile, R. and Piras, G. (2005) Using Spatial Panel Data in Modelling Regional Growth and Convergence, SSRN Electronic Journal. doi: 10.2139/ssrn.936321.
- Bachtrögl, J., Fratesi, U. and Perucca, G. (2020) 'The influence of the local context on the implementation and impact of EU Cohesion Policy', *Regional Studies*, 54(1), pp. 21–34. doi: 10.1080/00343404.2018.1551615.

- Badinger, H., Müller, W. G. and Tondl, G. (2004) 'Regional convergence in the European Union 1985-1999: A spatial dynamic panel analysis', *Regional Studies*, 38(3), pp. 241–253. doi: 10.1080/003434042000211105.
- Baltagi, B. H. (2005) *Econometric analysis of panel data*. 3rd edn. J. Wiley & Sons.
- Barro, R. J. and Sala-i-Martin, X. X. (1992) 'Convergence Xavier Sala-i-Martin', *Journal of Political Economy*, 100(2), pp. 223–251. doi: 10.1086/261816.
- Barro, R. J. and Sala-i-Martin, X. X. (1991) 'Convergence Across States and Regions', *Brookings Papers on Economic Activity*, 1991(1), p. 107. doi: 10.2307/2534639.
- Batabyal, A. (2017) 'Output, Growth, and Convergence in a Creative Region: An Analysis of Some Measurement Issues', *Regional Science Inquiry*, Vol. IX, (1), pp. 11–19.
- Becker, B. S. O., Egger, P. H. and Ehrlich, M. Von (2013) 'Absorptive capacity and the growth and investment effects of regional transfers: A regression discontinuity design with heterogeneous treatment effects', *American Economic Journal: Economic Policy*, 5(4), pp. 29–77. doi: 10.1257/pol.5.4.29.
- Becker, S. O., Egger, P. H. and von Ehrlich, M. (2010) 'Going NUTS: The effect of EU Structural Funds on regional performance', *Journal of Public Economics*. Elsevier B.V., 94(9–10), pp. 578–590. doi: 10.1016/j.jpubeco.2010.06.006.
- Becker, S. O., Egger, P. H. and von Ehrlich, M. (2018) 'Effects of EU Regional Policy: 1989-2013', *Regional Science and Urban Economics*. Elsevier Ltd, 69 (December 2017), pp. 143–152. doi: 10.1016/j.regsciurbeco.2017.12.001.
- Becker, S. O., Egger, P. H. and Von Ehrlich, M. (2012) 'Too much of a good thing? On the growth effects of the EU's regional policy', *European Economic Review*. Elsevier, 56(4), pp. 648–668. doi: 10.1016/j.euroecorev.2012.03.001.
- Berkowitz, P., Monfort, P. and Pieńkowski, J. (2020) 'Unpacking the growth impacts of European Union Cohesion Policy: transmission channels from Cohesion Policy into economic growth', *Regional Studies*. Taylor & Francis, 54(1), pp. 60–71. doi: 10.1080/00343404.2019.1570491.
- Boldrin, M., and Canova, F. (2001) 'Inequality and convergence in Europe's regions: reconsidering European regional policies', *Economic Policy*, 16(32), 206–253. doi:10.1111/1468-0327.00074.
- Bondonio, D. and Greenbaum, R. T. (2006) 'Do business investment incentives promote employment in declining areas?: Evidence from EU Objective-2 regions', *European Urban and Regional Studies*, 13(3), pp. 225–244. doi: 10.1177/0969776406065432.
- Bouayad-Agha, S., Turpin, N. and Védrine, L. (2013) 'Fostering the Development of European Regions: A Spatial Dynamic Panel Data Analysis of the Impact of Cohesion Policy', *Regional Studies*, 47(9), pp. 1573–1593. doi: 10.1080/00343404.2011.628930.
- Bussoletti, S. and Esposti, R. (2004) 'Regional Convergence, Structural Funds and the Role of Agriculture in the EU', *Quaderno de Ricerca*, p. 42. Available at: <https://www.econbiz.de/Record/regional-convergence-structural-funds-and-the-role-of-agriculture-in-the-eu-a-panel-data-approach-espsti-roberto/10004990564>.
- Butkus, M., Maciulyte-Sniukiene, A. and Matuzeviciute, K. (2020) 'Heterogeneous growth outcomes of the EU's regional financial support mediated by institutions with some empirical evidences at NUTS 3 level', *Review of Regional Research*, 40(1), pp. 33–66. doi: 10.1007/s10037-019-00137-z.
- Çolac, O. (2015) 'Convergence Revisited: Case of EU and Eastern Europe', *Regional Science Inquiry*, Vol. VII, (1), pp. 69–81.
- Cerqua, A. and Pellegrini, G. (2018) 'Are we spending too much to grow? The case of Structural Funds', *Journal of Regional Science*, 58(3), pp. 535–563. doi: 10.1111/jors.12365.
- Crescenzi, R. (2009) 'Undermining the principle of concentration? European union regional policy and the socio-economic disadvantage of European regions', *Regional Studies*, 43(1), pp. 111–133. doi: 10.1080/00343400801932276.
- Crescenzi, R., Fratesi, U. and Monastiriotis, V. (2020) 'Back to the member states? Cohesion Policy and the national challenges to the European Union', *Regional Studies*, 54(1), pp. 5–9. doi: 10.1080/00343404.2019.1662895.
- Crescenzi, R. and Giua, M. (2020) 'One or many Cohesion Policies of the European Union? On the differential economic impacts of Cohesion Policy across member states', *Regional Studies*, 54(1), pp. 10–20. doi: 10.1080/00343404.2019.1665174.
- Dall'erba, S. and Groot, H. L. F. De (2006) 'A Meta-Analysis of EU Regional Policy Evaluation', Paper presented at the 53rd Annual North American Meetings of the RSAI, Toronto., pp. 1–20.
- Dall'Erba, S. and Fang, F. (2017) 'Meta-analysis of the impact of European Union Structural Funds on regional growth', *Regional Studies*, 51(6), pp. 822–832. doi: 10.1080/00343404.2015.1100285.
- Dall'erba, S., Guillain, R. and Le Gallo, J. (2009) 'Impact of structural funds on regional growth: How to reconsider a 9-year-old black box', *Région et Développement*, 2009–30, pp. 77–100.

- Dall'erba, S. and Le Gallo, J. (2008) 'Regional convergence and the impact of European structural funds over 1989-1999: A spatial econometric analysis', *Papers in Regional Science*, 87(2), pp. 219–244. doi: 10.1111/j.1435-5957.2008.00184.x.
- De Dominicis, L. (2014) 'Inequality and Growth in European Regions: Towards a Place-based Approach', *Spatial Economic Analysis*, 9(2), pp. 120–141. doi: 10.1080/17421772.2014.891157.
- Deller, S. C., Gould, B. W. and Jones, B. (2003) 'Agriculture and Rural Economic Growth', *Journal of Agricultural and Applied Economics*, 35(3), pp. 517–527. doi: 10.1017/s107407080002825x.
- Durlauf, S. N. (2009) 'The rise and fall of cross-country growth regressions', *History of Political Economy*, 41(SUPPL.1), pp. 315–333. doi: 10.1215/00182702-2009-030.
- Ederveen, S. et al. (2003) *Funds and Games: The Economics of European Cohesion Policy*, ENEPRI Occasional Paper. Available at: https://www.researchgate.net/publication/5014355_Funds_and_Games_The_Economics_of_European_Cohesion_Policy.
- Esposti, R. and Bussoletti, S. (2008) 'Impact of Objective 1 funds on regional growth convergence in the European Union: A panel-data approach', *Regional Studies*, 42(2), pp. 159–173. doi: 10.1080/00343400601142753.
- European Commission (2018) <https://cohesiondata.ec.europa.eu/stories/s/Historic-EU-payment-data-by-region-NUTS-2-/47md-x4nq/>, Initial access on 29.10.2019 and check for publication of up-dated data on 16.05.2020.
- European Union (2016) 'Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union (Tfeu)', Official Journal, C 202/01 (Article 174). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C:2016:202:FULL>.
- Eurostat (2018) *Eurostat Regional Yearbook*. 2018 edition. doi: 10.2785/231975.
- Eurostat Database, <https://ec.europa.eu/eurostat/web/regions/data/database>.
- Falk, M. and Sinabell, F. (2008) 'The Effectiveness of Objective 1 Structural Funds in the EU15: New Empirical Evidence from NUTS 3 Regions', (September 2015).
- Fayolle, J. and Lecuyer, A. (2000) 'Regional growth, national context and the European Structural Funds: An empirical appraisal', *Europe and the Politics of Capabilities*, (April), pp. 140–162. doi: 10.1017/CBO9780511489075.012.
- Fiaschi, D., Lavezzi, A. M. and Parenti, A. (2018) 'Does EU cohesion policy work? Theory and evidence', *Journal of Regional Science*, 58(2), pp. 386–423. doi: 10.1111/jors.12364.
- Foray, D., and Goenaga, X. (2013) 'The goals of smart specialisation, JRC Scientific and Policy Report (S3 Policy Brief Series No. 01). doi: 10.2791/20158.
- Fratesi, U. and Perucca, G. (2014) 'Territorial capital and the effectiveness of cohesion policies: An assessment for CEE regions', *Investigaciones Regionales*, 29(29), pp. 165–191.
- Fratesi, U. and Wishlade, F. G. (2017) 'The impact of European Cohesion Policy in different contexts', *Regional Studies*. Taylor & Francis, 51(6), pp. 817–821. doi: 10.1080/00343404.2017.1326673.
- Gagliardi, L. and Percoco, M. (2017) 'The impact of European Cohesion Policy in urban and rural regions', *Regional Studies*, 51(6), pp. 857–868. doi: 10.1080/00343404.2016.1179384.
- Guastella, G. and Timpano, F. (2010), 'Spillover Diffusion and Regional Convergence: A Gravity Approach', *Regional Science Inquiry Journal*, Vol. II (2), pp. 71–82.
- Islam, N. (2003) 'What have we learnt from the convergence debate?', *Journal of Economic Surveys*, 17(3), pp. 309–362. doi: 10.1111/1467-6419.00197.
- Jarque, C. M. and Bera, A. K. (1980) 'Efficient tests for normality, homoscedasticity and serial independence of regression residuals', *Economics Letters*, 6(3), pp. 255–259. doi: 10.1016/0165-1765(80)90024-5.
- Kaldor, N. (1967) 'Strategic Factors in Economic Development'. New York State School of Industrial and Labor Relations, Cornell University, Ithaca.
- Karras, G. (2010), 'Regional Economic Growth and Convergence, 1950-2007: Some Empirical Evidence', *Regional Science Inquiry Journal*, Vol. II, (1), pp. 11–24.
- Koudoumakis, P., Botzoris, G., Protopapas, A. and Profillidis V., (2019) 'The Impact of the Economic Crisis in the Process of Convergence of the Greek Regions', *Regional Science Inquiry Journal*, Vol. XI (1), pp. 25–32.
- Krugman, P. (1991) 'Increasing returns and economic geography', *Journal of Political Economy*, 99(3), pp. 483–499. doi: 10.1086/261763.
- Le Gallo, J., Dall'erba, S. and Guillain, R. (2011) 'The local versus global dilemma of the effects of structural funds', *Growth and Change*, 42(4), pp. 466–490. doi: 10.1111/j.1468-2257.2011.00564.x.
- Lee, D. S. and Lemieux, T. (2010) 'Regression Discontinuity designs in economics', *Journal of Economic Literature*, 48(2), pp. 281–355. doi: 10.1257/jel.48.2.281.
- LeSage, J. P. and Fischer, M. M. (2008) 'Spatial growth regressions: Model specification, estimation and interpretation', *Spatial Economic Analysis*, 3(3), pp. 275–304. doi: 10.1080/17421770802353758.

- Manzella, G. P. and Mendez, C. (2009) 'The turning points of EU Cohesion policy', Working Paper Report to Barca Report, (January), pp. 1–28.
- Maynou, L. et al. (2016) 'The Impact of Structural and Cohesion Funds on Eurozone Convergence, 1990–2010', *Regional Studies*, 50(7), pp. 1127–1139. doi: 10.1080/00343404.2014.965137.
- Midelfart-Knarvik, K. H. and Overman, H. G. (2002) 'Delocation and European integration: is structural spending justified?', *Economic Policy*, 17(October), pp. 321–359. doi: 10.1111/1468-0327.00091.
- Mohl, P. and Hagen, T. (2010) 'Do EU structural funds promote regional growth? New evidence from various panel data approaches', *Regional Science and Urban Economics*. Elsevier B.V., 40(5), pp. 353–365. doi: 10.1016/j.regsciurbeco.2010.03.005.
- Pellegrini, G. et al. (2013) 'Measuring the effects of European Regional Policy on economic growth: A regression discontinuity approach', *Papers in Regional Science*, 92(1), pp. 217–233. doi: 10.1111/j.1435-5957.2012.00459.x.
- Percoco, M. (2017) 'Impact of European Cohesion Policy on regional growth: does local economic structure matter?', *Regional Studies*. Taylor & Francis, 51(6), pp. 833–843. doi: 10.1080/00343404.2016.1213382.
- Piattoni, S. and Polverari, L. (2016) *Handbook on Cohesion Policy in the EU*, Handbook on Cohesion Policy in the EU. doi: 10.4337/9781784715670.
- Pieńkowski, J. and Berkowitz, P. (2015) 'Econometric assessments of Cohesion Policy growth effects: How to make them more relevant for policy makers? - Regional Policy - European Commission'. Available at: https://ec.europa.eu/regional_policy/sources/docgener/work/2015_02_econ_assess.pdf.
- Pinho, C., Varum, C. and Antunes, M. (2015) 'Under What Conditions Do Structural Funds Play a Significant Role in European Regional Economic Growth? Some Evidence from Recent Panel Data', *Journal of Economic Issues*, 49(3), pp. 749–771. doi: 10.1080/00213624.2015.1072382.
- Puigcerver-Peñalver, M.-C. (2007) 'The impact of Structural Funds policy on European regions' growth: a theoretical and empirical approach', *European Journal of Comparative Economics*, 4, pp. 179–208.
- Quah, D. (1993) 'Galton's Fallacy and Tests of the Convergence Hypothesis', *The Scandinavian Journal of Economics*, 95(4), pp. 427–443.
- Ramajo, J. et al. (2008) 'Spatial heterogeneity and interregional spillovers in the European Union: Do cohesion policies encourage convergence across regions?', *European Economic Review*, 52(3), pp. 551–567. doi: 10.1016/j.euroecorev.2007.05.006.
- Rodríguez-Pose, A. and Fratesi, U. (2004) 'Between development and social policies: The impact of European Structural Funds in Objective 1 regions', *Regional Studies*, 38(1), pp. 97–113. doi: 10.1080/00343400310001632226.
- Rodríguez-Pose, A. and Garcilazo, E. (2015) 'Quality of Government and the Returns of Investment: Examining the Impact of Cohesion Expenditure in European Regions', *Regional Studies*, 49(8), pp. 1274–1290. doi: 10.1080/00343404.2015.1007933.
- Rodríguez-Pose, A. and Novak, K. (2013) 'Learning processes and economic returns in European pdf.Cohesion policy', *Investigaciones Regionales*, (25), pp. 7–26.
- Rodrik, D. (2012) 'Why We Learn Nothing from Regressing Economic Growth on Policies', *Seoul Journal of Economics*, 25(2), pp. 137–151.
- Romer, P. M. (1986) 'Increasing Returns and Long-Run Growth', *Journal of Political Economy*, 94(5), pp. 1002–1037. doi: 10.1086/261420.
- Sala-I-Martin, X. X. (1996) 'Regional cohesion: Evidence and theories of regional growth and convergence', *European Economic Review*, 40(6), pp. 1325–1352. doi: 10.1016/0014-2921(95)00029-1.
- Solow, R. M. (1956) 'A Contribution to the Theory of Economic Growth', *The Quarterly Journal of Economics*, 70(1), pp. 65–94. Available at: <http://www.jstor.org/stable/1884513>.
- Swan, T. W. (1956) 'Economic growth and capital accumulation', *Economic Record*, 32(2), pp. 334–361. doi: 10.1111/j.1475-4932.1957.tb01279.x.
- SWECO (2008) Final Report - ERDF and CF Regional Expenditure. Available at: https://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/expost2006/expenditure_final.

Appendix A

Table A.1: Classification of regions into groups

Num	Region	Group	Num	Region	Group	Num	Region	Group	Num	Region	Group
1	AT11 - Burgenland	B	56	DE92 - Hannover	C	111	ES70 - Canarias	B	166	IT11 - Provincia Autonoma di Bolzano	C
2	AT12 - Niederösterreich	C	57	DE93 - Linz	B	112	FI19 - Länsi-Suomi	C	167	IT12 - Provincia Autonoma di Trento	C
3	AT13 - Wien	C	58	DE94 - West-Ems	C	113	FI18 - Hälsinki-Uusimaa	C	168	IT13 - Veneto	C
4	AT21 - Kärnten	C	59	DE11 - Düsseldorf	C	114	FI19 - Etelä-Suomi	C	169	IT14 - Friuli-Venezia Giulia	C
5	AT22 - Steiermark	C	60	DEA3 - Köln	C	115	FI19 - Pohjois- ja Itä-Suomi	C	170	IT15 - Emilia-Romagna	C
6	AT31 - Oberösterreich	C	61	DEA3 - Münster	C	116	FI20 - Åland	C*	171	IT11 - Toscana	C
7	AT32 - Salzburg	C	62	DEA4 - Demold	C	117	FR10 - Ile de France	C	172	IT12 - Umbria	C
8	AT33 - Tirol	C	63	DEA5 - Aynberg	C	118	FR21 - Champagne-Ardenne	C	173	IT13 - Marche	C
9	AT34 - Vorarlberg	C	64	DEB1 - Koblenz	C	119	FR22 - Picardie	B	174	IT14 - Lazio	C*
10	BE10 - Région de Bruxelles-Capitale	C	65	DEB2 - Trier	C	120	FR23 - Haute-Normandie	C	175	IT10 - Liguria	A
11	BE21 - Prov. Antwerpen	C	66	DEB3 - Rheinlissen-Pfalz	C	121	FR24 - Centre	C	176	LU00 - Luxembourg	C
12	BE22 - Prov. Limburg	C	67	DEB4 - Saarland	C	122	FR25 - Basque-Normandie	C	177	LU01 - Larvija	A*
13	BE23 - Prov. Ost-Vlanderen	C	68	DEB5 - Dresden	C	123	FR26 - Bourgogne	C	178	MT00 - Malta	B*
14	BE24 - Prov. Vlaams-Brabant	C	69	DEB6 - Chemnitz	B	124	FR30 - Nord - Pas-de-Calais	B	179	NL11 - Groningen	C
15	BE25 - Prov. West-Vlanderen	C	70	DEB7 - Leipzig	C	125	FR41 - Lorraine	B	180	NL12 - Friesland	C
16	BE31 - Prov. Brabant Wallon	C*	71	DEB8 - Sachsen-Anhalt	B	126	FR42 - Alsace	C	181	NL13 - Drenthe	C
17	BE32 - Prov. Hainaut	B	72	DEB9 - Schleswig-Holstein	C	127	FR43 - Franche-Comté	B	182	NL21 - Overijssel	C
18	BE33 - Prov. Liège	B	73	DEB9 - Thüringen	B	128	FR51 - Pays de la Loire	C	183	NL22 - Gelderland	C
19	BE34 - Prov. Luxembourg	B	74	DK01 - Hovedstaden	C	129	FR52 - Bretagne	C	184	NL23 - Flevoland	C
20	BE35 - Prov. Namur	B	75	DK02 - Sjælland	B	130	FR53 - Poitou-Charentes	B	185	NL31 - Utrecht	C
21	BG31 - Severozapaden	A	76	DK03 - Sydlandmark	C	131	FR61 - Aquitaine	C	186	NL32 - Noord-Holland	C
22	BG32 - Severen iztočinen	A	77	DK04 - Midtjylland	C	132	FR62 - Midi-Pyrénées	C	187	NL33 - Zuid-Holland	C
23	BG33 - Severozachodni	A	78	DK05 - Nordjylland	C	133	FR63 - Limousin	B	188	NL34 - Zeeland	C
24	BG34 - Yugozachodni	A	79	EL00 - Eski	A*	134	FR71 - Rhône-Alpes	C	189	NL41 - Noord-Brabant	C
25	BG41 - Yugozapaden	A	80	EL40 - Attiki	C*	135	FR72 - Auvergne	B	190	NL42 - Limburg	C
26	BG42 - Yugozentralni	A	81	EL41 - Voreto Aigato	A	136	FR81 - Languedoc-Roussillon	B	191	PL11 - Łódź	C
27	CY00 - Kypros	C	82	EL42 - Noto Aigato	A	137	FR82 - Provence-Alpes-Côte d'Azur	C	192	PL12 - Mazowieckie	B
28	CZ01 - Praha	C	83	EL43 - Kriti	A	138	FR83 - Corse	B	193	PL21 - Malopolskie	A
29	CZ02 - Stredni Čechy	B	84	EL51 - Anatoliki Makedonia, Thaki	A	139	FR91 - Guadeloupe	A	194	PL22 - Śląskie	A
30	CZ03 - Jihozapad	A	85	EL52 - Kentriki Makedonia	A	140	FR92 - Martinique	B	195	PL31 - Lubelskie	A
31	CZ04 - Severozapad	A	86	EL53 - Dytiki Makedonia	A*	141	FR93 - Guyane	A	196	PL32 - Podkarpackie	A
32	CZ05 - Severovýchod	A	87	EL54 - Ipeiros	A	142	FR94 - Réunion	A	197	PL33 - Świętokrzyskie	A
33	CZ06 - Jihovýchod	A	88	EL61 - Thessalia	A	143	HR03 - Jadranska Hrvatska	A	198	PL34 - Podlaskie	A
34	CZ07 - Stredni Morava	A	89	EL62 - Ionia Nisia	B*	144	HR04 - Kontinentální Hrvatska	A	199	PL41 - Wielkopolskie	A
35	CZ08 - Moravskoslezsko	A	90	EL63 - Dytiki Ellada	A	145	HU10 - Közép-Magyarország	C*	200	PL42 - Zachodniopomorskie	A
36	DE11 - Stuttgart	C*	91	EL64 - Sterea Ellada	A	146	HU21 - Közép-Dunántúl	A	201	PL43 - Lubuskie	A
37	DE12 - Karlsruhe	C	92	EL65 - Peloponisos	A	147	HU22 - Nyugat-Dunántúl	A	202	PL51 - Dolnośląskie	A
38	DE13 - Freiburg	C	93	ES11 - Galicia	B	148	HU23 - Dél-Dunántúl	A	203	PL52 - Opolskie	A
39	DE14 - Tübingen	C	94	ES12 - Principado de Asturias	B	149	HU31 - Észak-Magyarország	A	204	PL61 - Kujawsko-Pomorskie	A
40	DE21 - Oberbayern	C	95	ES13 - Cantabria	B	150	HU32 - Észak-Alföld	A	205	PL62 - Warmińsko-Mazurskie	A
41	DE22 - Niederbayern	C	96	ES21 - País Vasco	C	151	HU33 - Dél-Alföld	A	206	PL63 - Pomorskie	A
42	DE23 - Oberpfalz	C	97	ES22 - Comunidad Foral de Navarra	C	152	IE01 - Border, Midland and Western	C*	207	PT11 - Norte	A
43	DE24 - Oberfranken	C	98	ES23 - La Rioja	C	153	IE02 - Southern and Eastern	C*	208	PT15 - Algarve	B
44	DE25 - Mittelfranken	C	99	ES24 - Aragón	C	154	ITC1 - Piemonte	C	209	PT16 - Centre	A
45	DE26 - Unterfranken	C	100	ES30 - Comunidad de Madrid	C	155	ITC2 - Valle d'Aosta/Vallee d'Aoste	C	210	PT17 - Lisboa	B
46	DE27 - Schwaben	C	101	ES41 - Castilla y León	C	156	ITC3 - Liguria	C	211	PT18 - Alentejo	A
47	DE30 - Berlin	C	102	ES42 - Castilla-La Mancha	B	157	ITC4 - Lombardia	C	212	PT20 - Região Autónoma dos Açores	A
48	DE40 - Brandenburg	C	103	ES43 - Extremadura	A	158	ITF1 - Abruzzo	C	213	PT30 - Região Autónoma da Madeira	B*
49	DE50 - Bremen	C	104	ES51 - Cataluña	C	159	ITF2 - Molise	B	214	RO11 - Nord-Vest	A*
50	DE60 - Hamburg	C	105	ES52 - Comunidad Valenciana	B	160	ITF3 - Campania	A	215	RO12 - Centre	A
51	DE71 - Darmstadt	C	106	ES53 - Illes Balears	C	161	ITF4 - Puglia	A	216	RO21 - Nord-Est	A
52	DE72 - Gießen	C	107	ES61 - Andalucía	A	162	ITF6 - Calabria	B	217	RO22 - Sud-Est	A*
53	DE73 - Kassel	C	108	ES62 - Región de Murcia	B	163	ITF6 - Calabria	A	218	RO31 - Sud - Muntenia	A*
54	DE80 - Mecklenburg-Vorpommern	B	109	ES63 - Ciudad Autónoma de Ceuta	B	164	ITG1 - Sicilia	A	219	RO32 - Bucuresti - Ilfov	C*
55	DE91 - Braunschweig	C*	110	ES64 - Ciudad Autónoma de Melilla	B	165	ITG2 - Sardegna	B	220	RO41 - Sud-Vest Oltenia	A*

(*) Regions (N = 31) that were not included in the analysis of the econometric model of the corresponding group, due to the outliers of the residuals of the disturbance term.

(**) Regions (N = 4) that were not classified into group, due to limited time series data.

Source: Eurostat and own processing.