Thesis: Have Structural Funds affected EU regional convergence?

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Abstract

EU cohesion and decline of EU regions disparities are at first concern of EU institutions. Besides extensive planning of Cohesion Policy and financial support through Structural Funds, wide literature explores the effectiveness and wonder whether there are options of improvement of EU strategy. In our survey we employ a pairwise approach to detect regional convergence, firstly unconditionally and also including Structural Funds. Avoiding implications and restrictions of neoclassical framework, stochastic approach offers us the advantage of examining all possible pairs of regions, given our sample of 284 regions and 21 years period (2000-2020), by testing for unit root. Rejection of null hypothesis represents stationarity, yet convergence and we summarize with a low proportion of pairs to convergence in all the cases applied. In both cases the result of convergence is moderate; in some cases of regions such as greek ones, little or no affection of EU supports appears to happen. Reasoning of the result demands further investigation which exceed to purpose of this survey. However, we submit our suggestions to further exploration at this field supporting other authors' opinion about sensitivity to specific features of economies in order to planned strategies' effectiveness.

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1. Introduction

EU cohesion is a matter of high concern since the foundation of EEC[1] (nowadays EU) and that is why wide literature refers to this topic. It is rather intriguing the debate emerges from whether Structural Funds - one of the largest instruments of EU institutions (approximately 1/3 of EU budget) and the basic one of EU Cohesion Policy, another one is Common Agricultural Policy (CAP) - prove to contribute on regional and country convergence, by reducing disparities on growth level among and within EU Member States. EU through this plan provides beneficiary via grants and indirect financial support, but the absorption of the initially modeled budget is another parameter taking account of in the literature, performing several doubts about the effectiveness of the Cohesion Policy and partly attributing that to other structural features of economies, e.g. institutions, diffusion of technology etc. or to first- and second-nature geography as Arvanitopoulos et al. (2021) define them.

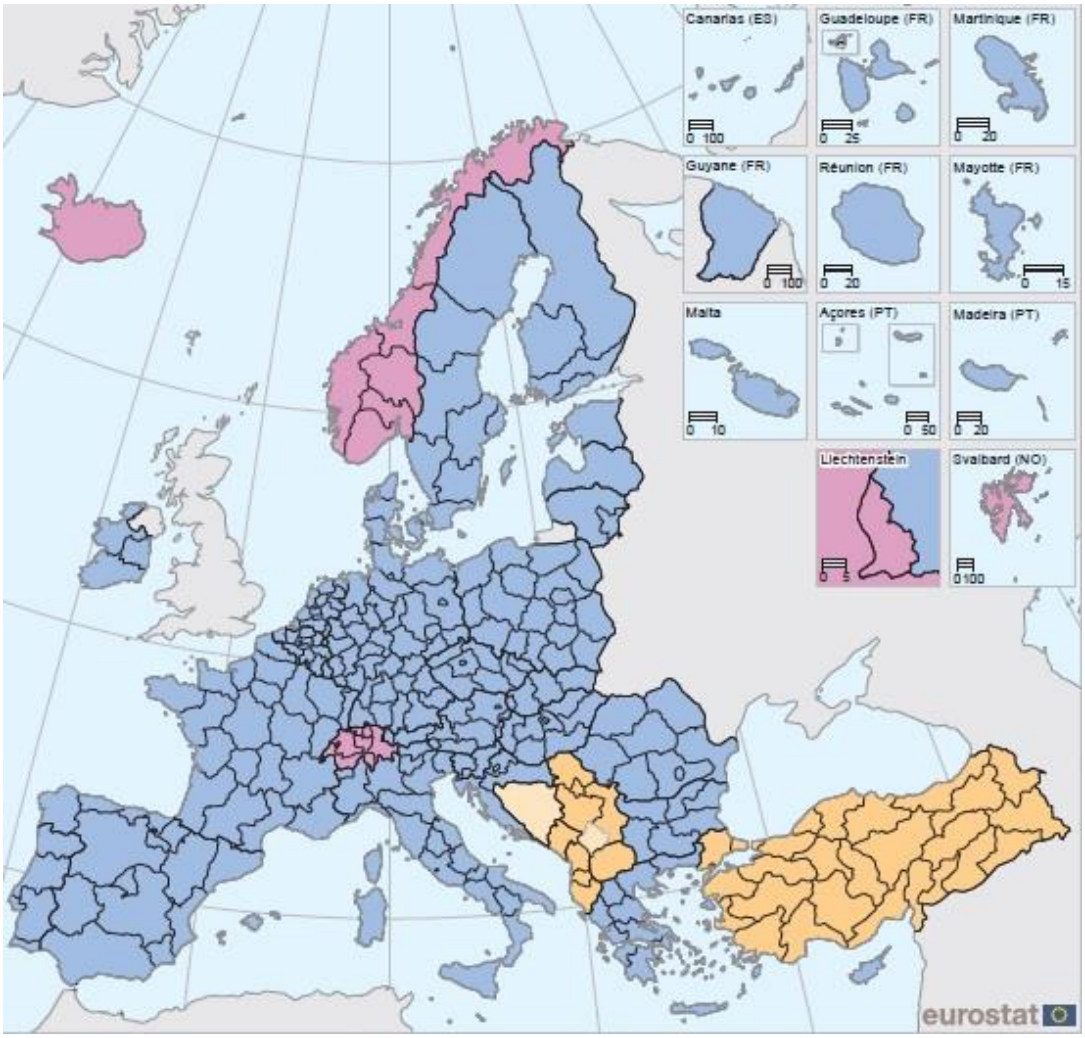

Figure 1: NUTS 2 regions in the Member States of the EU according to NUTS 2021, with corresponding statistical regions in EFTA countries, candidate countries and potential candidates.[2]

[1] Foundation of European Economic Community, Treaty of Rome (1957)/ European Community, Treaty of Maastricht (1993) or European Union.

[2] With blue color are symbolized the MS of EU, with purple the EFTA countries, with yellow the candidate countries and with beige the potential candidates. Source: https://ec.europa.eu/eurostat/documents/7116161/7188972/NUTS-2021-2.pdf.

Figure 1 points out that, there are plenty of EU regions receiving at this moment beneficiary from Structural Funds and the level of this aid depends on the economic status of each of them. Although this map does not illustrate the funding distribution, shows us the planning for expansion of the EU in the near future, leading to increased need for financial support as the receiving regions multiply. According to the Maps of Regional Aid[3], the combination of the size of an enterprise and the geographical area it is located, plays an important role for the proportion of an investment (private /public sector) EU support covers. Another criterion for a project in private and/or public sector to be eligible to receive beneficiary, is the features of the project itself and the orientation and goals expected to be succeed through the development of this project, in accordance with specific guidelines EU establishes at the beginning of each programming period[4]. The motivation of this method is that less advantaged areas and/or sectors of economy should be supported more generously and consequently declining the disparities among regions occurs. Besides that, the plan is the continuous enlargement of EU, so the figure above shows that in the next period even more regions will be elected to receive this beneficiary and/or some of the old Member States theoretically should not receive support anymore. As a matter of fact, new entries traditionally have priority to the support procedure, taking account of the aforementioned criteria and considering the initial point far behind of the old Member States they stand. This phenomenon has been observed by the extensive enlargement of 2004, when mostly Central Eastern European (CEE) countries entry to EU. The question is whether the already receiving for a long period aid regions/Member States have managed to convergence or not to the wealthiest ones and there is a crucial matter to get trapped in the middle income status; Greece seems to be an example of this situation.

Figure 2 highlights the absorption of EU funding by reviewing the regions that changed status for better or worse and the stable ones. Greece seems not to be affected positively (or negatively) by Structural Fund's support and this is a hint coherent to our empirical results in section 4. On the contrary, CEE countries demonstrate a drastic affection of the beneficiary EU provides them and perform high or very high increase in most of the cases.

[3] There is one map per country and per programming period, this link lead to the new ones for the upcoming programming period 2021-2027: https://competition-policy.ec.europa.eu/state-aid/legislation/modernisation/regional-aid/maps-2022-2027_en .

[4] See more in sections 2.2 and 3.1.2.

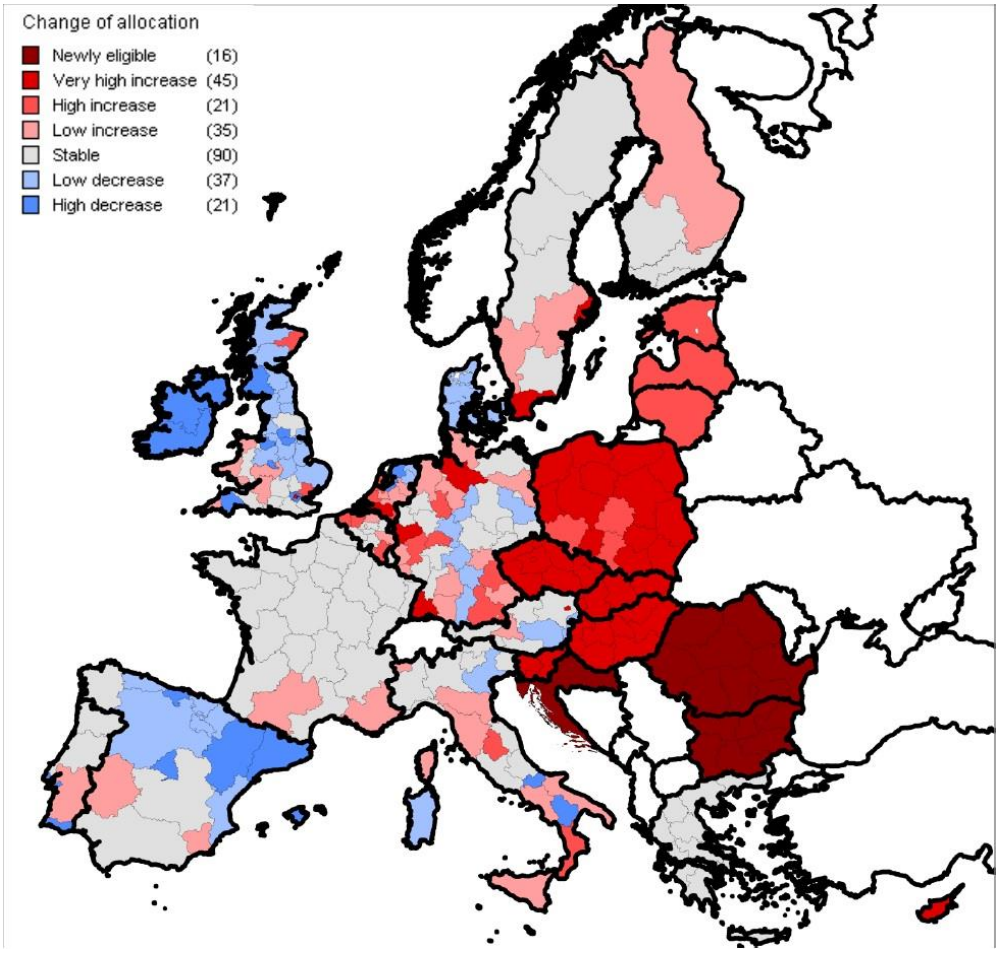

Figure 2: Change of allocation at regional level between 2000-2006 and 2007-2013, Source: Gorzelak et al. (2017).

Plenty of researchers seek evidence for long-run effect, while some of them indicate the restriction to convergence provoked by the same fundamental principles of the creation of EU and consequently integration as fundamental aim, Alcidi (2019). As existing literature is rather extensive, this survey aims to reveal the sufficiency or not of the basic instrument of European Union, Structural Funds, to support financially and to reduce disparities among and between EU regions.

As traditional modeling, including beta and sigma convergence, receives plenty of criticism, we employ an alternative method of stochastic convergence, this of pairwise approach via unit root testing. Neglecting initial conditions and neoclassic framework, that beta and sigma convergence depend on, examination of pairs of regions to be stationary or not, we conclude whether convergence takes place by the proportion of pairs result in stationarity. By this method cross-dependence of the series is avoided to provoke bias results and allows us to explore possible existence of paths of convergence.

More specifically, we run a regression of gaps in terms of GDP, representing pairs of regions, and on second basis we include the variable of a Structural Fund at a time for

the three of Structural Funds: ERDF, EAFRD and ESF. The model follows the Pesaran's (2007) analysis, a pairwise convergence research for a sample of panel data of 284[5] EU regions and time period of 21 years (2000-2020). We use the Augmented Dickey-Fuller (ADF) test to control stationarity or not of the examined pairs of regions; stationarity equals to a convergent pair. We proceed to one step further with the inclusion to the analysis of the variable of Structural Funds in order to unveil possible implications of our fist step measurement of unconditional convergence and/or to enhance our findings and finally to pay attention to the contribution of Structural Funds to regional convergence with the application of Beylunioglu (2017) methodology, also using the ADF tool for unit root test on the basis of the pairwise approach. In that way we result in a considerable proportion of cases that Structural Funds do not lead to convergence, even end to the opposite effect of divergence compared to the result of absolute convergence test at the first part of the research. The sources of data are the websites of Eurostat and for 3 years of Brexit (2018, 2019, 2020) ONS[6] and we transform UK data from sterling currency to euro, taking account of the exchange rate at the end of each year; this last information origins to Bank of Greece daily exchange rate report[7]. One of the advantages of the method adopted here is the independent of initial conditions observation of our data. Both stages of the survey consider the pairwise approach and actually the second step refers to a transformation of the first regression equation examining the residuals to trace stationarity equals to convergence.

The main aim of this study is to answer whether the disparities among the EU regions have declined, after a long period (in most of the cases) of EU financial support via Structural Funds to regions. In favor of the extensive skepticism expressed whether Structural Funds contribute to EU convergence, our purpose is to indicate the role of Structural Funds through an empirical analysis of conditional convergence. The effectiveness if any affection at all occurs is of high concern and the ambition of this study is to offer some enlightenment about that. To achieve that, we move in two directions, both referring to pairwise convergence. With the unconditional convergence research we produce an updated result to existing findings of previous surveys. Although many authors explore EU convergence and their results differ, they mostly employ neoclassical modeling and focus on beta and/or sigma convergence. The benefit of pairwise approach adopted here is the independence on neoclassical assumptions. Furthermore, even in some cases this methodology is used by authors, e.g. Carvalho & Harvey (2005), they do not include Structural Funds to examine their effect. Our contribution to this field of research is the use of an innovative method and to a dataset of more resent information. The combination of recently established method and the employment of Structural Funds as variable consist our innovative aspect with interesting results, such as even divergence in cases of Structural Funds

[5] Croatia is excluded from the analysis, when Structural Funds are included, cause of its late entry to EU and consequently little evidence for the examined period. See more about EU enlargement in Appendix 1.

[6] Office for National Statistics

[7] https://www.bankofgreece.gr/kiries-leitourgies/agores/synallagmatikes-isotimies/deltia-timwn-synallagmatos-kai-ksenwn-trapezogrammatiwn-enanti-eyrw .

inclusion observed. Another hint is given by extracting a sample of our findings to compare regions to converge with and without Structural Funds considered. The divergence seems to be provoked by Structural Funds and through our study we enhance the argument about taking account of other parameters and features of economies. This last point is our suggestion for further investigation, as Arvanitopoulos et al. (2021) for economy of Greece attempted to.

The structure of the paper is as follows. In section 2, we present the literature review, first pointing out the definition of different types of convergence and main findings of authors using each of them (subsection 2.1) and in second subsection, 2.2, the most meaningful results of any affection of Structural Funds on EU convergence and further literature referring to convergence in other cases/territories. The sources and structure of data are briefly presented in subsection 3.1., while the methodology used in this survey is then discussed in subsection 3.2. Section 4 presents the main findings, dividing them into five subsections. The 4.1 subsection begins with unconditional outcome convergence and the following three ones to conditional to each one of the three Structural Funds at a time convergence. Subsection 4.5 offers the summary of our findings. Concluding remarks locate at the final section 5.

2. Literature Review

First of all we have to mention the main contributors on convergence literature and their most well known and broadly used findings on convergence empirical analysis. Additionally it is needed to be referred briefly to some of recent surveys on convergence empirical study, from which we make use of some hints in our research. To continue with the impact of EU Structural Funds on economic growth and consequently on EU regional convergence, we allude to authors who have investigated this issue from different points of view/aspects.

2.1. Convergence theories

To begin with, Barro and Sala-i-Martin (1992) have presented the basic intuition of convergence and specifically β-convergence and σ-convergence concepts based on the fundamental neoclassical growth model of Solow and Swan, an exogenous growth model, establishing the “iron law” of 2% growth rate per year.

By β-convergence they meant that the countries (or states/regions etc.) converge to a common steady state interpreting that those countries(/states/regions) with less initial capital grow faster than the richest ones (speed of convergence based on diminishing returns to the accumulation of per capita physical capital) unconditionally (absolute convergence), while σ-convergence represents the reduction of the dispersion of per capita GDP between the countries, measured by the coefficient of variation in their per capita GDP over time.

Beta convergence is related to the notion of the speed of convergence and is represented by the coefficient β in the following regression equation, Barro and Sala-i-Martin (1992):

$(\ln y_{T,i} - \ln y_{0,i})/n_t = \alpha + \beta \ln y_{0,i} + \varepsilon_{t,i}$

From the equation above it is obvious that the growth rate, be represented by the natural logarithmic differences of GDP (=y) divided by the number of the periods under examination, depends on the initial condition of the economy; $y_{0,i}$ is the GDP at time zero for economy i. Based on the assumptions of neoclassical theory, as they were expressed by the Solow-Swan model, all the economies end up to the same point to, so their transition from their own initial condition to the common end point is that which differs among the units of the sample. Economies that initially lack of capital and consequently the level of their GDP is relatively lower, have the opportunity to move faster while there is technology innovation not even adopted or absorbed by them and other parameters they do not so far take advantage of. On the contrary, relatively richer economies (natural resources, geographic location etc.) follow a path which begins from a better initial position, but the return of their capital is lower, so they move slower than to poorer ones. This procedure leads the economies to develop different between them speeds to accomplice their aim of the best growth level and this is what beta convergence methodology searches. Beta convergence investigates the catch-up hypothesis of that, longer distance to the steady state because of their initial condition means faster growth rate of economies. Including to the regression other variables representing structural features of economies, such as institutions, the concept of convergence is defined conditional.

Sigma convergence refers to a different aspect of observation of economies. Convergence here occurs when the economy performs a decline of the distance between its GDP level and GDP*. The last one refers to the level of GDP in steady state. While the gap of $\ln(y_{t,i}) - \ln(y_i^*)$ declines, the economy approaches the steady state value. The instrument of sigma convergence measures the dispersion of GDP over time and whether the variation of the GDP level is restricted over time. The notion is that the economy, absorbing in a better, more effective way the disturbances of the external environment, the volatility should be more mediocre over time. This phenomenon, reduction of the dispersion of GDP level represents the sigma convergence and the instrument of measurement is the Coefficient of Variation ($CV=\sigma/\mu$, where σ=standard deviation and μ=mean).

Summarizing, beta and sigma convergence are suitable for a different kind of observation, while both take into account initial conditions and refer to a steady state. Whilst beta convergence is the appropriate tool for observation of the speed and catching up cases among economies, sigma convergence is associated with the distribution of the GDP observing the dispersion through time. In order to sigma convergence occurs, beta convergence is a necessary condition.

As a matter of fact, Abramovitz (1986) was one of the first ones, as far as we are concern, who conceived the idea of convergence at a primarily stage, taking account of the productivity levels of a group of advanced industrial countries and examining the catch-up hypothesis, concluding that many characteristics such as diffusion of knowledge, mobility of resources and rate of interest play an important role in order to (conditional) convergence between countries take place. In accordance to that, only some countries of the examined group show to convergence and great speed and strength of the post-war catch-up process among the follower countries and between them and US seems to happen.

The following literature is mostly based on Barro and Sala-i-Martin's theory and reproduces models respect to conditional convergence, club convergence and catch-up cases. In contrast to unconditional convergence, the conditional one, necessary but not sufficient for absolute convergence Kant (2019), captures the idea of implementation of initial conditions, except for initial income rates including and other structural features, which play an important role to the process of economic growth for each unit of the sample.

On the other hand, according to Arvanitopoulos et al (2021), stochastic convergence relates to the examination of countries to converge independently on their initial conditions (e.g. initial per capita income). This innovative method shows some relative advantages, Pesaran (2007), one of them is the pairwise analysis, which is taking place at this current survey, and another one is the option examining also subperiods of the sample. Besides that, Arvanitopoulos et al. (2021) explore via stochastic convergence the reasons convergence occurs; not only detecting the existence of convergence but defining the determinants of it. By employing pairwise analysis both benchmark[8] to regions comparison and for all the possible pairs of regions of Greece, they conclude mostly to club convergence evidence and between and within various subgroups of the sample which are constructed depending on several features initially firs-nature geography (location, distances and nature features) and furthermore for second-nature geography, such as agglomeration and structure and other economy features and using dummies to insert them in the regression. In the field of stochastic convergence, Holmes et al. (2014) provide an enlightening analysis of a 48 US states and 346 MSAs[9] sample, which indicates weak convergence for the whole period. In more detail, they observe the house market prices' convergence as an alternative approach (compared to income convergence), based on the fact that houses represent valuable and permanent property of the households, consequently a considerable measure of economies' wealth and growth level. The stochastic convergence approach offers the opportunity to investigate on a more disaggregated level the data, but the first result still holds. They also present a stronger convergence in favor of distance, a first-nature geography feature as Arvanitopoulos et al (2021) define it. Rosés & Wolf (2021) through beta and sigma

[8] Country average and region of capital of Greece (Athens) and capital of northern Greece region (Thessaloniki).

[9] Metropolitan Statistical Area.

convergence estimations also argue that first-nature geography feature play an important role in EU context.

The innovative **pairwise approach** provides an alternative option of convergence observing pairs of a sample, independently on initial conditions and other restrictions of neoclassic perspective (stochastic convergence). In that basis, divergence is also an option even diminishing returns take place. In fact, many advantages emerge from the use of pairwise methodology, Pesaran (2007), which correspond to no restrictions to the selection of period or subperiods of the sample for the survey and the club convergence cases as a result. Parallel paths of growth without a common steady state are an option too. Unit root tests apply to the coefficient β in the following regression equation, while d_{ijt} represents the first differences of the GDP level, expressed in natural logarithm of the two regions of i and j at time t.

$$d_{ijt} = y_{it} - y_{jt} = \beta_t + \varepsilon_t$$

The indication of no unit root equals to stationarity or in other words, to a convergent pair. Using this test for all possible pairs of the sample a proportion of convergent to the total of the pairs demonstrate the convergence or no conclusion for the sample as a whole.

2.2. Structural Funds and EU region cohesion

From the post-war period since nowadays many studies present various results about the convergence of EU Member States and in continuation of that, the successful or not contribution of Structural Funds of European and Economic Community or European Union to decline of disparities and cohesion attainment among and between EU Member States at regional and country level. This variety is related to different theoretical background and/or the period selection and data availability in accordance with the countries' sample, as well as the instrumental variables taken account of in order to highlight the effectiveness of EU Cohesion Policy and complementally the influence of business cycle. The exact definition of Structural Funds is given by the Article 130a of the Treaty on European Union (1992): "In order to promote its overall harmonious development, the Community shall develop and pursue its actions leading to the strengthening of its economic and social cohesion.", and the basic concept is that all Member countries and regions of EU should eventually demonstrate a similar level of development and growth, additionally to the backing and reinforcement of the poorer regions, Alcidi (2019).

Cohesion Policy is taking place mostly at regional level, because of the disparities observed also within the countries and in that way the process of cohesion by financial support shall be more effective. It is worth to be mentioned that this treatment has developed through the reform of Structural Funds in 1989, based mostly on the Delors Report proposal, establishing since then the programming periods; initially of a 5-year long (1989-1993) and a 6-year long (1994-1999), for the two first periods and 7-year period programs thereafter. Figure 3 presents the evolution of EU expenditure referring to three Structural Funds; ERDF, EAFRD and ESF.

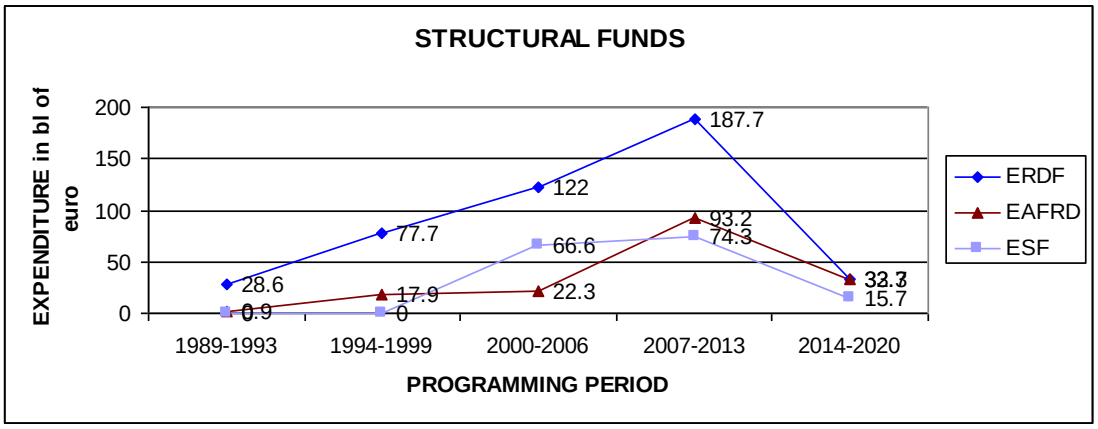

Figure 3: Evolution of Expenditure of EU Structural Funds (ERDF, EAFRD, ESF) per fund and programming period in billions of euro. Author's creation using European Commission dataset, **https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_2gdp** .

Interestingly, Alcidi (2019) points out that the integration concept reflects the deepening/ caution of divergence in some cases, as a result of the Schengen Agreement, signed on June 24 (1985) with agglomeration effects, leaving behind already relatively poorer areas, and makes the implementation of Structural Funds and Cohesion Policy even more essential.

The selection of the studies has been made as follows, at first we reviewed the main findings of surveys at EU region level convergence and in addition, country level research at the same territory. Furthermore, studies related to convergence with similar methodology adopted and/or taking account of structural features in order to exam conditional convergence are mentioned in this section. Considering the time aspect, a first conclusion of this review is that the limited period for the first chronologically studies plays an important role to their results about the existence or not of convergence of EU regions and/or countries. For the post-war period of 1950-1990 (until the reform of Cohesion Policy), Fagerberg & Verspagen (1996) with the use of instrumental variables for R&D personnel and projects, investment loans, EU support, gross fixed capital formation as a share of GDP, unemployment rate, agriculture share and country dummies including some of them each time in their estimations, concluded existence of three speed club convergence and an insignificant role of Structural Funds, as well as stagnation of convergence during the 1980's. The last remark consists with the claim of Rosés & Wolf (2021) that in 1900 a spread of economic activity across regions and convergence between them until about 1980 takes place, pointing out that more disaggregated level of data unveils hidden patterns compared to country level research and creating indirectly regional GDP per sector data in order to take into account structural features of regions in their estimations of beta-convergence and including first and second nature variables. In addition, they result in and sigma-convergence weighted to population share in state and regional level shows higher dispersion in regional level case. Interestingly, they make use of an alternation sigma convergence formation, taking into account weighted to sector employment share. Agriculture demonstrates the larger decline compared to industry,

while services share seem to be increased from 1950, consequently higher dispersion appear in agriculture sector and sigma convergence takes place mostly in services sector. As Boldrin and Canova (2001) used a wider sample of 185 regions for the 1990-1996 period, still holds the conclusion that Structural Funds have no impact on convergence and they seem to perform only a redistribution of income. Additionally, for almost the same period - two first programming periods - , a weak effect of Structural Funds with stronger evidence of effectiveness and consequently convergence at the first period observed by Puigcerver-Penalver (2004), who considers Structural Funds as an enhancing of TFP factor (endogenously) and diffusion of technology as exogenous parameter, while Dall'erba & Le Gallo (2007) conclude no impact of Structural Funds in a conditional GDP beta-convergence analysis including Structural Funds. They insert to the model a set of instrumental variables of investment, share of agriculture sector and unemployment and spatial dummies for distinction of core and periphery regions to unveil geography feature specification and check out four models with and without that specification and inclusion or not of Structural Funds variable to the equation, while Rodrigues-Poze & Ugo Fratesi (2007) using sector data and more specifically the main four development axes[10], support only medium and short-term effects and no sign of outcome convergence. On the contrary, for the same period and sample of EU regions, Cappelen et al. (2003) using a different set of instrumental variables (agriculture, manufacturing and infrastructure shares, unemployment, population density, R&D, EU-support, for some of them also a time slope dummy and finally country dummies) find a positive impact of Structural Funds and stronger effectiveness after the reform of the funds especially for more developed environments, while Esposti & Bussoletti (2008) using proxies to represent human capital, private and public R&D expenditure and infrastructure endowment, show a positive contribution to convergence result only for the whole EU but not when examining region groups by country and negative effect holds. Different results among authors emerge here from slightly different methodology (definition of explanatory variables) although examining almost the same period. At country level, Crespo-Cuaresma et al. (2002) conclude that the beneficiary of EU membership contributes to growth and is larger for poorer regions and/or older Member States presenting a positive but asymmetric effect; the estimation of beta-convergence includes variables for investment, education, inflation government consumption and openness.

Carvalho & Harvey (2005) construct stylized facts with club convergence result of high and low income groups and in more detail about trends in these groups, while employing short-term cycles for five core countries, they conclude sigma convergence by the end of the 1990's. Beugelsdigk & Eijffinger (2005) creating regressions for "clean" and '"corrupted" countries in respect to proper adaptation of Structural Funds and additionally making use of two corruption variables, one of them related to Structural Funds, observe β-convergence as well, via GMM estimations of two steps.

[10] Agriculture and rural promotion (A), Business & tourism support (B), Investment in education and human capital (H) and Investment in infrastructure, transport networks and the environment (I).

Taking account of more recent and/or wider period of time data, both at country and region level, most of the surveys report a positive effect of Structural Funds even though temporary in many cases. Mohl & Hagen (2009) use GMM and spatial panel approach with plenty of robustness tests through a variety of econometric tools, Maynou et al. (2014) with Bayesian approach, involving different explanatory to regional and country level estimations, and Rodríguez-Pose & Di Cataldo (2015) present positive impact, as they have at their disposal more recent data, investigate a wider period and their results seem to be more reliable referring to beta-convergence. Rodríguez-Pose & Di Cataldo (2015) emphasize the importance of government implementation. Time lags play an important role in order to observe convergence, as the affection of Structural Funds appears after four or more years as Mohl & Hagen (2009) indicate. Despite the positive impact of Structural Funds observed, moderate effect in terms of development detected by Pellegrini et al. (2012) through Region Discontinuity Design in order to investigate the EU region policy effect, while Kyriacou & Roca-Sagales (2012) show that Structural Funds have reduced regional disparities over this period, but indicate the existence of optimal level of Structural Funds due to moral hazard and substitution effects as previously Beugelsdigk & Eijffinger (2005) point out. A more specific case study of particularly two of the most poor regions in UK (SF receiver until 2017, cause of Brexit), those of Cornwall and South Yorkshire, ran by Di Cataldo (2017) evident that lack of support to them lead to further impoverishment, indicating the short-run effect of Structural Funds. Another case study for UK regions of West Wales and East Wales, Brexit leads to loss of the funding, but for less developed regions no direct impact of Structural Funds reported by RDD estimations, Crescenzi (2020). Gray (2020), examining 12 UK regions finds evidence of north-south club convergence, a frequently observed case for plenty of EU Member States, e.g. Greece Arvanitopoulos et al. (2021). Rodríguez-Pose & Di Cataldo (2015) present the parameters of institutions, e.g. government effectiveness fighting corruption, Incaltarau et al. (2020), and the lack of potentiality to absorb innovation by lagging regions and provide development, as well as Katsaitis & Doulos (2009) at a county level research of EU_15 support a negative impact of law quality institution on FDI (used as depended variable in the usual panel data model of conditional convergence with the addition of a variety of explanatory variables), a weighty parameter to development and growth of an economy. Additionally, Garcilazo et al. (2021) report regional inequalities basically emerge from structural factors related to the composition of productivity. A recently established definition of five categories of regions in respect to their access to cities allows the authors to compare EU and US data. As time to approach the city consist a criterion both of geographical and structural features of a region, covers the total of characteristics of the economies under investigation.

Breidenbach et al (2016) also report no significant effect and negative spatial interaction effect is reported. Gouveia et al. (2020) using a non-parametric method, specifically value-based Data Envelopment Analysis (DEA) measuring the efficiency of Decision Making Units indicates the importance of a stable, development oriented

socioeconomic environment. Crisis of 2008 is another parameter affected both pc GDP and convergence Cabral & Castellanos-Sosa (2019) and Bolea et al. (2018) observe a backward effect yet that differs among sectors, more specific non-technological ones seem to be less affected, while environment sector aids to reverse the divergence pattern. Alternative measures of sigma convergence appear to Bolea et al. (2018) survey, defined as Direct VA[11], Total Intra Direct VA and EU Embodied VA, where they represent total income emerged from trade at all, included domestic production and EU-trade originated income and income created in EU and is used for final products of each county unconditionally, respectively. Criticism in existing literature about the adopted policy and the suggestion of considering of structural features of regions to success substantial affection of Structural Funds on EU convergence, insinuates a generous reform and planning of development strategy and financial support policy, as authors already mentioned, Iammarino et al. (2019) and Logan et al. (2021) indicate the need of place-sensitive Cohesion Policy.

Education level and human capital consists another structural feature, a main factor to handle the impact the aging of EU citizens present, Crespo-Cuaresma et al. (2013) & Crespo-Cuaresma et al. (2016). The income projection for 50 years ahead shows that human capital positively affects the speed of convergence and growth rate, even though not at the same level for poorer regions. EU but not EMU[12] contribute to convergence is another finding to pay attention to, Cabral & Castellanos-Sosa (2019). With the extension of time parameter of the sample and/or taking more recent data referring to the 3rd and 4th programming period, Becker et al. (2018) and Moreno (2019) confirm the redistribution of income and only short terms effect for Objective 1[13] regions and low absorption, respectively. Including more than the four programming periods, a survey of Postiglione et al (2020), hints clusterism based on similar GDP rates and a distinction of East and West Europe growth rates. Also, spatial parameter leads to faster convergence results. The last enlargements created heterogeneity, being responsible at some level for the lower speed of convergence. As for σ-convergence only for the 1st period occurs, when different pattern present each country of the sample. Similar aspect is submitted by Johnson & Papageorgiou (2020) with catching-up hypothesis fulfilled only between income groups.

Bouvet (2021) supports that gross and net income demonstrate opposite direction of inequality in respect of EMU participation of countries, lower and higher, respectively, and with more intense for peripheral countries, which could deal with these disparities by national welfare planning. Dall'erba & Fang Fang (2015) with the tool of ordered probit proceed on a meta-analysis of the so far investigation of the subject of EU convergence and report immediate but no long-run affection of Structural Funds. Casula (2020) suggests the adoption of a Hirschmanian approach for more overwhelming results in favour of Cohesion Policy. Garcilazo et al (2021) from

[11] VA means value added

[12] EMU means European Monetary Union and is one of integration steps, proposed by Delor in Delors Report proposal.

[13] Objective 1 regions characterized those that with a per capita gross domestic product (GDP) lower than 75 % of the Community average (source: Eurostat, link: https://eur-lex.europa.eu/EN/legal-content/summary/objective-1.html) .

a different point of view indicates the resilience of small and medium sized cities to macroeconomic shocks responding better than large ones, which used to perform more satisfying productivity rates but not after crisis. A case study for a founder Member State, Germany, observes the labour market and the ageing of population and workforce and ends up to the conclusion that this process emerges from supply dynamics for rural areas and demand forces for urban ones, Böhm (2021). Another clue of importance of smaller cities of an economy appears. Finally, a recent comment by Cörvers & Mayhew (2021) and an answer to the crucial argument of effectiveness of Structural Funds and EU Cohesion Policy, questioning the need of attenuation or increase of financial support given the disparities observed to widen in the last 40 years, is that in lack of this essential instrument, the deepening of region divergence would be even greater.

3. Data and methodology

3.1. Data

3.1.1. Measures of GDP

The European Union has developed the Nomenclature of Territorial Units for Statistics (NUTS) standard for statistical purposes. It is a geocode standard used for referencing administrative divisions of countries. There are three levels of NUTS divisions, namely NUTS-1, NUTS-2 and NUTS-3. NUTS-1 is a more general division, usually based on the existing national administrative subdivisions within a country. In cases where the population of the region is too small (less than three millions) or too large (more than seven millions), a second level (NUTS-2) and/or third level (NUTS-3) is created. In addition, in countries with population smaller than three millions (Cyprus, Luxembourg), all three levels of exist, however they all refer to the entire country.

In our analysis we use the NUTS-2 standard. As of today, NUTS-2 consists of 284 regions for the 28 EU countries (including UK). We proxy output using the GDP at current market prices measured at millions of euro. The data is available at the Eurostat[14]. Based on the availability of the data, the sample consists of annual observations from 2000 to 2020 (21 observations for each region). For the case of UK, after 2017, regional GDP is only available in sterling. To include the UK regions in our sample over the period 2018-2020, we use the source of ONS[15] for GDP and convert the sterling currency to euro using the exchange rate at the end of each year, obtained from the Bank of Greece. All time series are converted to natural logarithms.

[14] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_2gdp .

[15] https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/regionalgrossdomesticproductallnutslevelregions .

The following figure shows the economic status of EU regions based on their GDP in 2018. Comparing to a similar on of 1996 distribution of GDP, Boldrin and Canova (2001), the main conclusion is that regions remain at the same category or move to the previous/next level, but this happens in most of the cases. The direct consequence is the parallel movement of regions and no cohesion to take place among them in most of the cases.

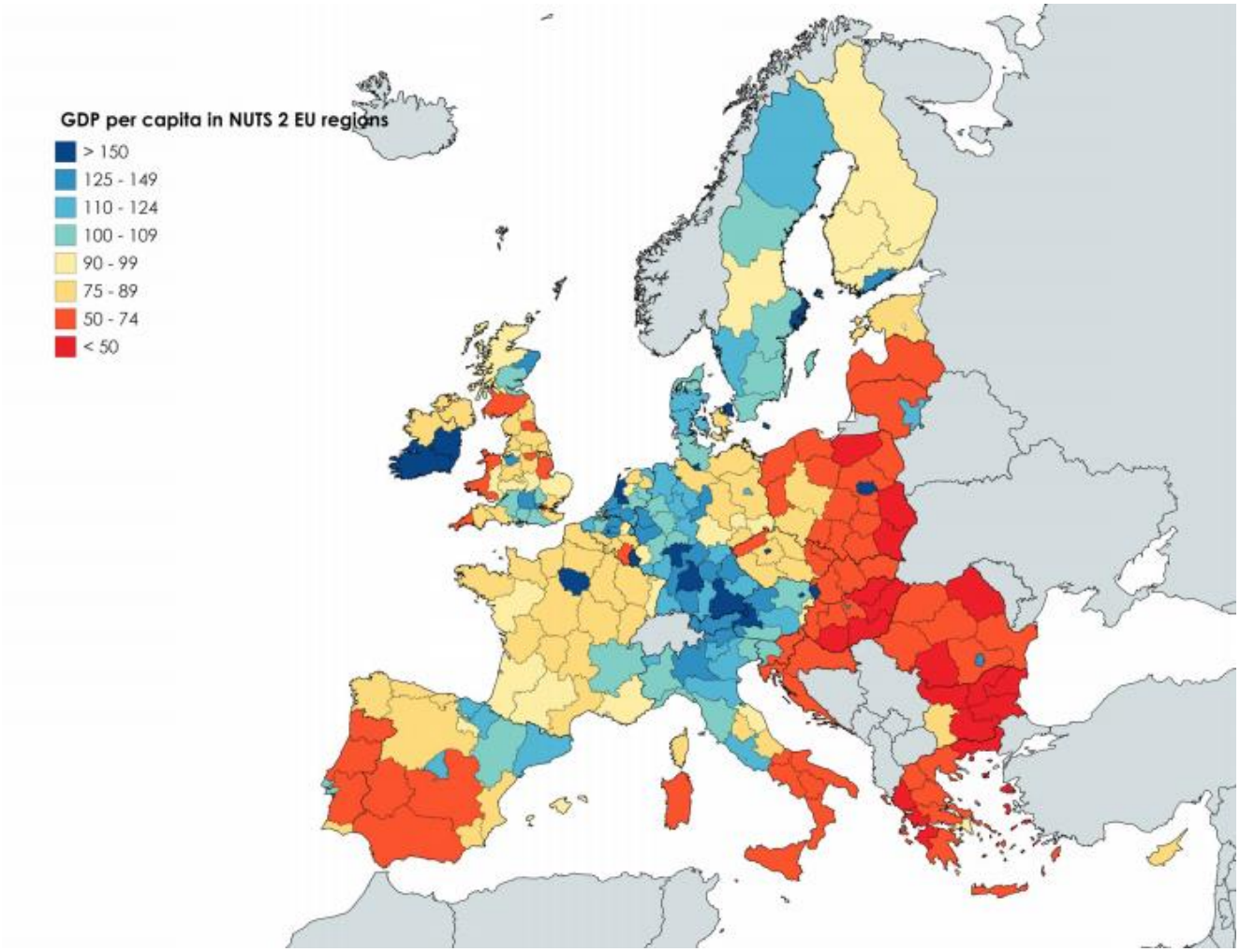

Figure 4: GDP for NUTS-2 regions in 2018.Source: Wikipedia.

3.1.2. Measures of Structural Funds

The main part of this research regards the effect of Structural Funds on EU output convergence. We consider three different funding programs. The first one is the European Regional Development Fund (ERDF). The aim of ERDF is to improve imbalances between regions and create a coherent EU economically and socially welfare. To this end, the program focuses on five policy objectives regarding i)

economic innovation of smaller businesses, ii) transition to environmental friendlier energy sources, iii) connection of Europe in terms of transportation, iv) social welfare (through education, quality employment) and v) local and urban development.

During the sampling period, there are three programming periods, 2000-2006, 2007-2013 and 2014-2020. However, it is not unlikely that a payment regarding a specific programming period is made after the end of the period. In the analysis, we consider the sum of ERDF payments made each year regardless of the corresponding programming period. As a result, in several cases we include payments regarding funding from periods before 2000 (1989-1993 and 1994-1999). We follow this approach in all funding programs considered in the analysis. All data regarding the Structural Funds are obtained from the European Commission[16]. Regarding the ERDF program, there are available data for 265 regions.

The second Structural Fund we consider is the European Agricultural Fund for Rural Development (EAFRD) program. It is a program that mainly focuses on the improvement of competitiveness as a mean of economic growth leading to a balanced territorial development of rural economies and communities. Furthermore, the program supports a greener environment through a more sustainable management of the natural resources. During the last programming period, 2014-2020, EAFRD contributed more than 100 billion Euros to rural development programs across the EU. Over the sampling period, there are data available for 262 regions.

The last Structural Fund we examine is the European Social Fund (ESF). It is part of the European Structural and Investment Funds (ESIF) and is dedicated to the improvement of economic welfare and social cohesion across the regions of EU. Depending on their relative wealth, each region receives a different amount of funding. The program groups the regions in four categories by comparing their regional GDP per capita compared to the EU average (EU with both 15 and 25 Member States). Although the ESF supports poorer regions to eliminate divergence, Dubois and Fattore (2011) argue that within a region, the funding is allocated towards richer municipalities and leads to the creation of greater intra-regional inequalities. The European Commission provides payment data for 263 regions.

Actually, there are two more Structural Funds, the EMFF (European Maritime and Fishing Fund) and the CF (Cohesion Fund). The first one is rather self-explicable to the orientation of support it provides as it refers to specific sectors of economy. The Cohesion Fund applies as a complementary to other funds in some cases and exclusively for Member States that their GNI (Gross National Income) per capita locates below 90% EU-27 average. Table 10 in appendix 3 shows the eligible to receive Cohesion Fund support Member States per programming period. It is worth mentioning that for the first programming period four Member States, Ireland (1973), Greece (1981), Spain (1986), and Portugal (1986) receives support of this fund. The information in the brackets refers to the year of EU entry of each country. Ireland

[16] https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv/data .

remarkably managed to achieve an index above the aforementioned threshold, so do not receive support since the 3rd programming period, Spain follows in next period, while Greece and Portugal, both seem unable to correspond to improving their relative position and still receive beneficiary from Cohesion Fund. The relatively lower amounts of expenditure by EMFF and the particular mission of Cohesion Fund aiming only to part of the sample countries, leads us to exclude them from the analysis.

Table 1 informs us about the progress of EU expenditure per fund over time and the high of the total budget per programming period. It is worth to mention that the budget increases from period to period for each of three funds but not for the last one. The payments for the last programming period will probably take place all through the extension period until 2023 and in some cases 2024 and that is symbol (*) used for. Furthermore ESF established for the 2000-2006 programming period and so on.

Table 1: Expenditure per fund and programming period in billion of euro.

Programming Period :	1989-1993	1994-1999	2000-2006	2007-2013	2014-2020
Structural Fund :					
ERDF	28.6	77.7	122.0	187.7	32.7*
EAFRD	0.9	17.9	22.3	93.2	33.3*
ESF	-	-	66.6	74.3	15.7*
Total sum of 3 SF	29.5	95.6	210.9	355.2	81.7*

In more detail, Table 2 includes the descriptive statistics for each country of the sample for the GDP, while in appendix 2 locate the tables 6, 7 and 8 for the ERDF, EAFRD and ESF respectively. Although information about Croatia is provided, regions of the country are excluded from the analysis due to relatively late entrance to EU (2013).

Table 2: Descriptive statistics per country for the GDP.

Country	Mean	SD	Kurtosis	Skewness	Min	Max
AT (Austria)	34.73	8.42	2.19	0.17	17.38	53.36
BE (Belgium)	31.99	12.34	4.32	1.35	16.1	71.83
BG (Bulgaria)	4.52	2.63	6.44	1.69	1.33	14.84
CY (Cyprus)	21.47	2.87	2.43	-0.58	15.57	26.09
CZ (Czech Republic)	14.14	7.9	7.73	2.13	5.04	46.83
DE (Germany)	32.39	9.63	4.09	1.01	16.11	67.3
DK (Denmark)	40.35	9.97	3.83	1	23.78	69.68
EE (Island)	12.38	5.07	1.97	0.06	4.4	20.93
EL (Greece)	15.23	3.61	4.88	1.27	9.75	29.22
ES (Spain)	21.41	4.86	2.83	0.52	10.15	36.05
FI (Finland)	36.21	8.49	2.45	0.42	20.65	56.8
FR (France)	22.95	8.59	6.05	0.5	3.76	61.53
HR (Croatia)	3.47	0.22	0.05	1.28	1.53	8.47
HU (Hungary)	9.57	5.3	6.71	1.96	3.17	31.03
IE (Ireland)	42	18.06	3.93	1.25	18.99	97.45
IT (Italy)	26.36	7.33	2.28	0.26	12.98	48.42
LT (Lithuania)	11.49	6.03	2.74	0.69	3.13	25.61
LU (Luxembourg)	80.36	16.66	1.78	-0.39	52.6	101.76
LV (Latvia)	9.73	3.95	1.85	-0.09	3.65	16.02
MT (Malta)	17.63	5.5	1.92	0.56	11.31	27.85
NL (the Netherlands)	34.93	8.72	3.03	0.69	19.53	62.64
PL (Poland)	8.57	4.13	10.46	2.22	3.5	30.55
PT (Portugal)	16.19	3.67	3.24	0.81	9.98	27.13
RO (Romania)	9.86	9.28	4.11	1.55	1.46	35.69
SE (Sweden)	38.12	9.03	4.79	1.29	24.89	65.7
SI (Slovenia)	14.32	6.22	2.31	0.18	3.1	27.61
SK (Slovakia)	15.68	10.78	2.82	1.07	3.38	39.81
UK (United Kingdom)	57.47	813.55	836.8	28.9	14.4	23600

Figure 5: Average annual funding payment (top) and average annual regional GDP.

The top part of Figure 5 presents the average annual payment for the three funding programs. We observe that the ERDF payment is greater from both the EAFRD and ESF. In addition, there is a decline in payments for all cases during 2017. The bottom part of Figure 1 presents the average regional GDP based on the 284 time series. There is an upward trend from the start of the sample with only a minor decrease during 2009.

Table 3: Average descriptive statistics for the time series used in the analysis.

Variable	GDP	ERDF	EAFRD	ESF
Mean	20.49	6.92	2.87	3.01
SD	3.17	2.03	1.56	1.00
Kurtosis	-0.68	-1.02	-1.67	0.46
Skewness	-0.3	0.32	-0.4	-0.16
Minimum	14.64	4.15	0.54	0.83
Maximum	26.03	10.75	4.84	5.1
Cross section	284	265	262	263

Table 3 summarizes the average descriptive statistics for the four time series used in the analysis.

3.2. Methodology

Depending on the perspective of the observation at convergence field there are plenty of choices developed by the authors be referred in previous section. Beta convergence is widely used in order to examine the growth rate by the notion of speed of convergence and observing catching-up cases, while countries converge to a common steady state, based on neoclassical framework. The inverse connection of initial condition (distance to steady state) and returns of accumulation of capital is the central idea of countries to convergence or not. While beta convergence occurs, sigma convergence could also take place. The dispersion of GDP relative to the mean is defined as sigma convergence. The dispersion of GDP over time is measured by the standard deviation divided to the mean, called Coefficient of Variation and the decline of this dispersion represents sigma convergence. Both beta- and sigma-convergence are widely used in surveys, to measure convergence in terms of GDP. In literature review we refer to some alternative applications of these with measurements of other parameters of an economy such employment, house prices, FDI etc., with enlightening results, some of them with severe explanatory power about whether convergence occurs and in some cases also defining the determinants of that. This survey adopts a stochastic convergence modeling to be explained in more detail in the following subsection.

3.2.1. Output convergence

To examine for pairwise convergence among the regions of European Union countries, we rely on the seminal paper of Pesaran (2007). Let y_{it} denote logarithmic output of region *i* at time t, where $i = 1,2,\ldots,N$ and $t = 1,2,\ldots,T$. We denote $d_{ijt} = y_{it} - y_{jt}$. According to Pesaran (2007), if d_{ijt} is a stationary process, then the regions *i* and *j* are (output) convergent. More formally, the output gap between regions *i* and *j* is written as follows:

$$d_{ijt} = y_{it} - y_{jt} = \beta_t + \varepsilon_t \sim I(d) \quad (1)$$

where d = 0, 1 denotes the level of integration of the process d_{ijt}, the error term, ε_t, is assumed to be a stationary $I(0)$ process, and β_t denotes relevant macroeconomic indicators such as structural funds, unemployment, etc. Whether convergence exists depends solely on β_t. If β_t is a stationary (non-stationary) process then the pair of regions is convergent (divergent). The test for pairwise output convergence boils down to examining the order of integration of d_{ijt}. If d_{ijt} is a stationary (non-stationary) process then the pair of regions is convergent (divergent). To examine the stationarity of d_{ijt} we employ the Augmented Dickey-Fuller (ADF) test which we discuss in section 3.2.3.

The approach described above allows us to examine output convergence between all possible pairs of regions. According to Pesaran (2007) one could employ this approach to examine of club convergence among all regions. To this end, we should first perform a unit root test on all possible $N(N-1)/2$ pairs of output gaps and then

calculate the rejection frequency of the unit root tests. If the rejection frequency of the unit root test (H_0: $d_{ijt} \sim I(1)$) is greater than the nominal size of the unit root test then all *N* regions are said to be convergent.

3.2.2. The role of structural funds

In equation (1) β_t denotes regional differences of some relevant macroeconomic indicators that could potentially drive regional output apart. Here, we examine the effect of Structural Funds on the regional output convergence and equation (1) becomes, according to Beylunioglu et al. (2017):

$$d_{ijt} = \mu_{ij} + \tau_{ij}(F_{it} - F_{jt}) + e_t \quad (2)$$

, where μ_{ij} and τ_{ij} are the cross-pair coefficients and F_{it} is the Structural Funds in region *i* at time *t*. Equation (2) is the case of conditional convergence which is common in the empirical literature. In this case, convergence or divergence stems from the stationarity or non- stationarity of the residuals e_t. Similar to the previous case (absolute convergence) we rely on the ADF test to check the stationarity of the residuals. Furthermore, we can check for convergence among all considered regions using the approach discussed in the end of the section 3.2.1.

3.2.3. The ADF test

In this section we describe the ADF test put forward by Dickey and Fuller (1979) and further developed by Said and Dickey (1984). Let y_t denote the variable we want test for unit root. We assume that all necessary transformations have been performed. Under the null hypothesis of the ADF test, y_t contains a unit root and thus in a non-stationary process. If the null hypothesis is rejected then the process is stationary or trend-stationary.

The tests assume that the examined time series is an autoregressive process of first order (AR(1)).

$$y_t = \alpha_0 + \alpha_1 t + \rho y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p} + u_t \quad (3)$$

Using the lag operator Δ, the model in equation (3) can be written as:

$$\Delta y_t = \alpha_0 + \alpha_1 t + (\rho - 1) y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p} + u_t \quad (4)$$

Setting $\varphi = \rho - 1$, equation (4) becomes:

$$\Delta y_t = \alpha_0 + \alpha_1 t + \varphi y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p} + u_t \quad (5)$$

Under the null hypothesis $\varphi = 0$. The alternative hypothesis states that $\varphi < 1$. Once the coefficients of regression (5) are estimated, the test statistic is computed as

$$DF = \varphi / s.e.(\varphi)$$

where φ and s.e.(φ) denote the estimation and the respective standard error of φ. The test statistic is assumed to follow a Dickey-Fuller distribution. If the test statistic is less than the corresponding critical value, the null hypothesis is rejected in favor of a stationary process. The number of lags, p, is based on the Akaike Information Criterion (AIC).

4. Empirical results

4.1. Output convergence

In this section we describe the results obtained from the analysis, our aim is to evaluate whether the structural funds can improve output convergence between the NUTS-2 regions. In the first case, we consider only regional output without taking into account the effect of Structural Funds.

Given that the total number of available regions is 284, the number of all possible region pairs is equal to 40,186. Out of all the possible pairs, less than 20% are convergent (α=5%). Specifically, we detect convergence for 7,780 pairs in total. Table 4 provides an example of the results for ten regions: Abruzzo, Aragon, Metropolitan Area of Lisbon, Arnsberg, Attiki, Budapest, East Yorkshire and Northern Lincolnshire, Grad Zagreb, Hamburg and Wien. The element in position (*i*,*j*) takes the value 1 or 0 if the output gap between the regions *i* and *j* is stationary or non-stationary, respectively. For the 45 output gap pairs presented in the Table 4, we obtain 12 cases of pairwise convergence. The region that forms the most convergent pairs is the Grad Zagreb which converges with the regions of Abruzzo, Aragon, the Metropolitan Area of Lisbon, Attiki, and East Yorkshire and Northern Lincolnshire. Regarding these five regions, the results indicate two more cases of pairwise convergence between the Metropolitan Area of Lisbon and Abruzzo and East Yorkshire and Northern Lincolnshire, respectively. The Metropolitan Area of Lisbon is in fact the second region in terms of convergence since it convergences with four regions (the other two regions are Budapest and East Yorkshire and Northern Lincolnshire). Furthermore, we observe that each one of the ten regions presented here converges with at least one other region. Specifically, each one of Attiki, Hamburg and Wien form exactly one convergent pair with some other region. Both Hamburg and Wien form convergent pairs with Arnsberg.

We can make similar observations for the rest of the regions not included in this example. Furthermore, there are a few cases of regions which form convergent pairs with an extremely great number of other regions. These cases concern the regions of Bucuresti-Ilfov (213), Eesti (207), Mayotte (197), and Centru (124), where the number in parentheses denotes the number of regions with which they form convergent pairs.

Each region forms at least one convergent pair. Specifically, the region of Inner London, which forms the least convergent pairs, converges with 7 other regions. The second region that forms a single digit number of convergent pairs is Vorarlberg (9 pairs). All other regions form more than 10 convergent pairs.

Table 4: An example of regional output convergence. (unconditional)

Region	Abruzzo	Aragon	MA of Lisbon	Arnsberg	Attiki	Budapest	East Yorkshire & Northern Lincolnshire	Grad Zagreb	Hamburg
Abruzzo									
Aragon	0								
MA of Lisbon	1	0							
Arnsberg	0	0	0						
Attiki	0	0	0	0					
Budapest	0	1	1	0	0				
East Yorkshire & Northern Lincolnshire	0	0	1	0	0	1			
Grad Zagreb	1	1	1	0	1	0	1		
Hamburg	0	0	0	1	0	0	0	0	
Wien	0	0	0	1	0	0	0	0	0

4.2. The effect of ERDF on regional convergence

The next step in the analysis is to take into account the effect of Structural Funds in the regional output convergence to examine whether it helps ameliorate output imbalances among NUTS-2 regions. The first funding program we consider is the ERDF. As noted in section 3.1, data for the ERDF payments is available for 265[17] regions, which form 34,980 pairs. Based on the methodology described in subsection 3.2.1, we are able to detect 6,649 convergent pairs (the results of this approach are discussed in detail in the previous subsection). Next, we proceed with the methodology discussed in subsection 3.2.2. The results indicate that when the ERDF payments are taken into account the number of convergent pairs increases to 8,612. This finding could indicate that ERDF has a positive effect on regional output convergence in NUTS-2 regions. However, a more thorough examination suggests that this is not entirely true. The inclusion of ERDF in the analysis allows us to identify 5,186 new convergent pairs. However, the total number of convergent pairs is not 11,835 (6,649 + 5,186). This is because when we account for the ERDF payments,

[17] Regions excluded from the analysis: Area Metropolitana de Lisboa, Budapest, Cyprus, Eastern and Midland, Grad Zagreb, Inner London - West, Karlsruhe, Landkreis, Karlsruhe, Stadtkreis, Mayotte, Northern and Western, Outer London - South, Outer London - West and North West, Panonska Hrvatska, Pest, Shropshire and Staffordshire, Sjeverna Hrvatska, Sostines regionas, Vidurio ir vakaru Lietuvos regionas, Weser-Ems.

there are 3,223 divergent pairs that were convergent when ERDF payments were not taken into account.

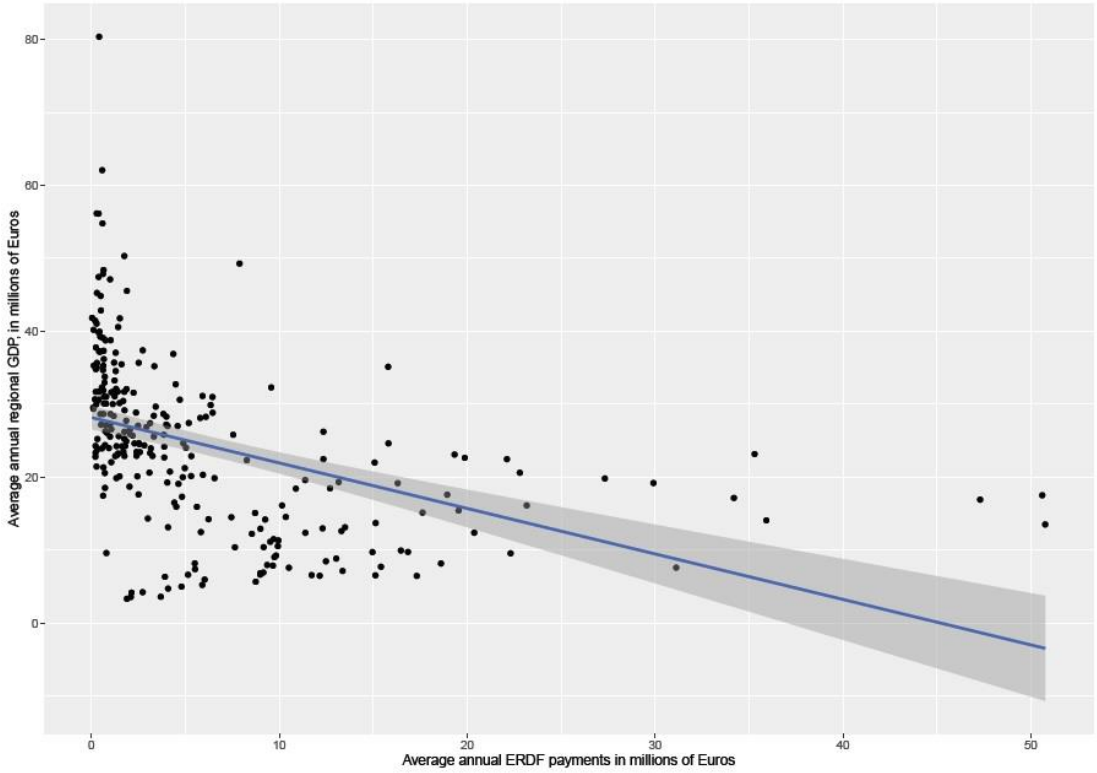

Figure 6: Relationship between average annual regional GDP and average annual ERDF payments, both in millions of euro.

Focusing on whether there is convergence regardless of whether there was convergence without the ERDF, we find that each region forms at least 4 convergent pairs. Specifically, there are three regions that form less than 10 convergent pairs. These regions, which all belong to Greece, are Anatoliki Makedonia and Thraki (4), Dytiki Ellada (6), Ionia Nisia (8). On the contrary, there are several regions which form an excessive number of convergent pairs. The region of Eszak-Alfold and Del-Alfold which both are part of Hungary, form the greatest number of convergent pairs, 228 and 215, respectively. Interestingly enough, the two other regions that form more than 200 convergent pairs also belong to Hungary. These are Del-DunAntúl (204) and Eszak-MagyarorszAg (203).

Until now, we observe several cases of regions that converge with an unusually great number of regions. A potential explanation for this is the size distortions in the ADF test caused by the small number of observations in the time series. If the sample length was sufficient enough, some of these findings could be different. However, our analysis is limited by the availability of the data.

We now focus more on the effect of ERDF on regional output. Table 5 provides an example of the results for ten regions. Some of the regions are the same as in Table 4, but for illustrative purposes some have been replaced by other regions. Similar to

Table 4, each value in each cell of the table denotes a relationship between the two regions in the respective row and column. We use 0 to denote that there the pair diverges regardless of whether we include the ERDF in the analysis. The unit value denotes that there is convergence between two regions both with and without the inclusion of the funding. In this example, there is no such case. If the two regions do not converge in the first case but converge when we account for the ERDF, then we use the value 2. Finally, the value 3 denotes that there is convergence in the first case but the use of the ERDF leads to divergence result.

According to Table 5, Abruzzo diverges with all the other nine regions. When we do not use the funding payments, Aragon also diverges with the rest of the regions. However, when we include the ERDF in the regression, Aragon converges both with Brandenburg and East Yorkshire and Northern Lincolnshire. On the contrary, the region of Brandenburg forms convergent pairs with Arnsberg, Hamburg, Koln and Wien when we employ the first approach, but diverges with the aforementioned regions when we employ the second methodology (the one that uses the funding payment). We can reach to similar conclusions for the rest of the regions not presented in this example. In general, we conclude that while ERDF yields a substantial increase in convergence among the NUTS-2 regions, in several cases it causes convergent pairs to diverge.

Table 5: An example of regional output convergence, detecting ERDF affection.

Region	Abruzzo	Aragon	Arnsberg	Attiki	Brandenburg	Cataluna	East Yorkshire & Northern Lincolnshire	Hamburg	Koln
Abruzzo									
Aragon	0								
Arnsberg	0	0							
Attiki	0	0	0						
Brandenburg	0	2	3	0					
Cataluna	0	0	0	0	2				
East Yorkshire & Northern Lincolnshire	0	2	0	0	0	2			
Hamburg	0	0	3	0	3	0	0		
Koln	0	0	3	0	3	0	0	0	
Wien	0	0	3	0	3	0	0	0	2

4.3. The effect of EAFRD on regional convergence

The second funding program we consider is the EAFRD. For EAFRD there are available data for 262[18] regions. Similar to the previous subsection, we first present the results from the first methodology (which does not consider the funding). This allows us for a better comparison and evaluation of the impact of the program on the output differences between the NUTS-2 regions. If we do not consider the funding payments for the 262 regions, we find that out of the 34,191 pairs, we detect convergence for 6,467 (approximately 20%) pairs. If we add the EAFRD payments in the model, then the number of convergent pairs increases to 10,859. However, this result does not indicate that there are now 4,392 new convergent pairs. The number of new convergent pairs is 6,949. This is due to the fact that when we add the effect of EAFRD, 2,557 pairs of convergent regions are now divergent. This finding is in line with the results from the ERDF, which indicates that while funding programs aim to improve the output imbalances among the regions, in several cases can lead to the expansion of output gaps. However, in the case of EAFRD this phenomenon occurs less often than in the case of ERDF, indicating that the EAFRD program fits better for improving output imbalances among the examined regions.

All regions form at least one convergent pair. In particular, two Greek regions, the regions of Anatoliki Makedonia & Thraki and Dytiki Ellada form seven convergent pairs each one. This finding is also in line with the results from the ERDF program where we observe that Greek regions converge with only a few other regions. The results for these regions when we do not include a funding program indicate almost a double number of convergent pairs for each region. This finding suggests that funding programs worsen the output gaps for the Greek regions.

[18] Regions excluded from the analysis: Area Metropolitana de Lisboa, Budapest, Castilla y Leon, Cyprus, Eastern and Midland, Grad Zagreb, Inner London - West, Karlsruhe, Landkreis, Karlsruhe, Stadtkreis, Kozep-DunAntúl, La Reunion, Mayotte, Northern and Western, Outer London - South, Outer London - West and North West, Panonska Hrvatska, Pest, Shropshire and Staffordshire, Sjeverna Hrvatska, Sostines regionas, Vidurio ir vakaru Lietuvos regionas, Warszawski stoleczny.

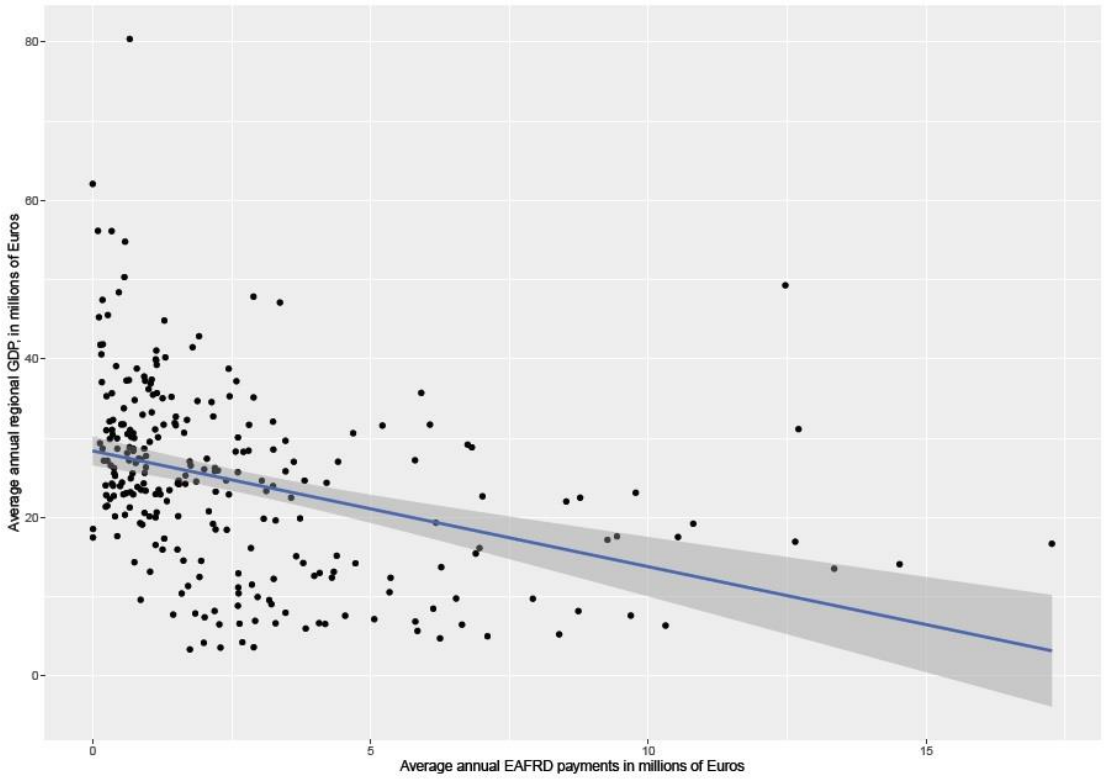

Figure 7: Relationship between average annual regional GDP and average annual EAFRD payments, both in millions of euro.

Table 6 presents a portion of the findings, similar to the previous table. When there is no convergence regardless of whether we add the EAFRD payments we use the value 0. Similarly, if for a pair of regions we are able to detect convergence with both approaches, we use the value 1. The value 2 denotes that two regions are output convergent only when we take into account the EAFRD payments. Finally, we use the value 3 when EAFRD leads to divergence. For example, with the exception of Latvia, the region of Berlin does not converge with any of the regions in the table, no matter whether we add EAFRD or not. Berlin and Latvia converge both with and without the inclusion of the funding program. According to Table 6, East Yorkshire and Northern Lincolnshire converges with both Aragon and Wien only when we account for the EAFRD payments. The latter is an example of EAFRD improving the output gap between NUTS-2 regions. On the contrary, the region of Latvia converges with Aragon and Berlin when we employ the first methodology but diverges with both regions when we insert the EAFRD payments in the model. The same finding is true for the case of Arnsberg and Wien pair.

Table 6: An example regional output convergence, detecting EAFRD affection.

Region	Aragon	Arnsberg	Attiki	Berlin	East Yorkshire & Northern Lincolnshire	Latvia	Luxemburg	Sicilia	Stockholm
Aragon									
Arnsberg	0								
Attiki	0	0							
Berlin	0	0	0						
East Yorkshire & Northern Lincolnshire	2	0	0	0					
Latvia	3	1	1	3	1				
Luxemburg	0	0	0	0	0	1			
Sicilia	0	0	0	0	0	1	0		
Stockholm	0	0	0	0	0	1	0	0	
Wien	0	3	0	0	2	1	0	0	0

4.4. The effect of ESF on regional convergence

The last funding program we consider in the analysis is the ESF. The European Commission provides payment data for 263[19] NUTS-2 regions. When we do not consider the ESF in the analysis, the 263 form 6,507 convergent pairs out of the 34,453 total pairs. This percentage is approximately 19%. When we include the ESF payments in the analysis, the percentage of convergent pairs rises to 24% (8,298 pairs). Although we detect 1,791 more convergent pairs when we consider the ESF payments, it is not clear whether the program actually helps poorer regions more than the wealthier ones. This is due to two reasons. First, the absolute increase in the convergent pairs is moderate. Second, although there is an increase in the number of convergent pairs, it is possible that the introduction of the ESF program leads several pairs that previously converged, to now diverge.

To properly evaluate the impact of the ESF program on the improvement of GDP imbalances across the regions, we should examine the changes caused by the introduction of the ESF payments in the analysis. The findings reveal that, when we add the ESF payments in the analysis, we are able to detect 4,913 new convergent pairs. This would be an encouraging result; however, the addition of the funding payments causes 3,122 convergent pair to diverge. These results suggest ESF program affects differently each region. This could be caused by the different management of the funding in each region. As Dubois and Fattore (2011) argue, the allocation of the

[19] Regions excluded from the analysis: Area Metropolitana de Lisboa, Budapest, Cyprus, Eastern and Midland, Grad Zagreb, Inner London - West, Karlsruhe, Landkreis, Karlsruhe, Stadtkreis, Kozep-DunAntúl, La Reunion, Mayotte, Northern and Western, Outer London - South, Outer London - West and North West, Panonska Hrvatska, Pest, Shropshire and Staffordshire, Sjeverna Hrvatska, Sostines regionas, Vidurio ir vakaru Lietuvos regionas, Warszawski stoleczny.

funding within a region is towards the richer municipalities, thus the total output of the region is not affected significantly.

When we include the ESF payments in the analysis, the findings suggest that each region converges with more than ten other regions. The only exception is the region of Vorarlberg which forms only 9 convergent pairs. In addition, the Greek regions that form only a few convergent pairs, when the ERDF and the EAFRD are considered, continue to form a relatively small number of pairs (no more than 16). Regarding the regions that form the most convergent pairs, the results indicate three regions that converge with more than 200 regions. These are Yugozapaden, Sud-Est and Severen tsentralen that converge with 232, 222 and 201 regions, respectively. As we discussed in a previous subsection, the excessive number of convergent pairs is due to size distortions caused by the small number of observations in the examined time series.

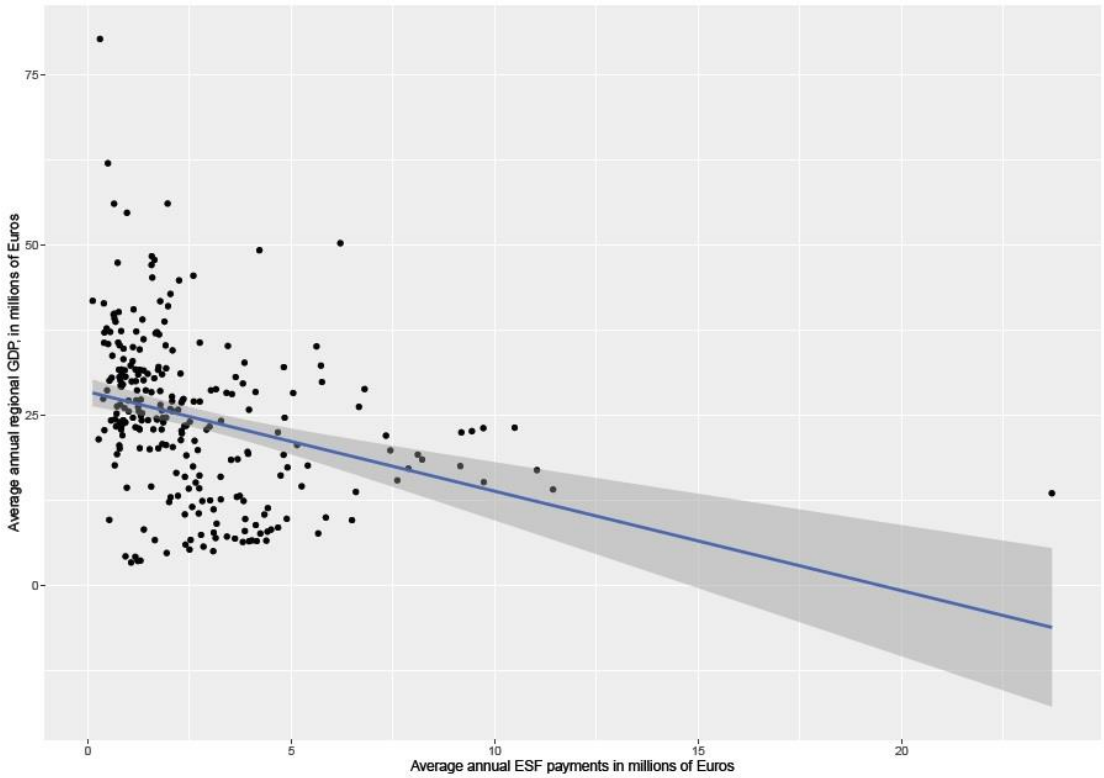

Figure 8: Relationship between average annual regional GDP and average annual ESF payments, both in millions of euro.

Finally, we present an illustrative example similar to the previous subsections. Table 7 reports the results for ten selected regions. The values of 0 and 1 denote that the two regions (in the corresponding row and column) diverge and converge, respectively, regardless of whether we take ESF into account. The sum of 0 and 1 entries in the results provides a measure of ineffectiveness of the ESF to affect regional output. This is suggested by the fact that the addition of the funding program in the model, does not affect (for better or worse) more than 75% of the examined cases. In Table 7, we observe that 33 out of the 45 pairs are not affected by the addition of the ESF payments in the model. For example, the ESF does not have an impact on the

convergence relationship between the regions of Attiki and Berlin, since in both methodologies suggest that there is no output convergence between these two regions. On the contrary, the output imbalances between the regions of Berlin and Cheshire are improved when we take the ESF into account. Similarly, ESF leads to convergence among the regions of Chesire and Wien. However, in several cases the funding payments yields negative results, meaning that it broadens the output gap across regions. According to Table 7, this occurs in cases such as the regions of Molise and Moravskoslezsko, and Liege and Wien. These two pairs of regions converged when we did not consider the ESF payments but diverge when we take the funding payments into account.

Table 7: An example regional output convergence, detecting ESF affection.

Region	Attiki	Berlin	Cheshire	Eesti	Groningen	Kujawsko	Molise	Moravskoslezsko	Liege
Attiki									
Berlin	0								
Cheshire	0	2							
Eesti	3	3	1						
Groningen	0	0	0	1					
Kujawsko	0	0	0	0	2				
Molise	2	0	0	1	0	1			
Mor/sko	3	0	0	0	1	0	3		
Liege	0	0	0	1	2	2	0	1	
Wien	0	2	2	1	0	1	0	1	3

4.5. Summary of pairwise convergence

On table 8 we present the cases that the pairs are convergent at different level of statistical significance for each of the above measurements. The case of rejection refers to hypothesis of unit root to be rejected. Evidently, rejection of H_0 reflects stationarity. We observe that at first step of testing for absolute convergence, taking account of solely GDP variable, the result of convergence appears for almost 20% of the pairs examined (α=5%). This proportion seems to increase to approximately 25% (α=5%) when we investigate conditional to a Structural Fund, ERDF or ESF, convergence. For the EAFRD the proportion of pairs that performs convergence equals to 32% (α=5%). Considering that Structural Funds suppose to accelerate the region cohesion and this aid is taking place reformed since 1989, the result of the survey is not quite overwhelming. However, the implication of the Structural Funds performs a positive rather mediocre affection to EU cohesion.

Table 8: Rejection frequency of pairwise convergence (%)

Proportion of tests rejected H_0 at significance level:			
A	10%	5%	1%
GDP	29.12	19.35	7.34
ERDF	37.99	24.61	5.96
EAFRD	45.69	31.75	10.72
ESF	37.95	25.91	5.80

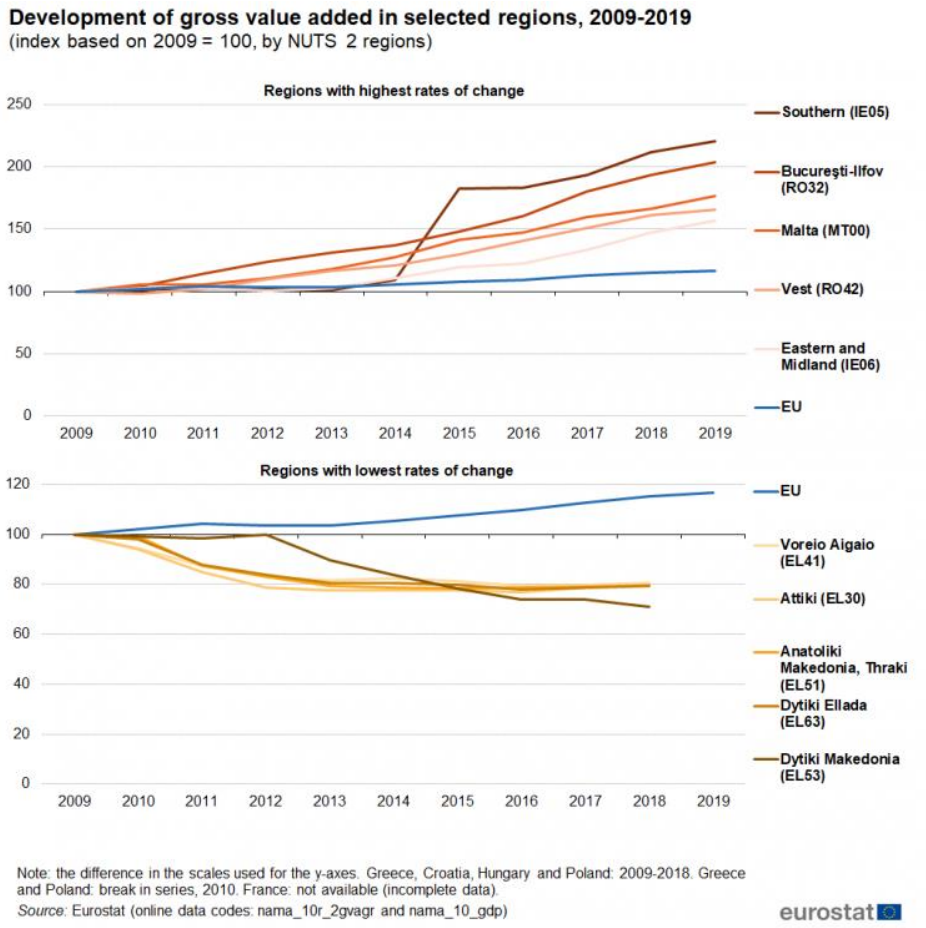

Figure 9: Development of Gross Value Added in period 2009-2019. Source: Gorzelak et al. (2017).

Figure 9, reinforces the conclusion of our empirical analysis that Greek regions do not perform an encouraging absorption of Structural Funds. The bottom part of the chart shows that all the four regions demonstrating minimum changes in their Gross Added Value belong to Greece. Deviation of the EU average for all of them is also observed. It is a matter of high concern the fact that a Member State since 1981, Greece, do not appear to adjust to Cohesion Policy and EU strategy. On the contrary, the top chart

informs us about regions which demonstrate the opposite picture and most of them belong to new entries; two Romanian regions and Malta (considered as one unique region). The other two regions form Ireland and show that, besides the fact that both Greece and Ireland appears a GNI rate below 90% EU average (Cohesion Fund receivers), Ireland takes advantage of it more effectively. Actually, as Table 10 informs us, Ireland is not from the 2007-2013 a receiver anymore and this is what the above figure verifies. The following two figures give the total picture for the 2007-2013 programming period confirming both the above scenarios to exist. Greece receives relatively high amounts of Structural Fund support, yet absorption is low. The question is whether absorption should be better if support was less like in case of Spain and what if this notion holds. Hungary, although a new entry, seem to absorb better the support provided.

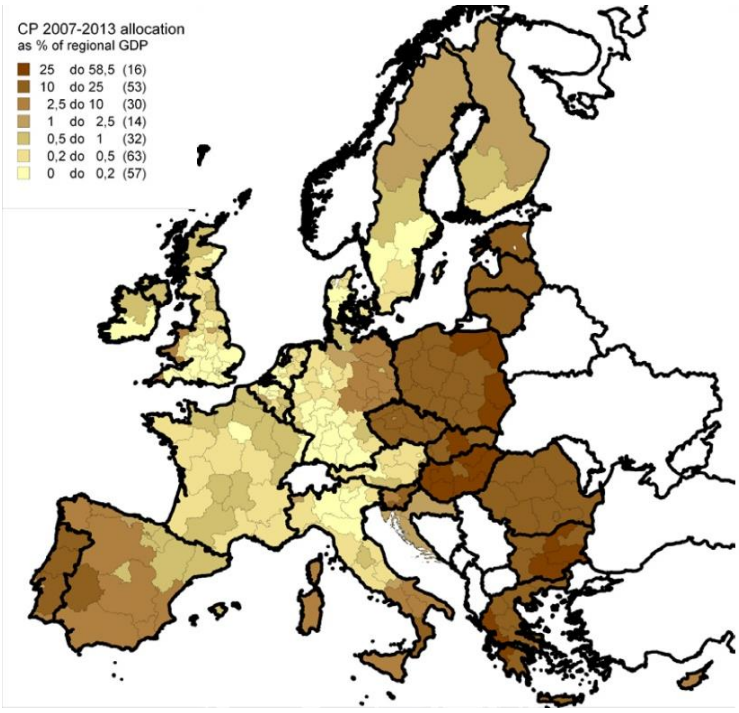

Figure 10: Cohesion Policy allocation 2007-2013 as % GDP (in 2007) by NUTS2 regions. Source: Gorzelak et al. (2017).

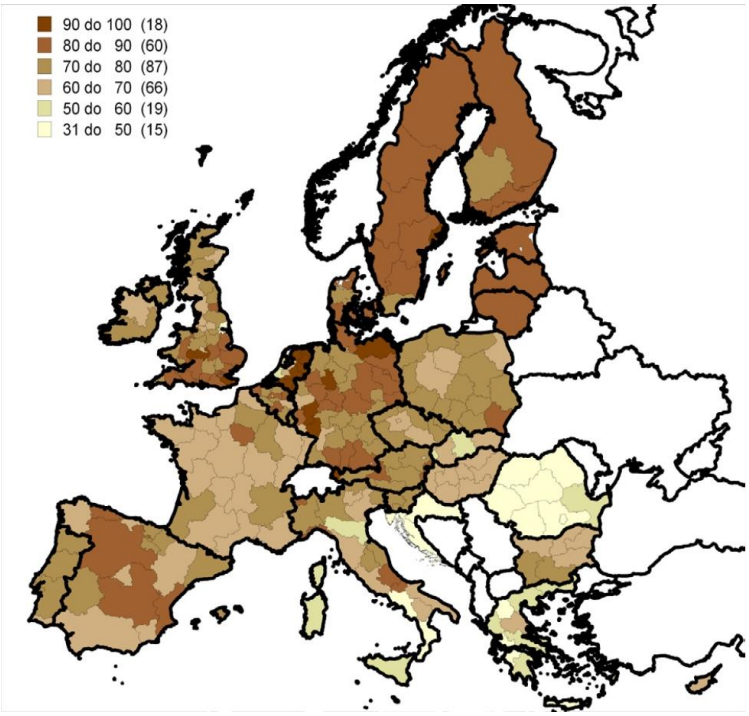

Figure 11: Absorption of rate of Cohesion Policy 2007-2013 – expenditures as a per cent of allocation at the end of 2014 [%], Source: Gorzelak et al. (2017)

5. Concluding remarks

This essay takes place in order to explore the case of Structural Funds affecting the EU region convergence. From its foundation, EU institution addresses as fundamental aspiration to provide the social and economic welfare for all of the EU Member States. To achieve this goal EU establishes the Cohesion Policy to diminish the disparities among and between countries and to drive the Union to the same development trajectory. One of the most important and large financial instruments is the Structural Funds, consisting approximately the 1/3 of EU budget, each one of them having a different, but complementary to the others, orientation and field of action.

Extensive literature presents bipolar results as the time period examined, data availability and methodology used, play an important role to the outcome of the research. A significant parameter to have robust findings is the consideration of instrumental variables and at this area the literature show a variety of choices. Sector share to output/income, human capital, innovation and diffusion of technology are only some of them.

Our analysis following the pairwise approach based on Pesaran (2007) paper, initially detects convergence unconditionally, taking account of only the GDP of our sample of 284 EU regions for a time period of 21 years (2000-2020). At second level, our interest concentrates on the inclusion of one of the following three Structural Funds: European Regional Development Fund (ERDF), European Agricultural Fund for Rural Development (EAFRD) and European Social Fund (ESF) at a time, while

Structural Funds consist of two more (EMFF, CF), but of relatively smaller budget, so we prefer except them from this survey. To achieve that inclusion, we apply a transformation of the aforementioned methodology, according to Beylunioglu (2017) and explore to one step further the EU convergence. Convergence, taking account of solely GDP data for 284 regions, so 40,186 pairs, appears at a level of approximately 20% to happen (α=5%), a rather disappoint result. Only a few cases of regions perform extreme behavior of converging to or diverging of the most of the other ones.

We additionally present an example of 10 regions' pairs randomly selected, for illustrative purposes not the same 10 regions each time, to depict the microscopic view of this research. In continuation of the little evidence of convergence at the first attempt, we rerun with the appropriate adjustment our model, inserting to the regression each one of the Structural Funds at a time. In three cases of inclusion ERDF, EAFRD or ESF measurements complications may take place as a result of the (small) size of the sample referring to time dimension, as the convergence evidence is rather overwhelming for some regions. Besides that, concluding that all of Greek regions show the less pairs of convergence proves the case of Greece being trapped at the middle income situation.

This is coherent with the result of Arvanitopoulos et al. (2021) show little evidence of convergence among Greek regions. Furthermore, the impressive convergence of the four of Hungarian regions confirms the findings of Alcidi (2019). EAFRD, in general, indicates better planning than the ERDF in terms of contribution to regions' convergence. Improvement of development policy and beneficiary treatment should be the highest priority, as in these two cases the convergence shows lower rate when Structural Funds are included in the equation; a hint of imbalances provoke at some part even from the funding. For ESF Greece continues to perform little evidence to be affected.

Similar investigation could take place for the rest of the regions, but Greece is an interesting case being a relatively old Member State and has not accomplice an impressive growth level as other, less advantaged regions have, such as CEE countries, Alcidi (2019). This case enhances the skepticism about Cohesion Policy and EU's strategies towards integration. Economic and Monetary (not for all Member States) Union as well as free movement of goods/services, capital and citizens are not sufficient.

To conclude, for each of the aforementioned Structural Funds the convergence affection, seems rather moderate and EU Cohesion Policy is far from achieving the aim of co-movement in terms of growth and development at regional level. A very insightful aspect of the importance of second-nature geography to taken into account is proposed by Arvanitopoulos et al. (2021). Another matter is whether time itself plays an important role too. Alcidi (2019) offers intriguing hints comparing US and EU evolution. Considering that these two institutions present similarities yet some severe differences in terms of grade of integration, our results reinforce the argument

of time as a considerable parameter to absorption and effectiveness of provided support.

Structural Funds at first sight do not demonstrate the anticipated effectiveness and seem not to be able to accomplice their aim of declining disparities among EU regions. Even in cases of old Member States convergence does not take place, yet they are eligible for a long time and have received large amounts of beneficiary via the Structural Funds. The expected result from long time support is a remarkable increase in terms of growth, which do not seem to happen, given our empirical analysis and the aforementioned literature. Yet, it is hard to argue that Structural Funds are not useful at all. They constitute the main EU tool for social and economic welfare and our results present a slightly better outcome to convergence due to Structural Funds. The crucial matter is that in many cases as Di Cataldo (2017), Cörvers & Mayhew (2021), Alcidi (2019) and others argue that lack of supportiveness by EU institutions would lead to deepening the gap between regions.

To summarize with a policy making point of view, we suggest that economies' structural features consist a key role to the effectiveness of Structural Funds. As Cappelen et al. (2003) indicate, the lack of development of relatively high value added sectors (manufacture) and the weakness to derive or/and absorb innovation consist the main drivers to little evidence of positive effect and refer mostly to Southern regions, e.g. greek ones. Institutions are the other parameters that create an appropriate environment for regions to accept the support and benefit the most of it. The year of 1998 consist a benchmark for EU policy to decline region disparities with the reform of the Funds and maybe this is the right moment for the next step to planning EU Cohesion Policy with specific guidelines to EU Member States, suitable to their own features. As a matter of fact, due to Covid-19 crisis to economic environment EU established before the beginning of the current programming period of 2021-2027, a new Fund, RRF[20] to provide support until 2025 to the most vulnerable enterprises with direct (grants) and indirect beneficiary (loans). From its initial planning till now, the RRF appears to be evolved from a recovery and survival treatment (low amount to enhance working capital) to a development oriented tool providing growth. In accordance with the aforementioned evolution of Cohesion Policy, national institutions should also proceed to some reform in order to Structural Funds be better received and contribute to EU convergence at regional level. This field demands further investigation which is not included in the purposes of this research.

[20] Recovery and Resilience Facility

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Appendices

Appendix 1: History of EU enlargement

Table 6: History of EU enlargement

	HISTORY OF EU ENLARGEMENT							
	EU-6	EU-9	EU-10	EU-12	EU-15	EU-25	EU-27	EU-28
	6 FOUND MEMBERS_**1957**	1st_enl_**1973**	2nd_enl_**1981**	3rd_enl_**1986**	4th_enl_**1995**	5th_enl_**2004**	6th_enl_**2007**	7th_enl_**2013**
1	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM
2	FRANCE	FRANCE	FRANCE	FRANCE	FRANCE	FRANCE	FRANCE	FRANCE
3	GERMANY	GERMANY	GERMANY	GERMANY	GERMANY	GERMANY	GERMANY	GERMANY
4	ITALY	ITALY	ITALY	ITALY	ITALY	ITALY	ITALY	ITALY
5	LUXEMBURG	LUXEMBURG	LUXEMBURG	LUXEMBURG	LUXEMBURG	LUXEMBURG	LUXEMBURG	LUXEMBURG
6	NETHERLANDS	NETHERLANDS	NETHERLANDS	NETHERLANDS	NETHERLANDS	NETHERLANDS	NETHERLANDS	NETHERLANDS
7		DENMARK	DENMARK	DENMARK	DENMARK	DENMARK	DENMARK	DENMARK
8		IRELAND	IRELAND	IRELAND	IRELAND	IRELAND	IRELAND	IRELAND
9		UK	UK	UK	UK	UK	UK	UK
10			GREECE	GREECE	GREECE	GREECE	GREECE	GREECE
11				SPAIN	SPAIN	SPAIN	SPAIN	SPAIN
12				PORTUGAL	PORTUGAL	PORTUGAL	PORTUGAL	PORTUGAL
13					AUSTRIA	AUSTRIA	AUSTRIA	AUSTRIA
14					FINLAND	FINLAND	FINLAND	FINLAND
15					SWEDEN	SWEDEN	SWEDEN	SWEDEN
16						CZECH REPUBLIC	CZECH REPUBLIC	CZECH REPUBLIC
17						ESTONIA	ESTONIA	ESTONIA
18						CYPRUS	CYPRUS	CYPRUS
19						LATVIA	LATVIA	LATVIA
20						LITHUANIA	LITHUANIA	LITHUANIA
21						HUNGARY	HUNGARY	HUNGARY
22						MALTA	MALTA	MALTA
23						POLAND	POLAND	POLAND
24						SLOVAKIA	SLOVAKIA	SLOVAKIA
25						SLOVENIA	SLOVENIA	SLOVENIA
26							BULGARIA	BULGARIA
27							ROMANIA	ROMANIA
28								CROATIA

Appendix 2: Descriptive statistics per country for each SF payments (one table per fund)

Table 7: Descriptive statistics per country for the ERDF payments

Country	Mean	SD	Kurtosis	Skewness	Min	Max
AT (Austria)	9.27	10.13	5.05	1.45	0.37	55.17
BE (Belgium)	9.58	19.83	16.16	3.57	0.04	123.22
BG (Bulgaria)	30.11	38.29	4.47	1.38	6.72	174.00
CY (Cyprus)	20.32	25.36	2.91	1.12	1.70	75.13
CZ (Czech Republic)	92.65	104.88	6.49	1.57	4.20	570.60
DE (Germany)	42.89	77.59	10.59	2.70	0.01	527.68
DK (Denmark)	4.48	4.25	5.00	1.43	0.06	19.22
EE (Estonia)	113.91	115.66	2.22	0.72	22.60	338.95
EL (Greece)	114.03	133.37	11.54	2.55	7.32	873.02
ES (Spain)	146.97	239.24	18.22	3.41	0.82	1835.78

FI (Finland)	21.75	27.99	6.27	1.85	0.18	139.42
FR (France)	35.15	32.63	10.64	2.13	0.10	260.05
HR (Croatia)	0.79	0.63	-0.44	0.83	0.08	0.99
HU (Hungary)	115.57	120.25	3.39	0.97	9.61	516.02
IE (Ireland)	67.37	75.75	4.65	1.53	6.57	282.66
IT (Italy)	99.96	193.93	13.96	3.12	0.13	1339.99
LT (Lithuania)	229.22	241.71	2.28	0.77	58.39	745.16
LU (Luxembourg)	4.15	4.25	8.14	2.04	0.02	19.03
LV (Latvia)	149.63	152.76	1.63	0.48	31.71	406.49
MT (Malta)	25.13	28.45	6.49	1.68	3.48	118.79
NL (the Netherlands)	8.45	8.70	4.58	1.33	0.00	42.04
PL (Poland)	142.50	170.15	5.68	1.56	8.17	926.13
PT (Portugal)	196.57	219.82	7.44	1.95	0.60	1238.72
RO (Romania)	55.30	77.67	6.04	1.81	14.60	374.94
SE (Sweden)	12.91	12.22	4.20	1.30	0.40	57.35
SI (Slovenia)	52.12	64.99	3.31	1.20	6.30	233.54
SK (Slovakia)	85.54	101.12	3.01	1.09	2.30	350.10
UK (United Kingdom)	20.72	38.42	22.67	3.86	0.01	325.17

Table 8: Descriptive statistics per country for the EAFRD payments

Country	Mean	SD	Kurtosis	Skewness	Min	Max
AT (Austria)	31.59	41.38	3.45	1.31	0.03	142.82
BE (Belgium)	3.32	3.79	3.28	1.01	0.00	16.15
BG (Bulgaria)	23.06	26.21	2.32	0.74	15.71	85.51
CY (Cyprus)	9.56	8.97	1.36	0.02	10.46	22.91
CZ (Czech Republic)	23.64	25.90	2.67	0.81	0.12	99.09
DE (Germany)	20.46	31.41	9.00	2.38	0.00	191.36
DK (Denmark)	8.20	9.32	2.75	0.90	0.07	34.54
EE (Estonia)	53.61	51.54	1.45	0.31	5.68	129.93
EL (Greece)	28.79	29.15	7.83	1.85	0.75	190.32
ES (Spain)	39.36	56.95	7.64	2.06	0.00	338.24
FI (Finland)	36.80	43.10	2.70	0.96	0.01	168.60
FR (France)	23.33	33.41	23.32	3.57	0.01	304.71
HR (Croatia)	6.77	3.88	-0.13	0.64	1.80	13.69
HU (Hungary)	33.08	32.51	2.84	0.77	2.66	127.54
IE (Ireland)	93.39	96.87	2.07	0.68	1.77	303.74
IT (Italy)	36.61	47.30	6.60	1.84	0.00	260.04
LT (Lithuania)	122.40	114.94	1.15	0.07	7.55	260.03
LU (Luxembourg)	6.66	6.52	1.46	0.23	0.10	17.90
LV (Latvia)	79.21	78.68	1.50	0.38	10.68	214.81
MT (Malta)	4.42	5.05	2.81	0.89	0.25	17.18
NL (the Netherlands)	3.57	4.24	6.10	1.77	0.00	21.53
PL (Poland)	49.49	59.52	4.78	1.48	1.76	292.38
PT (Portugal)	56.98	75.86	5.91	1.89	1.91	335.38
RO (Romania)	61.72	82.58	4.42	1.37	2.49	368.12
SE (Sweden)	16.15	17.44	2.70	0.95	0.10	60.97
SI (Slovenia)	29.39	30.48	1.88	0.54	0.49	88.22
SK (Slovakia)	32.14	37.94	4.49	1.35	3.85	163.99
UK (United Kingdom)	9.41	11.49	5.14	1.47	0.01	65.33

Table 9: Descriptive statistics per country for the ESF payments

Country	Mean	SD	Kurtosis	Skewness	Min	Max
AT (Austria)	6.99	6.79	7.07	1.74	1.05	36.75
BE (Belgium)	10.25	13.16	13.81	2.75	0.01	96.77
BG (Bulgaria)	11.76	16.52	4.34	1.54	3.02	64.73
CY (Cyprus)	7.52	8.90	3.96	1.28	1.06	31.71
CZ (Czech Republic)	28.71	39.26	10.68	2.46	1.40	225.18
DE (Germany)	27.88	32.75	10.35	2.51	0.08	231.72
DK (Denmark)	6.82	5.44	4.37	1.14	0.07	27.23
EE (Island)	28.15	31.87	3.03	1.02	1.76	108.08
EL (Greece)	37.91	36.39	10.35	2.22	7.18	234.60
ES (Spain)	52.50	68.87	15.97	3.15	0.87	476.94
FI (Finland)	15.88	15.55	3.37	1.01	0.02	65.10
FR (France)	23.65	19.88	8.46	1.74	0.47	150.71
HR (Croatia)	1.49	1.36	1.10	1.30	0.12	4.39
HU (Hungary)	32.90	38.55	4.51	1.36	1.73	173.30
IE (Ireland)	35.09	27.96	2.55	0.60	7.35	105.54
IT (Italy)	36.23	47.23	13.00	2.72	0.02	338.62
LT (Lithuania)	68.03	70.02	1.69	0.47	12.08	181.47
LU (Luxembourg)	3.00	1.96	2.63	0.13	0.76	7.46
LV (Latvia)	38.70	49.04	2.99	1.09	5.63	157.61
MT (Malta)	6.63	8.30	3.98	1.38	1.07	27.16
NL (the Netherlands)	10.62	10.98	10.20	2.23	0.03	71.75
PL (Poland)	42.93	41.54	2.44	0.67	8.07	163.46
PT (Portugal)	92.76	102.56	7.35	1.98	0.03	536.04
RO (Romania)	21.58	32.69	4.68	1.68	1.77	134.17
SE (Sweden)	10.83	12.49	5.79	1.72	0.12	60.20
SI (Slovenia)	22.86	28.73	2.90	1.11	1.35	93.40
SK (Slovakia)	25.34	32.28	5.69	1.69	1.46	145.64
UK (United Kingdom)	15.09	22.52	23.75	3.80	0.01	223.09

Appendix 3: Cohesion Fund distribution to EU Member States over time. Indication NR means that the Member State is not a receiver one for the period, while X interprets that the country is a receiver for the period.

Table 10: Cohesion Fund supported EU Member States per programming period

Programming period	1989-1993	1994-1999	2000-2006	2007-2013	2014-2020
Member State					
BG (Bulgaria)	-	-	X	X	X
CY (Cyprus)	-	-	X	X	X
CZ (Czech Republic)	-	-	X	X	X
EE (Estonia)	-	-	X	X	X
EL (Greece)	-	X	X	X	X

ES (Spain)	-	X	X	X	NR
HR (Croatia)	-	-	-	X	X
HU (Hungary)	-	-	X	X	X
IE (Ireland)	-	X	X	NR	NR
LT (Lithuania)	-	-	X	X	X
LV (Latvia)	-	-	X	X	X
MT (Malta)	-	-	X	X	X
PL (Poland)	-	X	X	X	X
PT (Portugal)	-	-	X	X	X
RO (Romania)	-	-	X	X	X
SI (Slovenia)	-	-	X	X	X
SK (Slovakia)	-	-	X	X	X