The impact of European Regional Cohesion Policy on NUTS 3 disparities[1]

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ABSTRACT

The impact of the European Union's Cohesion Policy is still controversial. Now more than ever, there is a particular demand for the Regional Cohesion Policy to be impactful and effective. In this context, the paper aims to determine the effect of the regional Cohesion Policy on the NUTS 3 economic disparities. Although the regions eligible to receive Structural Funds, the main financial instrument of the Regional Cohesion Policy, are defined at NUTS 2 level, some local effects that remain hidden at this level and affect disparities might be revealed by performing the analysis at a finer level of disaggregation, the NUTS 3 level. Our results show that the impact of Structural Funds on regional disparities is not as expected, as eligible regions experience a larger increase in disparities than non-eligible ones.

Keywords: Inequalities, Regional Cohesion Policy, Convergence, European Union, NUTS 3 regions

JEL classification codes: C23, R58, F02

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1. Introduction

The study of regional disparities in the European Union (EU) has attracted considerable attention in the last decades mainly due to their inclusion in the Article 158 of the Treaty of the EU, which states "in particular, the Community aims to reduce the disparities between the levels of development of the different regions". The presence of disparities is considered to be detrimental for the competitiveness, integration and cohesion of the European Union. To that end, the Cohesion Policy, which is the main EU's policy instrument committed to reduce regional disparities, dedicates a large quantity of funds, targeted specially to lagging regions, to give them the chance to converge with the more prosperous ones.

According to the literature, there has been a reduction tendency in the inequalities among EU's member states in the last decades (Bourdin 2015; Duro 2004; Hegerty 2016; Monfort 2020; Monfort 2008; Petrakos et al. 2005) hence the European Union has been considered as a "convergence machine", at least until the global financial crisis in 2008 (Monfort 2020). However, despite the efforts of the Cohesion Policy, inequalities between regions within the same country have been growing in the last years, strengthened by the 2008 crisis and the accession of new countries to the European Union (Heidenreich and Wunder 2008; Meliciani 2015; Mora and Vaya 2004). As it is stated by Monfort (2020), within-country disparities accounted for one third of the total disparities in the EU in 2000, reaching 66% of the total inequalities in 2017. Indeed, in most EU's member states, due to the uneven spatial distribution and agglomeration of the economic activities (Geppert and Stephan 2008; Tvrdoň 2012), within-country disparities have been growing at both NUTS 2 and NUTS 3 levels, questioning the efficiency of the Cohesion Policy (Butkus et al. 2018).

The rising of inequalities, specially within a country, generates a climate of discontent between the population and increases the Euroscepticism towards the EU's actions and policies dedicated to combat those. Consequently, some citizens are questioning the contribution of the EU as the 'project' capable of eradicating the differences between the European regions and achieving economic cohesion to create a solid community capable of facing the uncertainties and problematic issues in which they are increasingly involved. The rise of nationalistic movements is reflecting this sentiment, which is a potential threat to democracy in the EU's member states and a threat to the continuity of the European Union as such. This context of political tensions and increasing inequalities between the levels of development and well-being of the citizens jeopardize the European Union project by placing it in a risky situation where its legitimacy is challenged. Therefore, now more than ever, the Cohesion Policy is requested to be impactful and effective.

The core hypothesis is that the Structural Funds, the main instrument of funding of the Cohesion Policy, decrease the cross-country inequalities but increase regional inequalities (Jovančević et al. 2015). During the policy programming periods reviewed in this analysis, Structural Funds comprised of five funds, but only three of them fell under the EU's Cohesion Policy. Two of the latter three (the European Regional Development Fund and the European Social Fund) are the ones studied in this research, since its eligibility criteria is defined at regional level.

Yet, essentially all existing work on the assessment of the Cohesion Policy at regional level mainly uses regional data at the NUTS 2 level. This may be problematic because, although the second level of the EU's classification (NUTS 2) is used for defining eligible regions to be benefited from the Cohesion Policy funding, "…the NUTS-2 level, at which eligibility and financial allocations are largely determined, may not be the appropriate level at which to capture policy effects…" as it was stated by Fratesi and Wishlade (2017, p. 819). Indeed, the allocation of the funds within NUTS 2 regions may be uneven throughout the NUTS 3 regions since the eligibility for receiving funds is defined at NUTS 2 level regardless of the economic performance of their NUTS 3 regions (Gagliardi and Percoco 2017). It is what these authors define as "accidental winners", NUTS 3 regions in theory not eligible for receiving funds according to the GDP threshold, but which end up being treated because they belong to eligible NUTS 2 regions. Additionally, the effectiveness of the Cohesion Policy is not homogeneous within the NUTS 2 regions, as it may be conditioned to some structural factors (Gagliardi and Percoco 2017; Percoco 2017) such as the structure of the public sector or the urban structure of the regions. These aspects could cause an increase of the differences in the level of economic development of the NUTS 3 regions belonging to the same NUTS 2 region, reversing the purpose of the Cohesion Policy.

Therefore, the consideration of these effects is essential in order to assure a more effective assessment of the policy impact on the regional economic inequalities, which is covered by using data at a finer level of disaggregation, the NUTS 3 level. By performing the analysis at a finer geographical scale, some local effects that are not evident at NUTS 2 level and remain hidden in the aggregated NUTS 2 regions might be revealed, since NUTS 2 level may be masking the heterogeneity of the EU's regional economic disparities (López-Villuendas and del Campo 2023). Also, taking a NUTS 3 perspective has the additional benefits of yielding a larger estimation sample, enriching the robustness of the analysis.

In order to fill this scale gap in the current literature, we will approach the NUTS 3 dimension in the present study by evaluating the impact of the Structural Funds on the NUTS 3 regional economic inequalities, covering all 1348 NUTS 3 regions during a wide time span of almost three fully policy programming periods. Year 2000 was selected as the starting point of the analysis as that was the year all ten countries officially joining the European Union in 2004 (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia) started to participate of the Cohesion Funds.

Hence, the contribution of the present study to the literature will be to offer a richer assessment of the Cohesion Policy impact on the regional economic inequalities by focusing on the NUTS 3 level which exposes the heterogeneity within the aggregates NUTS 2 regions. This heterogeneity could reverse the purpose of the Cohesion Policy and could cause an important bias in the proper evaluation of the Cohesion Policy. Additionally, this analysis considers all NUTS 3 regions and covers almost three complete policy programming periods, which is rather scarce in literature since studies usually focus on a specific programming period. Hence this paper provides a deeper assessment of the Cohesion Policy.

The remainder of the paper is structured as follows. In the following section a brief review of the literature on this topic is presented. The methodology is described in section 3 while section 4 presents the results and their policy implications are discussed. Concluding remarks and limitations of the study are then presented in section 5.

2. Background literature

The effectiveness of the Cohesion Policy has been broadly approached by studying the effect of the Structural Funds on, particularly, the economic growth and the regional and national convergence (understood as the catching up of the lagging regions with the prosperous ones), during the last decades employing a wide range of methodologies. Despite the vast literature addressing this issue, the effect of Cohesion Policy on economic growth and convergence is not clear, and it depends on the selected policy period and the employed methodologies. Some studies observed a positive effect of the structural spending on economic growth (e.g., Becker et al. 2010; Cappelen et al 2003; Crescenzi and Giua 2020). However, most of the studies determined that the positive effect is conditioned to some specificities such as the intensity of transfers (Di Cataldo 2017), the geography (Giordano 2017), the expenditure category and intervention area (Pontarollo 2017), the absorptive capacity of regions (Becker et al. 2013), the institutional quality (Becker 2012; Kyriacou and Roca-Sagalés 2014), or the quality of government (e.g., Rodríguez-Pose and Garcilazo 2015). On the other hand, some authors find that the Cohesion Policy improves national economic convergence (e.g., Beugelsdijk and Eijffinger 2005; European Commission 2017) and regional convergence (Dall’erba 2005), while others find no effects on regional convergence (e.g., Esposti and Bussoletti

2008; Dall'erba and Le Gallo 2008) or even a negative impact (e.g., Breindenbach et al. 2016). See Fidrmuc et al. (2024) for a thorough review of the impact of Cohesion Policy in the current literature.

Unlike the impact of Cohesion Policy on inter-country convergence, understood as the catching up of the lagging regions with the prosperous ones, the literature on the effects of Cohesion Policy on intra-country sigma convergence (understood as the reduction of inequalities) is rather scarce and inconclusive (Mogila et al. 2022).

Kyriacou and Roca-Sagalés (2012) studied the effect of the Structural Funds on NUTS 2 regional disparities in 15 EU's countries over period 1995-2006, determining that Structural Funding reduced disparities but this effect was reversed above some level of transfer intensity (approximately 1.6% of country GDP). Védrine and Le Gallo (2021), determined for period 2000-2014 that the regional within disparities of EU-15 NUTS 2 regions are negatively impacted by an increase of Structural Funds without incurring on any effect on economic growth, but the regions of the new member states, whose growth is positively affected by the Structural Funds, present an increase of their within disparities. Arcalean et al. (2007) found that Structural Funds slightly reduce the NUTS 2 regional disparities in Portugal over the period 1977-2002. Mogila et al. (2022) revealed that the Cohesion Policy will have a relatively small impact on reducing the within-country disparities (at NUTS 2 level) in the 2021-2027 period in some eastern countries, concluding that the Cohesion Policy will fail in terms of reducing within-country inequalities in the long run.

Beugelsdijk and Eijffinger (2005), testing convergence for the period 1995-2001 concluded that Structural funds appear to have a positive impact on interregional disparities. Eggert et al. (2007), who investigated EU's intervention in 16 German NUTS 1 regions from 1989 to 1999, stated that the Cohesion Policy stimulates intra-country convergence. Boldrin and Canova (2001), tested whether EU's policies had any impact on the regional per capita income for the period 1980-96 confirming no significant impact of Cohesion Policy on within-country regional disparities. The same conclusions of no significance are obtained in Ederveen et al. (2002) for period 1981-96.

Lastly, Butkus et al. (2020a) assessing the effect of regional financial support for period 2000-2006 on NUTS 3 regions (except regions of Romania, Bulgaria and Croatia) concluded than even though the effect of Structural Funds payments is positive, there is a need for a minimum threshold level of institutional quality in the region for this effect to become statistically significant. Additionally, it takes time for the positive and statistically significant effect to manifest, i.e. the estimated effect of Structural Funds' payments is significant just over the post- financial support period.

To the best of our knowledge there are only three studies focussed on the impact of Cohesion Policy on the NUTS 3 regional disparities (Butkus et al. 2020a, Butkus et al. 2021, and Védrine and Le Gallo 2021). However, Butkus et al. (2020a) only studies the policy programming period from 2000 to 2006, while Butkus et al. (2021) studies 2000 to 2006 and 2007 to 2013 programming periods and Védrine and Le Gallo (2021) only focusses on within NUTS 2 disparities (at NUTS 3 level) but estimating them with indicators at NUTS 2 level. Therefore, we intend to extend the literature determining the impact of the Structural Funds on the NUTS 3 inequalities by studying the disparities in both components (within and also between NUTS 3 regions) and estimating them using NUTS 3 level own characteristics for almost three complete programming periods.

It is of high importance for policymakers to determine whether the Cohesion Policy, defined at NUTS 2 level reduces disparities among the NUTS 3 regions, since the decomposition of disparities across the EU indicates that over the past 20 years the share of the total inequalities of the member states attributed to the NUTS 3 level has been increasing (Butkus et al. 2018), implying that the Cohesion Policy does not deal sufficiently enough with the problems within the NUTS 2 regions, i.e. on the NUTS 3 level, neglecting the specific characteristics and features of the NUTS 3 regions that can affect the effectiveness of the Cohesion Policy financing. Going to a finer level of disaggregation (NUTS 3 level) when estimating the effect of the Cohesion Policy will allow for a more accurate assessment of the compliance of its objective, which is to decrease the regional (economic) disparities. Indeed the level of disparities is an important indicator, calculated by the dispersion of per capita GDP, which reflects the differences of the regions' economic development as well as their potential economic problems.

3. Methodology and data

3.1. Regional inequality

Aiming to estimate the effect of Cohesion Policy on regional disparities, we study whether the NUTS 3 regions receiving Structural Funds experience a further increase of disparities than regions which are not eligible to receive Structural Funds. The eligibility criteria is stated at NUTS 2 level, therefore, if a NUTS 2 region is eligible for receiving Structural Funds, all their NUTS 3 regions are considered eligible. Structural Funds are the policy instrument most intensively used by the European Union to promote economic growth and to speed up the process of convergence among its member states.

In the context of the European integration process, convergence has become a long-lived field of study. It integrates neoclassical theories which state that as long as markets are not intervened, the levels of development of different regions (usually approximated through the per capita income) will be levelled over time. This theory has been conceptualized in specially two formulations proposed by Barro and Sala-i-Martin (1991, 1992, 2004), frequently used in literature, and called β- and σ-convergence. The first one refers to the catching up of the poorest economies with the richer ones, while the later refers to the reduction of the per capita income gap over time, so it can be seen as a way of looking at income inequality (Villaverde and Maza 2009). Therefore, in the present analysis, we will be dealing with σ-convergence, as it directly addresses the inequalities.

Several measures exist in the literature to quantify the inequality and there is not a unique criterion for selecting an appropriate inequality measure. In fact, the evolution of disparities over time may be different regarding the used measure, so it is recommendable to address several measures to corroborate the veracity of the obtained results (Ezcurra and Rodríguez-Pose 2009). In order to quantify the economic inequalities of the EU's NUTS 3 regions we will use the Theil index and the Mean Logarithmic Deviation (MLD) measures.

The Theil index (Theil 1967) has become a very popular measure for quantifying regional inequalities. It is scale and mean independent and not excessively affected by outliers. The Theil index is a particular case of the Generalised Entropy Index with coefficient 1. Following Rey and Janikas (2005), the Theil index is given by:

$$T=\sum_{i}^{n} s_i \log\left(n s_i\right)\left(Eq.1\right)$$

where *n* is the number of regions and

$$s_i = y_i / \sum_{i}^{n} y_i \left(Eq.2\right)$$

being y_i the per capita GDP in region *i*.

The Theil index can be interpreted as the logarithm of a weighted geometric mean of the regional per capita incomes, the weights being represented by the income shares. A dual form also exists, in which the income shares are changed by population shares. According to Gluschenko (2018), who claims that this weighted approach is conceptually inconsistent, we use the Theil index without weighting by population (Eq. 1).

The Mean Logarithmic Deviation is also a member of the generalised entropy family of inequality measures, corresponding to the Generalised Entropy Index with coefficient 0. MLD, compared to the Theil index, is more sensitive to the inequality that appears at the bottom of the income distribution. It is given by:

$$L=\sum_{i}^{n} 1/n \log \left(1/n/s_i\right)(Eq.3)$$

Bourguignon (1979), Shorrocks (1980) and Cowell (1995) showed that the Generalized Entropy Indices satisfy all the axioms of inequality measures[2].

The income variable used in the Entropy measures in the present paper is the per capita Gross Domestic Product in Purchasing Power Standars (GDP PPS), collected from the Cambridge Econometrics' European Regional Database that is available from the new Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO 2020).

The entropy measures have been calculated throughout the period from 2000 to 2019, which basically covers the three most recent EU's budgetary periods, and for all 1348 NUTS 3 regions in the EU28 (UK is included in the analysis as it was still a EU member throughout that period).

The eligibility criteria for receiving the Cohesion Policy funding is stated at NUTS 2 level. Eligible regions have been defined in all three studied funding periods as regions with a per capita GDP less than the 75% of the EU's average, receiving Structural Funds from the European Regional Development Fund and the European Social Fund. These are:

- Regions under the Objective 1 for policy period 2000-2006. Regions belonging to the ten countries which joined the European Union in 2004 (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia) have been also considered under Objective 1 from 2000 to 2004 since they were receiving pre-accession funds in that period. Regions belonging to Bulgaria and Romania, which joined the EU in 2007, have been considered, as well, under Objective 1 from 2000 to 2006 since they were receiving pre-accession funds in that period.
- Convergence regions for policy period 2007-2013. Regions belonging to Croatia, which joined the EU in 2014, have been considered also as convergence regions from 2007 to 2013 since they were receiving pre-accession funds in that period.
- Less developed regions for period from 2014 to 2019 in our case (the whole policy period is from 2014 to 2021).

We confine our study to this funding because it has the specific objective of increasing the level of development in regions that are lagging behind the EU's average and entail the largest part of the overall Structural Funds.

[2] Properties of inequality measures: mean or income scale Independence, Population Independence, Symmetry, The Pigou-Dalton Transfer principle, Decomposability.

The n+2 rule, which states the obligation to spend the funds allocated annually by the second year following the end of the programming period has not been taken into account in order to avoid overlaps in the different policy periods. However, it does not represent an issue in the analysis since only about 17% of regions changed their eligibility status over the three different programming periods and only about one third of these regions belong to countries with low absorption rates. Therefore, although a region might have not spent all the funds at the end of one period, it usually is still eligible and receives funds in the following programming period.

3.2. The model

Authors in the aforementioned literature have applied different methods when studying the effect of Cohesion Policy on intra-country convergence. Among them, Butkus et al. (2020a), applied a Difference-in-Difference model for a single policy programming period (2000-2006), Mogila et al. (2022) performed a macroeconomic approach while other studies used reduced-form single-equation econometric models (e.g. Kyriacou and Roca-Sagalés 2012; Védrine and Le Gallo 2021; Giua 2017) based on the Williamson hypothesis, which allows to model the dynamics and estimate the main determinants of the regional disparities. Following this last line of methodology, and since our aim is to test the impact of Cohesion Policy on disparities in NUTS 3 regions throughout different programming periods, we formulate a simple econometric model in which the level of inequalities for each NUTS 3 region, quantified by the inequality measures of Eq. 1 and Eq. 3, depends on the eligibility of the region to receive Structural Funds.

We have therefore limited ourselves to establish the simplest connection between the Structural Funds and the economic inequality across European regions, by conducting a panel regression model in which regional economic inequality during the period 2000-2019 is regressed on the eligibility of the region to be financed from Structural Funds (Eq. 4):

$$Inequality_{¿} = \beta_1 Eligibility_{¿} + \beta_2 X_{¿} + u_{¿} \left(Eq.4 \right)$$

Where $Inequality_{¿}$ is the inequality measure of each NUTS 3 region *i* in time *t* covering period 2000-2019, *X* stands for a set of control variables which account for additional factors that may have an influence on regional disparities and *u* is the corresponding disturbance term. *Eligibility* is a dummy variable which has a value of 1 when the *i* NUTS 3 region in year *t* is eligible for receiving Structural Funds and 0 otherwise. This variable only captures the policy status of the regions and does not account for the effective expenditure they benefit from. However, it captures the intention to treat effect and it is in line with many studies in the literature analysing the effect of Structural Funds on socio-economic variables (e.g. Giua 2017).

Using this dummy variable instead of the real intensity of the Structural Funds treatment may consider eligible regions as treated when they have actually received less funding than initially budgeted. Structural Funds are delivered to local stakeholders which apply for policy support by submitting projects to be financed. However, they may not result elected to be financed since they might not meet the policy requirements implying the return of funds to the European Union as there are not enough projects to absorb the funding. Additionally, the absorption of the EU's funds depends to a high degree on the abilities of institutions to effectively implement policies so the lack of administrative capacity of the regions may jeopardise the absorption of the funds.

Unfortunately, the effective expenditure of the regions, which would have enabled us to estimate more accurately the effect of the Structural Funds on the inequality by confirming that each region considered eligible has received and spent funds, is not available at NUTS 3 level. Nevertheless, coefficients estimated by considering the eligibility dummy capture the intention to treat effect that is the lower bound for the average treatment effect that a continuous policy variable would have captured (Giua 2017). Additionally, it indicates the eligibility criterion for each year, since a region could move from eligible to non-eligible and vice versa through the different programming periods (although it is not the usual).

When selecting our control variables we take into account characteristics which may affect both regional inequalities and Structural Funds and, therefore, its omission might bias the estimated impact of Structural Funds on regional inequalities. These variables have been selected from the literature that studies the effect of Cohesion Policy on inequalities as well as the literature that studies the determinants of regional inequalities.

Hence, our choice of control variables includes the level of economic development measured by per capita GDP, together with the population density, the area of the regions, the employment rate and the initial level of inequalities. The level of economic development is quite relevant when explaining regional disparities, as it has been broadly discussed in inequality literature (e.g. Petrakos et al., 2005). The per capita GDP is the criteria used to determine the eligibility of a region for receiving Structural Funds, however, GDP can also influence the regional disparities for independent causes (Kyriacou and Roca-Sagalés 2012; Védrine and Le Gallo 2021). Its effect on regional disparities is controversial, as one can argue distinct theoretical points of view particularly when considering growth of economic development. As it is stated in Petrakos et al. (2005), some scholars following Solow (1956) claim that disparities are bound to diminish with growth, because of diminishing returns to capital. However, other schools following Myrdal (1957), agree that growth is a cumulative process, which is likely to increase inequalities.

As we have not weighted the measures of regional inequality by population according to Gluschenko (2018), who claims that this practice might lead to inconsistent outcomes, we control it by including the population density in the model. This variable might be a factor explaining regional inequalities and furthermore, it will enable us to control agglomeration effects (Crescenzi et al. 2017) and the region's size. It will be expected that disparities are affected by agglomeration effects. Other authors have included the population growth (Védrine and Le Gallo 2021) in their models.

Additionally, to control the differences in population size across regions, we control for the size of the regions as it is done in the inequality literature (e.g. Leßmann 2014; Védrine and Le Gallo 2021). Since larger regions are often more heterogeneous than smaller regions, a positive relationship with inequalities will be expected (Williamson 1965). We also add the employment rate as a further control variable (authors as Védrine and Le Gallo (2021) included the employment density or the sectoral composition of employment), and we expect that more employment opportunities reduce the development disparities (Leßmann 2014).

Finally, we are going to control for the initial level of inequalities at the beginning of the study period in order to verify whether the regions with more initial inequalities continue to have more inequalities than the rest of the regions. The desired outcome will be that regions with high initial disparities have reduced them over time, implying a negative relationship with the dependent variable. However, it is highly likely that regions with high initial disparities continue to have high disparities, seen the evolution of the European regional disparities over the last decades.

The variables have been collected from the Cambridge Econometrics' European Regional Database that is available from the new Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO 2020) and Eurostat (See Table 1 for the exact source), except the initial level of disparities, which has been calculated from Equation 1.

Table 1. Data sources

Variable	Source
Per capita GDP	Cambridge Econometrics' European Regional Database (ARDECO 2020)
Population	Cambridge Econometrics' European Regional Database (ARDECO 2020)

Area	Eurostat
Eligibility	European Commission
Employment rate	Cambridge Econometrics’ European Regional Database (ARDECO, 2020)

Other studies in the inequality literature studying the driving forces behind inequality include control for ethnic groups, imports and exports, government quality, trade openness, etc (Kyriacou and Roca-Sagalés 2012; Védrine and Le Gallo 2021). Unfortunately, this kind of variables are not available at this regional NUTS 3 level. Nevertheless, the variables included in the model have turned out to have a good performance in the estimations and explain a high percentage of the variation of the dependent variable as we would see below.

The model (Eq. 4) will be first estimated by OLS. Authors often consider panel data models with fixed effects (typically individual effects) to estimate regional equations, claiming that unobservable factors driving inequality may exist and cause omitted variable bias, and therefore including fixed effects in the models takes account of this unobserved regional heterogeneity (Ederveen et al. 2002; Leßmann 2014). Individual fixed effects models rely on the time variation within each cross-sectional unit and are frequently utilized in regional growth equations, being their use scarcer when dealing with disparities due to a small individual variation. In fact, in our analysis, most of the variation registered by the dependent variable is between NUTS 3 regions, rather than over time (the within standard deviation of the regional inequality main measure is $1.27 \cdot 10^{-4}$ while the between and overall standard deviations are $9.64 \cdot 10^{-4}$ and $9.04 \cdot 10^{-4}$, respectively).

Hence, it will be more appropriated to include time fixed effects in our model to corroborate the results obtained by OLS. From equation 4, the error term includes the time fixed effect λ_t (Eq. 5):

$$u_{¿}=\lambda_t+\varepsilon_{¿}(Eq.5)$$

Resulting in Eq. 6:

$$Inequality_{¿}=\beta_1 Eligibility_{¿}+\beta_2 X_{¿}+\lambda_t+\varepsilon_{¿}(Eq.6)$$

Nevertheless, there might be unobserved regional characteristics, invariant over time, which can affect both the Structural Funds’ allocation and the regional inequalities, and may bias the estimation of the model. Therefore, we have considered as well individual fixed effects in the estimations by performing a two way fixed effects ($Inequality_{¿}=\beta_1 Eligibility_{¿}+\beta_2 X_{¿}+\lambda_t+\mu_i+\varepsilon_{¿}$ being *μi* the individual error component). However, by removing the variables invariant over time, the percentage of the dependent variable explained by the independent variables was drastically reduced, hence we have not included this model in the paper. Furthermore, as previously mentioned, controlling for individual fixed effects is not recommendable in our case, as the time variation within each cross-sectional unit is limited in our dependent variable. As pointed out by Ezcurra and Rodríguez-Pose (2013), in this case individual fixed effects models leave unexplained what is most important in the data and the results may be biased (Kyriacou et al. 2015).

Additionally, if a region receives funds and affects its regional disparities or other characteristics, it may cause an influence on the features of the neighbouring regions. Therefore, there might be some slight bias in the previous estimations by the omission of this spatial spillover effect. As a robustness test, we will include the spatial spillovers by conducting a spatial autoregressive combined model (SARAR), which includes a spatial lag of the dependent variable and a spatial autoregressive disturbance (Eq. 7). The spatial dependence on the dependent variable implies that the values of the dependent variable, at each location, are correlated with the observations of the dependent variable at other locations. The spatial dependence on the disturbance term implies that the values of the disturbance term, at each location, are correlated with the disturbance terms at other locations.

$$Inequality_{¿}=\beta_1 Eligibility_{¿}+\beta_2 X_{¿}+\eta\sum_{i\neq j} w_{ij}\, Inequality_{jt}+u_{¿}\,(Eq.7)$$

Where W is the spatial weights matrix, $W\,Inequality_{jt}$ is the spatial lag term of the dependent variable and η is the spatial autoregressive coefficient. The disturbance term $u_{¿}$ includes the time specific effect λ_t not spatially autocorrelated (Eq. 8):

$$u_{¿}=\lambda_t+\varepsilon_{¿}\,(Eq.8)$$

Being ε a vector of spatially autocorrelated innovations that follows a spatial autoregressive process of the form:

$$\varepsilon_{¿}=\rho\sum_{i\neq j} w_{ij}\,\varepsilon_{jt}+\upsilon_{¿}\,(Eq.9)$$

Where $W\varepsilon_{jt}$is the spatial lag of the error term and ρ is the autoregressive coefficient associated to the spatial lag $W\varepsilon_{jt}$.

4. Results, discussion and policy implications

The evolution of inequalities of NUTS 3 regions for the period 2000-2019 is displayed in Fig. 1, using the Theil index and MLD measures respectively (Eq.1 and Eq.3). Both measures start in 2000 from very similar values (0.1328 for Theil measure and 0.1339 for MLD), but although their trends diverge, they show similar patterns, with smoother features for MLD case, throughout years. Both measures show a clear decline in NUTS 3 inequalities until 2008, when the financial crisis took place, followed by a rise until 2016. From this year, inequalities slightly decrease again, to reach a value of 0.119 for Theil measure and 0.097 for MLD in 2019. Overall, NUTS 3 inequalities have decreased in the studied period considered as a whole.

The evolution of the NUTS 3 disparities does not seem to be linked to the policy programming periods, but it seems extremely affected by the global financial crisis of 2008, year from which the reduction tendency seen in the previous years is reversed. In order to observe the policy effects on NUTS 3 inequalities, we perform a regression over the model (Eq. 4).

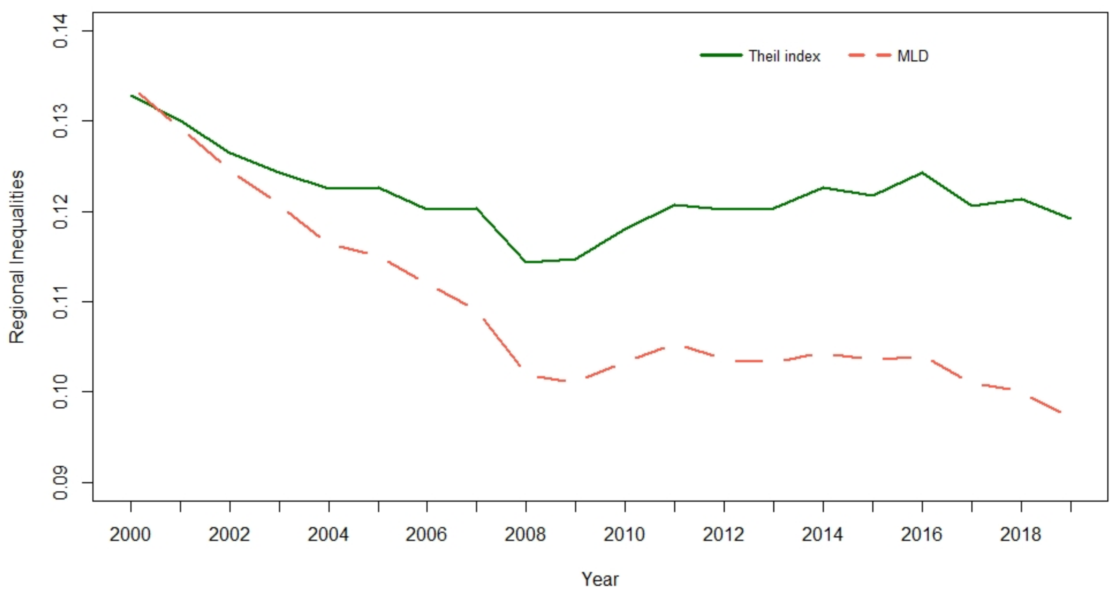

Fig. 1. Evolution of NUTS 3 inequalities during period 2000-2019 using Theil index (in green) and Mean Logarithmic Deviation (MLD, in red).

Table 2 reports the estimates of the model (Eq. 4) via OLS with heteroskedasticity and autocorrelation consistent errors, using Theil index (Eq. 1) as the inequality measure and the dependent variable. As indicated in Table 2 (column 1), the model presents relatively good values in terms of goodness-of-fit (adjusted R^2 =0.97).

Table 2. The impact of eligibility of regions on NUTS 3 regional inequality. Period 2000-2019

	(1) OLS	(2) Time fixed effects	(3) Spatial effects
Intercept	-2.625e-04*** (5.798e-06)	-3.176e-04*** (5.741e-06)	-2.471e-04*** (5.306e-06)
Per capita GDP	1.434e-08*** (1.850e-10)	1.862e-08*** (2.033e-10)	2.306e-08*** (2.109e-10)
Population density	-2.304e-08*** (8.060e-10)	-2.545e-08*** (7.809e-10)	-2.982e-08*** (8.986e-10)
Area	1.080e-10 (1.680e-10)	1.284e-10 (1.627e-10)	-5.286e-10** (1.884e-10)
Employment rate	-2.624e-06*** (1.420e-07)	-3.638e-06*** (1.396e-07)	-7.299e-06*** (1.416e-07)
Initial inequality	9.444e-01*** (2.798e-03)	8.944e-01*** (2.932e-03)	8.887e-01*** (2.951e-03)
Eligibility	1.642e-04*** (2.540e-06)	1.802e-04*** (2.480e-06)	1.715e-04*** (3.271e-06)
Observations	26960	26960	26960
NUTS 3 regions	1348	1348	1348
F-test	154495***	165939***	
Adj. R^2	0.97	0.97	
LM lag test			115.96***
LM error test			967.89***
Robust LM lag test			240.88***
Robust LM error test			822.8***
ρ			0.413*** (0.006)
η			-0.032*** (0.001)

Notes: *Significant at 10%, ** significant at 5%, *** significant at 1%. Theil index as measure of inequality. *Eligibility* is the dummy variable taking a value of 1 when regions are eligible for receiving Structural Funds and 0 otherwise.

Focussing on our coefficient of interest (β_1 in Eq. 4), we obtain that regions which are eligible to receive structural funds experience, on average, an increase of 1.642e-04 on the disparities with respect to those regions which do not receive funds. The difference in the increase of disparities of the eligible regions with respect to non-eligible ones might seem to be quite small, but one should take into account that the values of the dependent variable are around of 10^{-5}.

The area of the NUTS 3 regions, used to control the size of the regions, shows a positive relationship with the inequality measure, meaning that the bigger the region area the higher the inequalities, in line with what is reported in inequality literature (e.g. Leßmann 2014). However, this variable is not significant. The employment rate is negative, as we expected, implying that more employment opportunities reduce disparities. The relationship between inequalities and population density is also negative, suggesting that disparities are not affected by agglomeration effects, which is contrary to what was expected. The level of initial inequalities coefficient has a positive sign, denoting that regions with more initial inequalities continue to have high disparities. As previously mentioned, the desired outcome would have been the opposite, i.e., that regions with high initial disparities would have had them reduced over time.

Finally, we have obtained a positive impact of the level of economic development, measured by per capita GDP, on the level of disparities of NUTS 3 regions. This is in line with several empirical works in inequality literature. However, one can argue distinct theoretical points of view particularly when considering growth of economic development. As it is stated in Petrakos et al. (2005), some scholars following Solow (1956) argue that disparities are bound to diminish with growth, because of diminishing returns to capital. However, other schools following Myrdal (1957), agree that growth is a cumulative process, which is likely to increase inequalities. Williamson (1965) suggested an inverted-U-shaped relationship between inequality and economic development, based on the ideas of Kuznets (1955). Anyway, obtaining a positive relationship between economic development and regional inequalities indicates an ambiguous implication, since the objective of the Cohesion Policy is to reduce inequalities among its members and promote their economic development at the same time. Thus, this relationship is critical for Cohesion Policy (Petrakos et al., 2005). Nevertheless, the impact of the level of economic development should be interpreted cautiously since it may be also affected by regional inequalities (Leßmann 2014). The presence of this effect may cause endogeneity bias in the estimations. In order to provide robustness to our findings, we will perform some additional regressions.

In order to account for the unobserved regional heterogeneity in the model, we have included estimations with time fixed effects (Table 2, column 2). Time fixed effects' estimations present the same signs, significances and performance as the ones obtained by OLS, confirming the robustness of the model. Also, we include in the model the presence of spillover effects (Eq. 7), obtaining the same signs and significances as previously. As shown in Table 2 column (3), there is spatial autocorrelation in the data both in the error and in the dependent variable, implying that the inequalities of a region are affected by the inequalities of the neighboring regions and suggesting a non-spatial concentration of regional disparities values.

Continuing with robustness tests, we employ a Feasible General Least Squares (FGLS) estimator for the model. This is used instead of pooled OLS estimator when the series exhibit heteroskedasticity and serial correlation (Wooldridge 2006), which are present in our sample. As seen in Table 3 (column 1), we obtain again similar results, the same signs and similar goodness-of fit (adjusted R^2 =0.95). However, in this case, the area is now significant.

As it has been previously indicated (section 3.1.), disparities over time may be different regarding the measure used to calculate the inequality index, since each index differently aggregates the information contained in the distribution (Ezcurra and Rodríguez-Pose 2009). For this reason, we perform the model (Eq. 4) but using MLD inequality measure (Eq. 3) as the dependent variable with OLS, FGLS methods and time fixed effects. As it can be seen in Table 3 (OLS, FGLS and Time fixed effects with MLD, columns 2, 3 and 4), the signs are reversed for per capita GDP variable. When the relationship between the regression variables and the inequality variable measured by MLD or Theil index is complex or not lineal, as it might be the case (explained previously in section 4), differences in the signs of the regression coefficients could arise. In any case, the main result holds, as regions eligible to receive structural funds, experience a further increase on disparities with respect to regions which do not receive funds. Note that with MLD inequality measure the performance of the model decreases (adjusted R^2 =0.76, 0.72 and 0.83 respectively).

Table 3. Robustness analysis: alternative measures of inequality and FGLS estimation. Period 2000-2019

	(1) FGLS with Theil index	(2) OLS with MLD	(3) FGLS with MLD	(4) Time fixed effects with MLD
Intercept	-5.065e-04*** (6.838e-06)	6.944e-04*** (5.845e-06)	6.726e-04*** (4.963e-06)	8.101e-04*** (5.041e-06)
Per capita GDP	2.742e-08*** (1.806e-10)	-2.196e-08*** (1.863e-10)	-2.245e-08*** (1.027e-10)	-3.090e-08*** (1.785e-10)
Population density	-2.807e-08*** (1.829e-09)	-1.426e-08*** (8.130e-10)	-1.339e-08*** (1.822e-09)	-9.238e-09*** (6.856e-10)
Area	1.629e-09*** (3.734e-10)	1.295e-10 (1.698e-10)	8.827e-10* (4.031e-10)	5.980e-11 (1.428e-10)

Employment rate	-1.604e-06*** (1.363e-07)	-3.864e-06*** (1.436e-07)	-1.808e-06*** (7.987e-08)	-1.789e-06*** (1.225e-07)
Initial inequality	7.069e-01*** (3.924e-03)	2.246e-01*** (2.821e-03)	1.842e-01*** (3.533e-03)	3.295e-01*** (2.575e-03)
Eligibility	7.646e-05*** (2.861e-06)	2.242e-04*** (2.559e-06)	7.305e-05*** (3.269e-06)	1.930e-04*** (2.178e-06)
Observations	26960	26960	26960	26960
NUTS 2 regions	1348	1348	1348	1348
F-test		14689.5***		22600.3***
Adj. R2	0.95	0.76	0.72	0.83

Notes: *Significant at 10%, ** significant at 5%, *** significant at 1%. *Eligibility* is a dummy variable taking a value of 1 when regions are eligible for receiving Structural Funds and 0 otherwise.

As an additional test, we check whether the obtained results separately hold for the three different policy periods included in our 2000-2019 study period. Therefore, we run separated OLS and time fixed effects estimations for the Theil index inequality measure for the three included policy periods (2000-2006, 2007-2013, and 2014-2019). In table 4 we see that we reach the same findings of the coefficient for eligibility being significant and positive, pointing out that the effect (eligible regions experience further increase of disparities than ineligible ones) has been produced in the three policy periods, suggesting that the operational measures implemented to reduce the regional disparities have been similar in the different programming periods.

Additionally, we address potential bias due to cycle and policy periods effects, repeating the estimations for different subperiods of the whole 2000-2019 period. Table 5 reports the obtained results when subperiods of five years are considered, supporting earlier findings as well. The results indicate that all robustness tests for different periods and inequality measures performed with the time fixed effect model maintain the results obtained by OLS.

Table 4: Robustness analysis: policy periods

	OLS			Time fixed effects		
	(1) 1st policy period 2000-2006	(2) 2nd policy period 2007-2013	(3) 3rd policy period 2014-2019	(4) 1st policy period 2000-2006	(5) 2nd policy period 2007-2013	(6) 3rd policy period 2014-2019
Intercept	-7.473e-05*** (5.859e-06)	-2.636e-04*** (9.619e-06)	-4.168e-04*** (1.301e-05)	-8.654e-05*** (5.905e-06)	-2.675e-04*** (9.629e-06)	-4.358e-04*** (1.302e-05)
Per capita GDP	5.099e-09*** (2.247e-10)	1.443e-08*** (3.844e-10)	2.184e-08*** (4.458e-10)	6.060e-09*** (2.374e-10)	1.485e-08*** (3.902e-10)	2.287e-08*** (4.513e-10)
Population density	-5.080e-09*** (7.733e-10)	-2.360e-08*** (1.269e-09)	-3.747e-08*** (1.739e-09)	-5758e-09*** (7.700e-10)	-2.381e-08*** (1.268e-09)	-3.784e-08*** (1.726e-09)
Area	-1.308e-10 (1.548e-10)	9.374e-10*** (2.629e-10)	5.141e-10 (3.789e-10)	-1.657e-10 (1.537e-10)	9.291e-10*** (2.625e-10)	5.202e-10 (3.759e-10)
Employment rate	-1.074e-06*** (1.313e-07)	-2.933e-06*** (2.330e-07)	-4.808e-06*** (3.248e-07)	-1.261e-06*** (1.313e-07)	-3.075e-06*** (2.340e-07)	-5.006e-06*** (3.228e-07)
Initial inequality	9.694e-01*** (2.787e-03)	9.515e-01*** (5.253e-03)	9.056e-01*** (7.331e-03)	9.606e-01*** (2.866e-03)	9.473e-01*** (5.292e-03)	8.900e-01*** (7.403e-03)
Eligibility	5.492e-05*** (2.358e-06)	1.682e-04*** (4.142e-06)	2.524e-04*** (6.190e-06)	6.030e-05*** (2.385e-06)	1.706e-04*** (4.155e-06)	2.591e-04*** (6.169e-06)
Observations	9436	9436	8088	9436	9436	8088
NUTS 2 regions	1348	1348	1348	1348	1348	1348
F-test	157982***	62904.2***	36335.1***	160260***	63115.1***	36929.3***

Adj. R2	0.99	0.98	0.96	0.99	0.98	0.96

Notes: *Significant at 10%, ** significant at 5%, *** significant at 1%. Theil index as measure of inequality. *Eligibility* is the dummy variable taking a value of 1 when regions are eligible for receiving Structural Funds and 0 otherwise. Columns 1, 2 and 3 performed by OLS; columns 4, 5 and 6 are estimations with time fixed effects.

Table 5: Robustness analysis: different subperiods

	(1) 2000-2004	(2) 2005-2009	(3) 2010-2014	(4) 2015-2019	(5) 2000-2004	(6) 2005-2009	(7) 2010-2014	(8) 2015-2019
Intercept	-6.813e-05*** (5.009e-06)	-1.289e-04*** (1.079e-05)	-3.372e-04*** (1.172e-05)	-4.276e-04*** (1.445e-05)	-7.282e-05*** (5.017e-06)	-1.342e-04*** (1.086e-05)	-3.391e-04*** (1.173e-05)	-4.419e-04*** (1.445e-05)
Per capita GDP	3.547e-09*** (2.027e-10)	9.550e-09*** (4.296e-10)	1.691e-08*** (4.731e-10)	2.307e-08*** (4.869e-10)	3.978e-09*** (2.083e-10)	9.833e-09*** (4.354e-10)	1.708e-08*** (4.760e-10)	2.379e-08*** (4.905e-10)
Population density	-1.976e-09*** (6.548e-10)	-1.563e-08*** (1.395e-09)	-2.844e-08*** (1.576e-09)	-3.843e-08*** (1.920e-09)	-2.272e-09*** (6.527e-10)	-1.583e-08*** (1.395e-09)	-2.852e-08*** (1.576e-09)	-3.868e-08*** (1.910e-09)
Area	-1.297e-10 (1.302e-10)	6.074e-10* (2.815e-10)	6.657e-10* (3.330e-10)	5.521e-10 (4.197e-10)	-1.444e-10 (1.296e-10)	6.089e-10* (2.813e-10)	6.643e-10* (3.328e-10)	5.305e-10 (4.172e-10)
Employment rate	-2.751e-07* (1.101e-07)	-2.981e-06*** (2.504e-07)	-2.827e-06*** (2.956e-07)	-5.474e-06*** (3.605e-07)	-3.670e-07*** (1.101e-07)	-3.004e-06*** (2.502e-07)	-2.879e-06*** (2.956e-07)	-5.595e-06*** (3.587e-07)
Initial inequality	9.595e-01*** (2.391e-03)	9.922e-01*** (5.627e-03)	9.353e-01*** (6.603e-03)	8.905e-01*** (8.127e-03)	9.595e-01*** (2.418e-03)	9.886e-01*** (5.701e-03)	9.334e-01*** (6.632e-03)	8.790e-01*** (8.179e-03)
Eligibility	3.444e-05*** (2.032e-06)	1.230e-04*** (4.467e-06)	1.918e-04*** (5.237e-06)	2.620e-04*** (6.832e-06)	3.688e-05*** (2.044e-06)	1.241e-04*** (4.474e-06)	1.927e-04*** (5.243e-06)	2.666e-04*** (6.812e-06)
Observations	6740	6740	6740	6740	6740	6740	6740	6740
NUTS 2 regions	1348	1348	1348	1348	1348	1348	1348	1348

F-test	215886***	51763.7***	41761.8***	29775.3***	217978***	51858***	41810.8***	30135.7***
Adj. R2	0.99	0.98	0.97	0.96	0.99	0.98	0.97	0.96

Notes: *Significant at 10%, ** significant at 5%, *** significant at 1%. Theil index as measure of inequality. (1) and (5) Period from 2000 to 2004, (2) and (6) period 2005-2009, (3) and (7) period 2010-2014, (4) and (8) period 2015-2019. *Eligibility* is the dummy variable taking a value of 1 when regions are eligible for receiving Structural Funds and 0 otherwise.

Hence, based on the findings revealed when performing the panel regression in Eq. 4 and corroborated by the robustness tests, we have determined that NUTS 3 regions eligible for receiving cohesion funds experience a greater increase of disparities than ineligible ones.

Although Kyriacou and Roca-Sagalés (2012) determined that the structural funding reduced within-country disparities until certain threshold, it seems that the effect is reversed when tackling the NUTS 3 regional inequalities. Our results are in line with the ones reported by Butkus et al. (2020b) over the policy period 2000-2006, which concluded that structural funds are enlarging imbalances within NUTS 2 regions, at NUTS 3 level.

Our findings seem to suggest that the allocation of the funds at NUTS 2 level only accentuates the NUTS 3 inequalities. As stated by Butkus et al. (2020b), the distribution at this level does not ensure that the financial support arrives at the NUTS 3 regions really needing it. On the one hand, this may be caused by the fact that the effectiveness of the Cohesion Policy is not homogeneous within the NUTS 2 regions, as it may depend on factors such as the structure of the public sector or the urban structure of the regions (Gagliardi and Percoco 2017; Percoco 2017). On the other hand, the resources may be unevenly distributed among the NUTS 3 regions mainly due to the fact that the absorption of the EU's funds depends to a high degree on the abilities of institutions to effectively implement policies (Leonardi 2006; Tiginasu et al. 2018). This is especially the case in the new member states, which have a lack of administrative capacity in the regions and centralize the resources mostly in the capitals. The increasing spatial centralization in the distribution of funds was in the centre of the debate about the implementation of the 2021-2027 EU's Multiannual Financial Framework (Farole et al. 2018). However, almost the same operational programs are implemented the present programming period running the risk of a further concentration of EU's funds in the capitals and in some other more developed parts of the countries (Hadjinikolov 2020).

We are aware that the assessment of the Cohesion Policy has been done using the eligibility of the NUTS 2 regions and not the actual expenditure the NUTS 3 regions benefit from. Also, there are certain aspects when dealing with treatments (differences between treated and non-treated regions, staggered treatment or pre-treatment trends) which have not been analysed in the estimations and could affect the interpretation of the results. Regardless, the results of this analysis could be useful for policymakers since they indicate that the actual distribution of the funds within NUTS 3 regions does not seem to have the desired effect, as NUTS 3 regions which are supposed to be receiving funds, do not see their disparities to be reduced. The 'one fits all' logic should give way to a more flexible approach that considers the huge differences in all ambits of the European regions and maximizes the effect of the policy. Recent approaches suggest that place-based policies may be more effective in reducing regional disparities (Iammarino et al. 2019; Rodríguez-Pose 2020). Concretely, new approaches suggest that regional disparities in the European Union could be reduced by a twofold approach: reinforcing the strongest regions, and, at the same time, as it is currently done, boosting lagging regions, leading to a new “place-sensitive distributed development policy” (Iammarino et al. 2019).

In the long run, rising inequalities could affect the growth of all EU’s regions (Brülhart and Sbergami 2009; De Dominicis 2014). However, member states have diverse preferences in terms of regional policy objectives. Some members do not see the reduction and eradication of regional disparities as a priority objective to implement, giving more importance to their aggregate economic performance (Crescenzi et al. 2020).

Furthermore, some recent events such as the Covid-19 pandemic put aside the addressing of specific regional structural problems by being more focused on meeting EU’s wide objectives to ensure the economic recovery of their member states. While these policies and initiatives are of great importance for the long-term development of the European Union as a whole, they do not necessarily align with reducing regional disparities (Mogila et al. 2022). Probably, the Covid-19 crisis broadened the regional inequalities since “regions will disproportionally suffer from the impacts of the economic down-turn, making Cohesion Policy an important recovery tool, in a period where the feeling of being ‘left behind’ in the ‘geographies of discontent’ may actually grow in the short to medium term” (Sielker et al. 2021, p. 9). Therefore, in order to meet the objective of reducing the regional inequalities while assuring the economic performance of the regions, it is essential the EU-wide alignment of initiatives with national and regional programmes.

5. Conclusions

In this article we have examined the impact of the Structural Funds on the NUTS 3 regional inequalities with the purpose of determining whether NUTS 3 regions receiving those Structural Funds experience a further increase of disparities than regions which are not eligible to receive Structural Funds. To this end, we calculated the inequalities at NUTS 3 level and we constructed a panel model over the period 2000-2019 to study the relationship between regional inequality and the Structural Funds.

According to the Cohesion Policy purpose to reduce the disparities between the different regions’ levels of development, our findings reveal that the Structural Funds impact on regional disparities does not seem to be the expected one. We have obtained that the NUTS 3 regions eligible for receiving Structural Funds experience a further increase of disparities than the ineligible ones.

This result suggests that the resources may be unevenly distributed within eligible NUTS 2 regions. Therefore, the spatial scale at which the Cohesion Policy allocates the funds could be debatable or consider tailored specific approaches devoting more attention to the particular characteristics of the NUTS 3 dimension, such as the economic and geographical structure. Thus, the existence of “accidental winners” which may trigger an enlargement of the economic differences of this kind of regions with respect to the others, could be avoided. The increase of inequalities as a result of the heterogeneous effectiveness of the Cohesion Policy within the NUTS 2 regions and the centralization of the allocation of the resources, could also be prevented. Regarding the latter, policymakers should implement measures boosting the effectiveness of the absorption of the Cohesion Policy funds at the NUTS 3 dimension. But all of these suggestions will be successful only if an alignment of EU-wide initiatives with national and regional programmes is produced so that the aggregate economic performance of the member state’s objective and the reduction of regional inequalities objective are aligned.

Future research revealing the driving forces behind the economic inequalities at the NUTS 3 level and performing further analysis regarding the effectiveness of the funding at this level will be useful to apply tailored policies in order to achieve the Cohesion Policy main objective. Moreover, the actual expenditure the NUTS 3 regions benefit from was not available, hence the Cohesion Policy assessment has been done using the NUTS 2 regions eligibility. Should we in the future be able to obtain the actual expenditure the NUTS 3 regions benefit from, we might be able to provide more specific recommendations for improving the EU’s policy.

Finally, we have to highlight that there are some limitations in our research that should be considered when studying the Cohesion Policy impact. We have not contemplated the n+2 rule when indicating the eligibility of a region to receive Structural Funds, for which there are two additional years to spend the funds after the end of the policy period. Furthermore, we have not included the post-policy period effects in our study, which may affect the disparities although regions might no longer be receiving funds. It is also likely that, at NUTS 3 level, some part of the per capita GDP corresponds to commuters, causing some small inaccuracies in this indicator.

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Author contributions

Ana María López-Villuendas: Conceptualization, Methodology, Analysis and interpretation, Writing-Draft preparation.

Cristina del Campo: Conceptualization, Writing-Review & Editing, Direction.

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