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Impact of Cohesion Funds on Convergence Club's Economic Growth

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ABSTRACT

This paper empirically estimates the impact of the European Structural and Investment Funds (ESIF) on economic growth across European regions. The narrative of this paper is based on the convergence club hypothesis. In this context, we implement the data-driven Phillips and Sul test to classify European regions into endogenously identified convergence clubs that tend to converge to different steady-state equilibria. We find three substantially different convergence clubs in terms of both per capita output and spatial location: capital cities and metropolitan areas (along the so-called "Blue Banana"), core countries, and the periphery. We observe a persistent core-periphery pattern in terms of output per capita among European regions with different rates of convergence. The convergence club comprising capital cities and metropolitan areas converges almost four times faster than the rest of the EU. Subsequently, we estimate club-specific growth regressions to investigate the impact of ESIF expenditures on short-run economic growth. Our main identification strategy relies on two instrumental variables, namely the spatial lag of EFSI expenditures-to-GDP and the air distance to Brussels, to address a strong endogeneity problem in strongly biased relationship between ESIF expenditures-to-GDP and short-run economic growth. Our results indicate a positive impact of ESIF expenditures-to-GDP on short-run economic growth in the second (core) and third (periphery) convergence clubs, with the impact being twice as large in the latter compared to the former. These results remain robust when adjusting the growth regressions to use ESIF expenditures-to-population instead of ESIF expenditures-to-GDP, although the pronounced difference in effect magnitude among convergence clubs diminishes.

1 | Introduction

The EU devotes a significant part of its budget to cohesion policy to promote one of its fundamental objectives, "a high degree of convergence and economic performance" (*Article 2* of the Maastricht Treaty). The European Structural and Investment Funds (ESIF) is the main instrument of cohesion policy. On average, the ESIF represent about 15% of total public investment in the EU. Geographically, the levels of the ESIF vary considerably. Between 2015 and 2017, in most of the Central and Eastern European (CEE) countries the ESIF represented more than 40% of total public investment, while in the EU15 (except for Portugal and Greece) this figure is much lower, ranging from 13% in Italy to 0.5% in Germany (European Investment Bank 2019). Figure 1 depicts the average economic growth per capita (GDP p.c.) of the NUTS2 regions between 1996 and 2018, together with the total ESIF expenditure allocated to each region over the same period.

Figure 1 reveals that a higher relative ESIF expenditures are positively associated with above average GDP p.c. growth rates only in the Scandinavian and CEE countries, while the Spanish

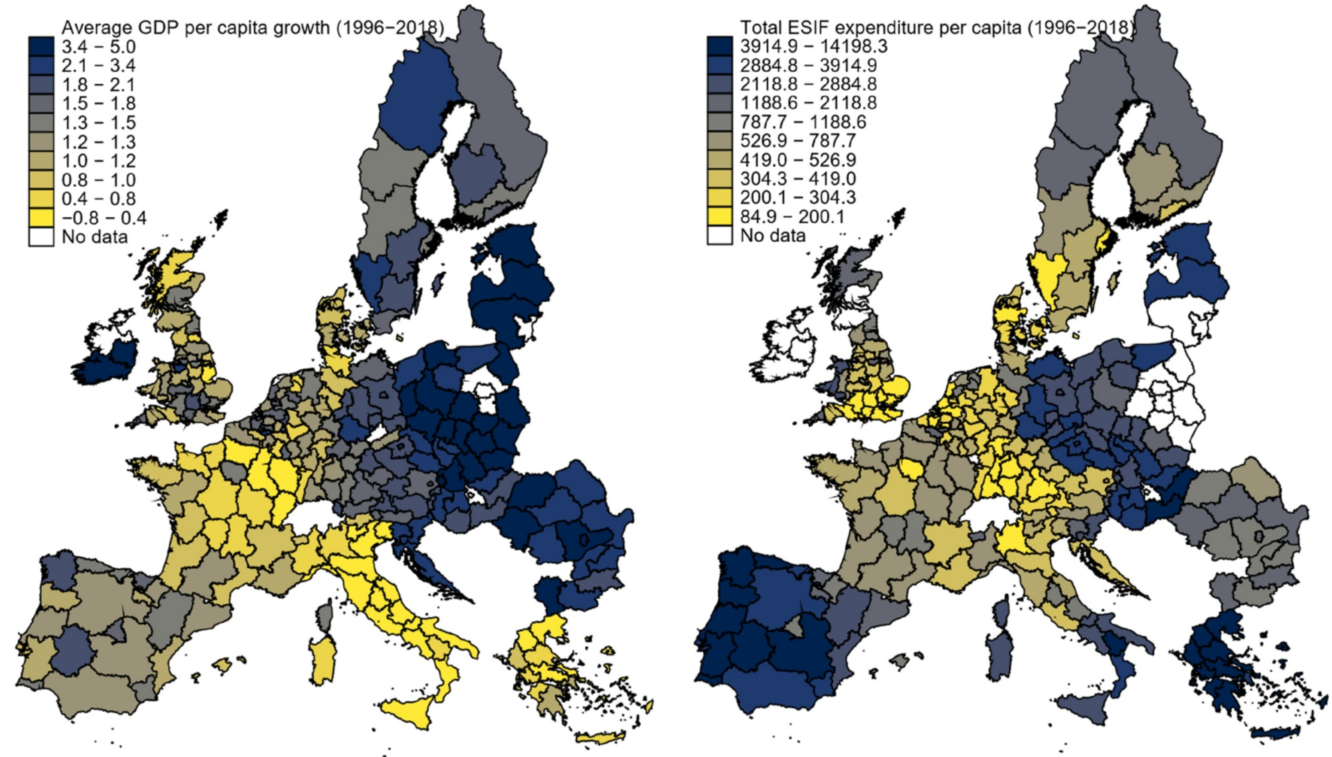

FIGURE 1 | Average economic growth and total ESIF expenditure per capita in EU28 regions between 1996–2018 period. *Source:* Authors' calculations based on ARDECO (European Commission, Joint Research Centre 2024) and European Commission (2020) databases.

and Southern Italian regions seem to struggle to achieve comparable economic performance despite relatively high ESIF allocations. Figure A1 in the Appendix illustrates the relationship between total ESIF expenditures per capita and average GDP per capita growth rates in greater detail across four major European subregions over the same period. The fitted linear curve in this simple relationship demonstrates only a weak positive association between these two variables. Figure A1 also shows that higher ESIF expenditures are strongly and positively associated with significant economic growth only in certain regions of Western, Northern, and Central and Eastern Europe. Most notably, when fitting a cubic polynomial to this simple relationship, the effect appears strongly negative after a turning point at approximately €2500 per capita, particularly among regions in Central and Eastern and Southern Europe, indicating a strong presence of negative biases in this relationship (as will be discussed below). These observations naturally raise the question of the overall effectiveness of the ESIF on the short-run economic growth.

Baumol (1986) was the first who suggested that economies may be grouped to so-called convergence clubs, where they tend to move toward a club specific steady state in the long run. Moreover, the current literature provides strong evidence that European regions do not converge to a single steady state, but rather follow a convergence club pattern (see e.g., Alexiadis 2012; Bartkowska and Riedl 2012; Baumont, Ertur, and Gallo 2003; Cavallaro and Villani 2021; Monfort, Cuestas, and Ordonez 2013; Von Lyncker and Thoennessen 2017; Mazzola and Pizzuto 2020). Splitting the European regions to so-called convergence clubs could partly control for the structural lock-in and high level of economic development biases (as will be discussed below) in growth regressions. This may be one of the main underlying factors why regions do not achieve expected growth performance from large EU-funded public investments when initially examined. Therefore, the visual analysis in Figures 1 and A1 will be further complemented by a more formal examination of the impact of ESIF on short-term growth across different convergence club regimes.

The literature does not even provide the expectation of the correct sign of the impact of cohesion funds on economic growth (Dall'Erba and Fang 2017). The problem lies in a strong endogeneity solved by very few authors (e.g. Becker, Egger, and Von Ehrlich 2010; Dall'Erba and Le Gallo 2008; Fiaschi, Lavezzi, and Parenti 2018; Fidrmuc, Hulényi, and Zajkowska 2019). The reason is a strong negative bias due to the inherent endogeneity problem in the relationship between economic growth and public spending. Fidrmuc, Hulényi, and Zajkowska (2019) identify three possible sources of the potential endogeneity problem in the given relationship (i) the regions that grow faster lose the eligibility to receive EU cohesion funds (negative bias), (ii) the poorer regions tend to grow faster than the richer ones (positive bias), (iii) the omission of variables that could capture the unfavorable industrial, demographic, and political lock-in that undermines growth performance (negative bias).

Previous empirical studies on the impact of EU cohesion funds on economic growth and convergence in Europe provide mixed and inconclusive results. Some scholars find a positive impact of cohesion funds on economic growth and convergence (Becker, Egger, and Von Ehrlich 2010; Cappelen et al. 2003; Cerqua and Pellegrini 2018; Crescenzi and Giua 2020; Di Caro and Fratesi 2022; Ederveen et al. 2002; Fidrmuc, Hulényi, and Zajkowska 2019; Mohl and Hagen 2010; Ramajo et al. 2008). Other find an insignificant impact of cohesion funds on convergence or growth, inter alia (Boldrin and Canova 2001; Dall'Erba and Le Gallo 2008; Sala-i-Martin 1996), and certain estimate even a negative impact of the cohesion funds on economic growth (Cappelen et al. 2003; Di Caro and Fratesi 2022). Dall'Erba and Fang (2017) find that the average meta effect of the elasticity of economic growth on cohesion funds is 0.17, ranging from (−0.03 to 0.41).

Even though the evidence on the empirical impact of cohesion funds is mixed, a large strand of theoretical literature describes a positive impact of cohesion funds on economic growth. The neoclassical framework assumes a more positive impact of capital deepening (also represented by public investment embodied in cohesion funds) on economic growth in the capital-scarce regions. Assuming diminishing returns to capital and exogenous technological change, strong convergence comes into play and regions converge to a single steady state (Solow 1956). The endogenous growth framework, based on the constant returns to capital and local externalities, does not predict convergence among regions at all. However, this framework also predicts a positive impact of capital deepening on economic growth, even if regional disparities increase at the same rate. In addition, public investment could increase the marginal product of private investment and thus indirectly induce more private investment. That would also have a positive impact on short- and long-term economic growth. Endogenous growth theorists may argue that public investment may also exhibit increasing returns to scale if it is used for innovative purposes, such as investment in the accumulation of human capital, knowledge, and skills (Aghion and Howitt 1990; Grossman and Helpman 1991). Neither neoclassical nor endogenous growth theories are specific about the type of public investments. On average, the largest share of cohesion funds in most regions finances transport infrastructure (European Commission 2018). Therefore, they reduce transport costs and consequently may affect the economic growth of the recipient regions in a way that cannot be captured by any of the previous growth theories (Dall'Erba and Fang 2017). However, this allocation is not uniform across regions and specific cohesion funds (see Vignetti et al. 2020, for an overview of the assessment of some major transport-related projects, including their source and share of financing). Crescenzi, Di Cataldo, and Rodríguez-Pose (2016) review the biggest culprits of value-destroying transport projects. Their work highlights, on the one hand, several examples from some of the less developed regions in weak institutional contexts, resulting in a plethora of "white elephants" of dubious economic and social value, especially in the periphery. On the other hand, investments in ordinary transport projects in regions with strong and functional institutions produce much higher returns in terms of economic growth promotion. Krugman (1991) pioneered the third strand of literature with the suggestion that improved infrastructure could lead to circular causation for the agglomeration of firms and workers. Improved accessibility allows labor (more negligible capital) to move with the less costs to more developed regions where labor could benefit from the agglomeration effect. Consequently, the richer regions could benefit from cohesion funds more than the poor regions. The result is a core-periphery pattern of economic growth (Fujita and Thisse 1996). In addition, cohesion funding typically requires co-financing from local governments, which places a substantial fiscal burden on the least developed regions than on the developed ones (Vickerman, Spiekermann, and Wegener 1999). Although, the co-financing share varies with the level of development and serves as a moderator, the requirement of even a low co-financing share may still constrain less developed regions from effectively utilizing EU funds due to their limited fiscal resources (Polverari and Bachtler 2014).

Based on the previous discussion, we try to empirically answer seemingly simple research questions: Do European Structural and Investment Funds (ESIF) expenditures have a positive impact on economic growth in the EU28 regions? If so, how does this impact differ among regions converging to different steady state equilibria (convergence clubs)?

We use the panel convergence test of Phillips and Sul (2007), based on the separation of the common factor of the regional GDP p.c. time series, which allows to test whether regions converge to a single steady state or form cluster-like structures: convergence clubs. Based on this identification of separate convergence clubs, we estimate an augmented regional short-run growth regression based on the model proposed by Solow (1956), with the addition of an endogenous variable measuring the ratio of ESIF expenditures-to-GDP or to regional population over the period 1996–2019 to study its relationships with the economic growth of the convergence club. Firstly, we estimate a traditional endogeneity-biased panel regression model to compare the results with the spatial panel model which controls for unobserved spatial heterogeneity and spatial spillovers across regions. Using a spatial panel regression, we find an economically small and significant impact of the ESIF expenditures-to-GDP on short-run economic growth. To address endogeneity problem, we employ the IV identification strategy, where we estimate a short-run growth regression. We use two instrumental variables: the spatial lag of ESIF spending and the distance to Brussels to instrument ESIF expenditures-to-GDP. We find this set of instruments to be properly identified, relevant, and allowing to estimate the exogenous impact of ESIF on economic growth. By estimating our third and preferred model on the subsets of the convergence clubs, we control for potential omitted variable bias due to unobserved region's structural lock-in or the high level of economic development. Furthermore, this strategy allows us to compare the different effects of ESIF among different convergence clubs. The convergence club-specific growth regression reveals that the convergence club, consisting of the core EU countries and some new member states,[1] is the only subset of regions that exhibits a large positive impact of cohesion funds on the economic growth. Our work differs from previous empirical approaches in at least one important aspect. To the best of our knowledge, we are among the first who empirically control for both the endogeneity problem and the omitted variable bias caused by structural lock-in or the high level of economic development when examining the effects of ESIF expenditures-to-GDP on short-run economic growth.

2 | Data

We created an annual database from 1996 to 2019 at the NUTS 2 regional level. To measure the impact of cohesion funds, we use annual NUTS 2 data for the estimated expenditures of the

European Structural and Investment Funds (ESIF) provided by European Commission (2020). More specifically, we assume that cohesion policy consists only of the sum of the European Regional and Development Fund the Social Fund and the Cohesion Fund. We complement the ESIF expenditures with the Quality of Government (QoG) EU Regional Dataset compiled by Charron et al. (2020), from which we use a regional population, and tertiary education attained as a proxy for human capital. In addition, we use the ARDECO database, from which we obtain regional GDP in constant prices and national capital stock, which we regionalize as a Bartik measure based on the ratio of regional Gross Value Added (GVA) to national GVA. To measure the quality of institutions, we obtain an estimate of the rule of law from the World Governance Indicators (Kaufmann, Kraay, and Mastruzzi 2011) that is measured only on the level of countries, and we imputed to regions unvaryingly. On average, less than 4% of the data were missing, so we use stochastic multiple imputation techniques to balance our panel since the spatial econometrics requires a balanced panel. We completely omitted seven[2] NUTS2 regions due to the high proportion of missing data in most years. We provide descriptive statistics for all the above variables at their levels in the Table A1 in the Appendix A.

3 | Methodology

There are many dynamic methods capable of testing the club convergence hypothesis (for an overview, see Alexiadis (2012) and Tomal (2023). Durlauf and Johnson (1995) utilize a regression-tree method to categorize countries into distinct subgroups. This approach attains a lot of attention and is applied to identify the regional convergence club patterns in output per capita in various countries (De Siano and D'Uva 2006; Alexiadis 2012; Dall'Erba and Le Gallo 2008; Basher, Iorio, and Fachin 2024). Conversely, Bernard and Durlauf (1996) adopt time-series methods founded on the notion of stochastic convergence, which is identified when the output disparity between an economy and a benchmark economy follows a stationary process (Carlino and Mills 1993). Typically, time-series tests for convergence are conducted using unit root tests (Durlauf, Johnson, and Temple 2005). Magrini (2004) uses this approach to study convergence among European regions. However, Phillips and Sul (2007) demonstrate that under conditions of heterogeneous technology, standard panel unit root tests and cross-sectional regression models are inadequate for analyzing growth convergence (Tomal 2023). They introduce an innovative method for testing the hypotheses of overall convergence and club convergence. This method is theoretically based on the Solow growth model but uniquely accounts for variations in technological progress and convergence speed. The Phillips and Sul (2007) approach is applicable to panel data and features the so-called $\log(t)$ regression, a straightforward ordinary least squares (OLS) regression that employs a one-sided $\log(t)$ test, simplifying its implementation (Phillips and Sul 2007).

Phillips and Sul (2007) model evolution of log income as the product of a time-varying idiosyncratic factor loading δ_{it} (that absorbs the error term e_{it}) which measures the deviation of a region i at time t from a common growth path defined by μ_t, as follows:

$$\log y_{it} = \delta_{it}\mu_t \tag{1}$$

Under this approach, all regions converge in the future to a single steady state if $\lim_{k\to\infty} \delta_{it+k} = \delta$ for all $i = 1, 2, ..., N$. Within this framework, convergence is a dynamic process, in which δ it can vary across regions and time. Phillips and Sul (2007) do not assume any parametric form for μ_t and focuses solely on δ_{it}. The latter cannot be estimated directly from Equation (1) due to overparameterization (Tomal 2023). Therefore, Phillips and Sul (2007) adopted a semiparametric form:

$$\delta_{it} + \delta_i + \sigma_{it}\xi_{it};\, \sigma_{it} = \frac{\sigma_i}{L(t)t^{\alpha}} \tag{2}$$

where δ_i is fixed, ξ_{it} is weakly dependent over t, but $iid(0,1)$ across i. Parameter σ_i is the scale parameter, α is the convergence rate, and $L(t)$ denotes a slowly varying function ($\log(t)$).

For the simple and practical modeling of δ_{it}, the relative transition parameter h_{it} needs to be introduced as a relative log output for a region i in relation to the panel average at time t:

$$h_{it} = \frac{\log y_{it}}{N^{-1}\sum_{i=1}^{N}\log y_{it}} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N}\delta_{it}} \tag{3}$$

Convergence is present if $h_{it} \to 1$ for all i, as $t \to \infty$; and the variance of h_{it} satisfies $H_{it} = N^{-1}\sum_{i=1}^{N}(h_{it}-1)^2 \to 0$ as $t \to \infty$. This condition is equivalent to convergence of idiosyncratic factor loading coefficients $\lim_{t\to\infty} \delta_i = \delta$ for all i.

Based on these preliminaries Phillips and Sul (2007) construct a $\log(t)$ test with the following hypotheses:

$$H_0\text{: } \delta_i = \delta \text{ and } \alpha \geq 0 \text{ to alternative } H_1\text{: } \delta_i \neq \delta \text{ and } \alpha < 0 \tag{4}$$

They propose an implementation of the hypotheses testing making use of $\log(t)$ regression model $\log\left(\frac{H_1}{H_t}\right) - 2\log(\log(t)) = \alpha + b\log(t) + \varepsilon_t$. Phillips and Sul (2007) verified that $b = 2\alpha$, which reduce to a one-sided t-test to test $\alpha \geq 0$, with test statistics $t_b = \frac{\hat{b}-b}{s_b}$, where the $\hat{b}$ is estimated coefficient of b, and s_b is a long-run standard error. If the $t_b > -1.65$ we do not reject convergence to one steady state in the whole group of regions.

If the $\log(t)$ test is jointly rejected for all regions, Phillips and Sul (2007) suggest using a clustering algorithm to detect either convergence clubs or diverging regions. The idea is based on the sequential testing of each remaining region's convergence to the initially identified core group of at least two regions, based on the $\log(t)$ test. After the convergence cluster is formed, the algorithm is repeated for the remaining regions (those not converging to the first convergence cluster), and a second convergence cluster is formed, and so forth. This procedure tends to overestimate the number of convergence clusters present in the sample (Schnurbus, Haupt, and Meier 2017). Schnurbus, Haupt, and Meier (2017) recommend performing a joint log(t) test on all pairs of the initial convergence clusters in a similar way. If they jointly fulfill the convergence hypothesis, they are merged into a single convergence club. We perform the log(t) test and convergence club clustering algorithm improved by Schnurbus, Haupt, and Meier (2017) using the STATA community-written function created by Du (2017).

Subsequently, we estimate an augmented version of the standard Solow-Swan model (see for instance Solow 1956; Mankiw, Romer, and Weil 1992) at the regional level with balanced yearly panel data for 287 regions. More specifically, we estimate a common and club-specific growth (beta-convergence) regression in the following form:

$$\Delta \ln y_{ijt}^{\text{Club } c} = \beta_0 + \beta_1 \ln\left(\text{ESIF}_{ijt}/\text{GDP}_{ijt}\right) + \beta_3 \ln y_{ijt-1} + \beta_4 \ln k_{ijt} + \beta_5 \ln\left(n_{ijt} + 0.05\right) + \beta_6 \ln \text{Rule of Law}_{jt} + \beta_7 \ln \text{Human Capital}_{ijt} + \mu_j + \tau_t + u_{ijt} \quad (5)$$

where $\Delta y_{ijt}^{\text{Club } c}$ is a log approximation of output per capital growth in country j, region i, time t, and convergence club c. Term ln ($\text{ESIF}_{ijt}/\text{GDP}_{ijt}$) captures the main variable of interest: a ratio of modeled ESIF expenditures to regional GDP at time t. As a robustness check we also modify the model in Equation (5) by estimating the parameters for ln($\text{ESIF}_{ijt}/\text{Population}_{ijt}$) capturing the ratio of modeled ESIF expenditures to regional population at time t. The remaining terms contain a standard elements of Solow-Swan model: the lagged GDP per capita (y_{ijt-1}); the capital stock per capita (k_{ijt}); population growth (n_{ijt}) and the sum of technological progress rate and depreciation rate is assumed constant and equals to 0.05; quality of institutions (Rule of Law_{jt}); and the stock human capital to population (Human Capital_{ijt}). The μ_j; τ_j stand for the country, time fixed effects respectively, and u_{ijt} is a stochastic error.

We assume that the impact of ESIF and all other explanatory variables do not only impact growth in the region, but they can also impact economic growth in other regions. We apply a Generalized Nested Spatial Model (GNSM) (Rüttenauer 2022) proposed by Manski (1993) to eliminate the serious endogeneity problem due to interregional spatial spillovers. Specifically, we estimate:

$$\Delta \ln \boldsymbol{y} = \rho(\boldsymbol{I}_T \otimes \boldsymbol{W})\Delta \ln(y) + \boldsymbol{X}\beta + (\boldsymbol{I}_T \otimes \boldsymbol{W})\boldsymbol{X}\theta + \mu + \boldsymbol{u} \quad (6)$$

$$\boldsymbol{u} = \lambda \boldsymbol{W}\epsilon + \xi$$

where $\Delta \ln \boldsymbol{y}$ represents a vector of changes in output per capital growth again using logarithmic approximation; $\boldsymbol{X}$ is a matrix of all explanatory variables used also in Equation (5); $\boldsymbol{W}$ is a spatial weight matrix. We apply a binary first-order rook-contiguity matrix.[3] Coefficients vector, ρ, stands for the spatial lag of endogenous variable, and θ, is a coefficient of spatial lag of explanatory variables $\boldsymbol{X}$ moderated by the spatial weight matrix $\boldsymbol{W}$. Additionally, we model an error term as the sum of a spatially dependent process, where the parameter λ captures a spatial lag of the error term, and the ξ which represents an orthogonal stochastic variation in the error term.

To model the impact of an ESIF expenditures-to-GDP or to-population on economic growth that differs across convergence clubs, we could not use the spatial specification given in Equation (6) because convergence clubs are not contingent in space. Moreover, we want to address the endogeneity problem therefore we need to find an appropriate instrument that is independent from the economic growth (exclusion restriction) and is highly correlated with our main endogenous variable of interest (relevance condition). Following the approach of Dall'Erba and Le Gallo (2008), we use two instruments that are similar but not the same[4]: the distance from the centroid of a region i to the centroid of the Région de Bruxelles-Capitale (BE10)[5] and the spatial lag of the ESIF expenditures-to-GDP in the first neighboring regions of a local region i. We use the instrumental variable (IV) cross-sectional model setup with 2SLS estimation procedure. Dall'Erba and Le Gallo (2008) argue that these instruments satisfy exclusion restriction. To assess the validity of the instruments used, we use the Sargan–Hansen test to test exclusion restriction. The relevance of our IV approach is assessed by the first-order F-statistic.

4 | Results

To investigate the impact of ESIF on short-run economic growth that could differ among the regions not converging to same steady-state, we apply the log(t) test to all 287 NUTS regions, between 1995 and 2019 period. Based on the results presented in Table 1 the hypothesis of overall convergence of all regions to one steady state must be rejected at the 1% significance level.

Subsequently, we carried out the clustering process described in Section 3, where we identified eight convergence clusters. Afterward we merged these clusters into larger convergence clubs using the methodological procedure developed by Schnurbus, Haupt, and Meier (2017). We identified three convergence clubs, and one group of diverging regions. We present the results of the log(t) test for each convergence club in the Table 2, together with the average GDP p.c. in 2019 (2015 = 100 prices). Substantial large income (output) differences among convergence clubs could be observed in the last period. Three regions do not converge to any of the identified clubs (Anatoliki Makedonia (EL11), Thraki Dyriki Ellada (EL63), Inner London-West (UKI3)).

At the same time, we present a graphical depiction of the convergence clubs in Figure 2. It is immediately evident that the first convergence club is relatively heterogeneous in spatial distribution. Typically, this club consists mainly of regions housing

TABLE 1 | log(t) test overall convergence of all EU28 regions.

Variable	Coefficient ($\hat{b}$)	Standard error (s_b)	t-statistics
log(t)	−0.417***	0.015	−28.175

Source: Authors' calculations based on ARDECO database.

TABLE 2 | Classification of convergence clubs.

	Number of regions	Coefficient ($\hat{b}$)	*t*-statistics	Average GDP p.c PPS (2019)
Club 1	31	0.127***	2.920	55,881
Club 2	166	−0.028***	−0.827	32,707
Club 3	87	0.077***	1.499	16,106
Diverging regions	3	−1.193***	−44.237	—

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Authors' calculations based on ARDECO database. PPS, Purchasing Power Standards in 2019 Constant Prices: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Purchasing_power_standard_(PPS).

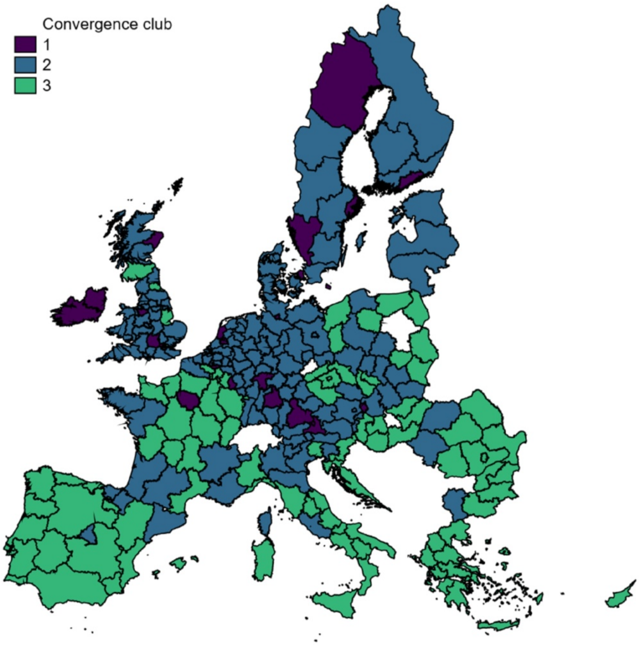

FIGURE 2 | Convergence clubs in the EU28 regions (1996–2019). *Source:* Authors' calculations based on ARDECO database. The colors indicate the convergence club each region belongs to according to the Phillips and Sul (2007) clustering algorithm, which was improved by Schnurbus, Haupt, and Meier (2017). (Dark blue, Club 1; Blue, Club 2; Green, Club 3.)

the country's capital or large metropolitan areas, often situated along the so-called "Blue Banana" a corridor extending in an arc from North West England across the Benelux countries, through the Rhine valley in Germany, and down to Northern Italy (see Hospers 2003). The second convergence club, to which more than half of the sample belongs, primarily encompasses Central and Northern Europe, along with some newly accessed countries such as the Baltic countries, Western Poland, Romania, and Slovakia. This club is relatively contiguous in space. The third convergence club comprises Southern Europe, central France, Hungary, Czechia, and other geographically peripheral regions. In the Phillips and Sul (2007) framework, an estimated $0 \leq \hat{b} < 2$ for the first and third convergence clubs implies convergence in growth rates. We cannot confirm convergence in levels within any of the convergence clubs, as no estimated $\hat{b}$ is larger than 2. This result is consistent with findings by Bartkowska and Riedl (2012), Pintera (2021), Von Lyncker and Thoennessen (2017), and the country-level study by Cavallaro and Villani (2021).

Visually comparing the right panel of Figure 1 with Figures 2, A1, and A2, we observe that regions in Bulgaria, Greece, Hungary, Portugal, eastern Romania, southern Italy, and Spain predominantly belong to the third convergence club. Despite receiving substantial shares of cohesion funds over the past 2 decades, these regions did not experience significant economic impact, particularly in terms of converging to higher steady-state equilibria (Figure 2) or improvements in income quintile distribution (see Figure A2 in the Appendix A).

Conversely, regions in Estonia, Finland, Latvia, Lithuania, Slovakia, western Poland, and Romania, initially categorized as poor, have ascended to membership in the second convergence club. Additionally, certain regions, such as those in Estonia, Finland, western Czechia, and northern Italy, achieved substantial convergence not only in growth rates but also in income levels, as evidenced by their convergence to lower steady-state equilibria (Figure 2) and observed improvement in income quintile distribution (Figure A2).

Therefore, the impact of ESIF on the formation of convergence clubs, particularly in Southern Europe (as documented in Figure A1 of the Appendix A), remains ambiguous. This echoes findings from Bartkowska and Riedl (2012), who suggest that cohesion funds weakly determine club membership.

This ambiguity may influence both short-run growth and long-run output per capita, potentially stemming from uncontrolled factors in our visual analysis, which we address subsequently. The convergence observed is partially attributable to the substantial allocation of ESIF funds. However, its absence in certain cases may be due to unobserved factors. We further investigate these factors within empirically identified convergence clubs, examining the convergence process and the impact of ESIF funds on economic growth in this context.

To establish a baseline of this relationship for future improvements, we initially estimate a standard beta-convergence model that does not incorporate the dimension of previously identified convergence clubs, as defined in Equation (5), nor any instrument to model ESIF expenditure intensity. The results of this estimation are presented in the column (1) in Table A2. The estimated coefficient capturing the elasticity of economic growth on ESIF expenditures-to-GDP is highly significant and negative ($\beta_1^{EU28} = -0.29$ s.e.: 0.07), indicating that a 1% increase in ESIF expenditures-to-GDP is, on average, associated with a decrease in short-run economic growth by 0.29%, holding all other variables in the model constant. This result sharply contrasts with expectations formulated in the theoretical literature we discussed previously and is likely highly negatively biased and endogenous, a problem we will address subsequently. The coefficient for lagged output per capita is negative and consistent with the β-convergence hypothesis, which predicts that more developed regions converge more slowly (for details, see Barro and Sala-i-Martin 1992). The coefficients for capital per capita and rule of law are positive. Estimates coefficients for other variables either have an unexpected sign or lack significance. Be that as it may, since this is our baseline estimate intended to illustrate the negative bias and endogeneity, we will not refine it further.

Secondly, we assume that ESIF and all other explanatory variables not only impact growth in the region but also affect economic growth in other regions. The column (2) in Table A2 reports these estimates of Equation (6). Using the GNS model, we find a significant positive relationship between the local ESIF expenditures-to-GDP and local economic growth of an average European region $\left(\beta_1^{\mathrm{EU28}} = 0.12 \text{ s.e.: } 0.05\right)$. To illustrate, our model predicts that if the ESIF expenditures-to-GDP increases by 1%, it is associated with an average increase in local economic growth of 0.12%.

Additionally, when examining the spatially lagged ESIF expenditures-to-GDP variable, we observe a negative but weakly significant relationship $\left(\theta_3^{\mathrm{EU28}} = -0.11 \text{ s.e.: } 0.06\right)$, suggesting that higher ESIF expenditures-to-GDP in neighboring regions are associated with a slight decrease in economic growth in the focal region. This result might be related to structural lock-in effects across a broader group of regions. This finding, although puzzling at first glance, underscores the complexity of regional economic interactions and suggests that the impacts of cohesion funds may be influenced by broader structural factors. Results on the local and spatially lagged impact of ESIF expenditures-to-GDP on economic growth obtained from this spatial analysis are consistent with those produced by Antunes et al. (2020) and Fidrmuc, Hulényi, and Zajkowska (2019) in terms of signs, but our results are larger in magnitudes. Nonetheless, a direct comparison is challenging because different time periods and sets of regions were used in these analyses. Moreover, the spatial lag of output growth is positive and strongly significant, implying positive spillovers in GDP per capita growth rates from neighboring regions $\left(\theta_1^{\mathrm{EU28}} = 0.86 \text{ s.e.: } 0.01\right)$, which aligns with results of previous studies (Antunes et al. 2020; Benos, Karagiannis, and Karkalakos 2015; Cuaresma, Doppelhofer, and Feldkircher 2014; Fidrmuc, Hulényi, and Zajkowska 2019).

To address how the impact of ESIF funds on short-run economic growth differs among regions converging to different steady-state equilibria, we empirically control for both the endogeneity problem by instrumenting the ESIF expenditures-to-GDP variable and by estimating the club-specific beta-convergence regression to control for the omitted variable bias caused by region's structural economic or political lock-in or the high level of economic development, as pointed out by Fidrmuc, Hulényi, and Zajkowska (2019). Therefore, we rely on the IV estimation strategy based on a more exogenous identification procedure for Equation (5), using the spatial lag and the region's air distance to Brussels as instruments for the region's ESIF expenditures-to-GDP, as discussed in the previous section. The results are presented in Table 3.

In the column (1) in Table 3, we report the results for all the EU28 regions with the standard beta-convergence regression where the ESIF is instrumented by the spatial lag of ESIF to GDP ratio and distance to Brussels to capture the core-periphery exogenous variation in preference of ESIF expenditures (see Dall'Erba and Le Gallo 2008). The first-stage F-statistics indicates that both instruments employed are relevant in the examined relationship, and the insignificant Sargan–Hansen test suggests that the instruments are valid.

The comparison of the obtained coefficient for the elasticity of short-run economic growth on ESIF expenditures-to-GDP $\left(\beta_1^{\mathrm{EU28}} = 0.37 \text{ s.e.: } 0.19\right)$ in the column (1) in Table 3 with our baseline estimate $\left(\beta_1^{\mathrm{EU28}} = -0.29 \text{ s.e.: } 0.07\right)$ in the column (1) in Table A2 shows a significant improvement. While the baseline model predicts a negative association between ESIF expenditures-to-GDP and short-run growth, after instrumenting the ESIF expenditures-to-GDP variable, this improved model not only predicts a positive effect but also enables us to make a causal interpretation. An improved model estimated across all regions predicts that, for regions with similar characteristics an increase in ESIF expenditures-to-GDP by 1% causes short-run economic growth to increase by approximately 0.37% on average, holding all other variables in the model constant. This effect on the sample of all European regions not only contradicts studies that found non-significant to negative impacts of cohesion funds on short-run economic growth (e.g., Boldrin and Canova 2001; Cappelen et al. 2003; Dall'Erba and Le Gallo 2008), but is also much higher in magnitude than the upper bounds among estimates in similar specifications (e.g., Mohl and Hagen 2010; Ederveen, De Groot, and Nahuis 2006; Bouayad-Agha, Turpin, and Védrine 2013), with comparisons closely aligned to the upper bounds of estimates in Bouvet (2005) and Esposti and Bussoletti (2008), but lower in magnitude than estimates in Fidrmuc, Hulényi, and Zajkowska (2019), despite some differences in regional and time samples across comparable studies.

In the context of the highly heterogeneous impact of cohesion policy found in Di Caro and Fratesi (2022) across European regions, this effect is expected. It could represent a lower estimate for regions where EU cohesion policy is very effective and an upper estimate for regions where the EU cohesion policy has marginal or zero effects. For instance, Di Caro and Fratesi (2022) found that policy effectiveness varies, with the periphery experiencing marginal to ineffective policy while the core benefits significantly. Echoing this observation, likely caused by structural economic or political lock-in or the high level of economic development as pointed out by Fidrmuc, Hulényi, and Zajkowska (2019), we split the sample and estimate the club-specific beta-convergence regression in columns (2)–(4) in Table 3.

Upon examining the estimated coefficients for the elasticity of short-run economic growth to ESIF expenditures-to-GDP within the first convergence club, which encompasses regions housing the country's capital or large metropolitan areas, we find an

TABLE 3 | Results of ESIF impact on economic growth among convergence clubs: Cross-sectional IV model.

	(1)	(2)	(3)	(4)
	$\Delta \ln y_{ijt}^{EU28}$	$\Delta \ln y_{ijt}^{Club\ 1}$	$\Delta \ln y_{ijt}^{Club\ 2}$	$\Delta \ln y_{ijt}^{Club\ 3}$
ln ($ESIF_t/GDP_t$)	0.3726*	1.3291	0.9306***	0.4106*
	(0.1916)	(2.3886)	(0.3270)	(0.2379)
ln y_{t-1}	−0.1337***	−0.4016***	−0.1331***	−0.1349***
	(0.0070)	(0.0290)	(0.0100)	(0.0123)
ln k_t	0.1320***	0.3853***	0.1225***	0.1349***
	(0.0073)	(0.0302)	(0.0105)	(0.0132)
ln $(n + 0.05)_t$	0.0009	0.0258***	0.0041	−0.0120**
	(0.0027)	(0.0096)	(0.0032)	(0.0047)
ln Rule Law_t	0.0135***	0.0418***	0.0116***	0.0102***
	(0.0014)	(0.0085)	(0.0023)	(0.0017)
ln Human $capital_t$	0.0085***	−0.0207	−0.0019	0.0196***
	(0.0022)	(0.0150)	(0.0030)	(0.0047)
Constant	0.7650***	2.4857***	0.8399***	0.7282***
	(0.0428)	(0.1831)	(0.0612)	(0.0748)
Observations	4687	415	2505	1767
R^2	0.4495	0.5603	0.4959	0.4981
Time FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
First stage F-statistics	201.5	61.62	197.7	68.99
Sargan–Hansen	2.558	1.036	1.594	0.0615
Sargan–Hansen p-value	0.110	0.309	0.207	0.804

Note: Instrumental variable: spatial lag of ESIF expenditures-to-GDP and distance to Brussels. W matrix for the spatial lag instrumental variable is based on contiguous neighbors. The distance to Brussels is calculated from the centroid of each region to the centroid of Région de Bruxelles-Capitale (BE10). The standard error estimates hold under the homoscedasticity of errors assumption. Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Authors' calculations based on ARDECO and European Commission (2020) databases.

effect that is statistically indistinguishable from zero. This outcome aligns with expectations, as these regions do not receive ESIF funding due to their already high level of economic development. Consequently, we partially alleviate the negative bias in the initial specification. As anticipated in Fidrmuc, Hulényi, and Zajkowska (2019), the estimated coefficients for the elasticity of short-run economic growth to ESIF expenditures-to-GDP within the remaining two clubs in columns (3) and (4) remained positive and are larger than the average effect across all regions in column (1). Despite the slight negative bias introduced by the most affluent regions, it has minimal impact on the studied relationships.

It is noteworthy that the second convergence club, which primarily encompasses Central and Northern Europe along with some later accessed countries such as the Baltic countries, Western Poland, Romania, and Slovakia, shows an average elasticity of short-run economic growth on ESIF expenditures-to-GDP that is approximately close to one. In regions belonging to the second convergence club, the effect of cohesion funds on short-run economic growth is approximately twice the magnitude compared to the average effect in the third convergence club, which encompasses regions in Southern Europe or the periphery of the EU $\left(\beta_1^{Club\ 2} = 0.93 \text{ s.e.: } 0.33 \text{ vs. } \beta_1^{Club\ 3} = 0.41 \text{ s.e.: } 0.24\right)$. Even though, the effect of cohesion funds on short-run economic growth in the third convergence club is only weakly significant. When we estimate using White (1980) heteroskedasticity-consistent standard errors (not reported here), the effect of cohesion funds on economic growth in the third convergence club completely loses significance. These findings are in line with broader results reported by others, such as Di Caro and Fratesi (2022), and partly with Cerqua and Pellegrini (2018).

The coefficients of all other control variables in Table 3 are significant and have the expected signs (except for population growth). The lagged output per capita is negative and consistent with the β-convergence hypothesis, across all convergence clubs, indicating convergence in growth rates among regions within each convergence club. This contrasts with the findings for the second (core) convergence club in Table 2, where the log(t) test did not confirm convergence in growth rates among regions. A higher capital stock per capita implies higher capital intensity of production and, consequently, a faster growth rate when the region is below its steady-state level. An interesting observation is that regions belonging to the first convergence club have, on average, a coefficient for capital intensity estimated to be three times higher than that of the other convergence clubs $\left(\beta_1^{\text{Club }1} = 0.39 \text{ s.e.: } 0.03 \text{ vs. } \beta_1^{\text{Club }2;3} = 0.12;0.13 \text{ s.e.: } 0.01;0.01\right)$. This suggests that they are much farther from the empirical steady-state equilibrium, and that capital accumulation in these regions has, on average, a much larger effect on short-run economic growth compared to both core and peripheral convergence clubs. The coefficients for rule of law and human capital are positive, indicating that incremental increases in institutional quality or educational attainment have a positive effect on economic growth. Nevertheless, these results are not always positive as expected or have ambiguous signs across convergence clubs.

As a robustness check, we modify the estimated beta-convergence regression specified in Equation (5) and previously estimated in Table 3 by using the ESIF expenditures-to-population ratio instead of ESIF expenditures-to-GDP as the main variable of interest. The results are presented in Table A3. The findings on the positive impact of ESIF expenditures on short-run economic growth remain robust using this measure of ESIF intensity across all convergence clubs. Additionally, the β-convergence process across all convergence clubs continues to have strong empirical support in this modified specification. Interestingly, the difference in the magnitude of the estimated elasticity of short-run economic growth with respect to ESIF expenditures-to-population for the second and third convergence clubs vanishes, now showing strong significance for both clubs. We verified that the standard errors produced in these regressions are also robust to heteroskedasticity (not reported here), with the standard errors in Table A3 remaining largely unchanged from those presented.

5 | Discussion

Our results on the convergence club clustering are comparable to at least three studies that used the same methodology developed by Phillips and Sul (2007). However, despite some common methodological ground, our results are not directly comparable with those of Bartkowska and Riedl (2012), Von Lyncker and Thoennessen (2017), or Pintera (2021) due to important differences. First, none of these studies utilize the augmented Phillips and Sul (2007) cluster merging algorithm developed by Schnurbus, Haupt, and Meier (2017). This difference is likely the most significant factor explaining why they identified four to six convergence clubs, whereas we identified only three. Moreover, the first two studies used only the regions within the EU15 sample and have completely different time spans for their analysis: 1990 to 2002 and 1980 to 2011, respectively. The study by Pintera (2021) is most closely comparable to ours, as it includes all EU28 regions, albeit with a slightly different time span for the analysis. Despite these differences, we compare our results to all three studies.

Most importantly, across all these studies, including ours, no convergence in income levels within convergence clubs at the regional level was observed; only convergence in growth rates was evident within most convergence clubs. This finding is further supported by the negative and significant estimates of lagged regional output in our beta-convergence regressions across all convergence clubs (Tables 3, A2, and A3), although the log(t) test weakly contradicts results in the second (core) club (Table 2). Hence, ESIF appears to be necessary but probably not sufficient for achieving convergence in income per capita levels.

In terms of the spatial pattern of convergence clubs in Europe, all three studies and ours identify a core and periphery pattern. All found that Portuguese, Southern Spanish, Southern Italian, and Greek regions, as well as peripheral regions in Central and Eastern Europe (this is part of regional sample only in Pintera (2021)), tend to converge to the lowest steady-state equilibria in terms of income per capita. Conversely, in line with these studies, we found that regions along the “Blue Banana” and large metropolitan areas tend to converge to the highest steady state in terms of income per capita.

A striking difference that highlights the success of Scandinavian regions is notable. Almost all regions in this area belonged to the middle-lower tier among convergence clubs in Bartkowska and Riedl's (2012) study from the beginning of the European integration period. Be that as it may, along with Von Lyncker and Thoennessen (2017) and Pintera (2021), we found that these regions are now part of the top tier in the convergence clubs. This fact underscores the success of regional policies and cohesion policies aimed at reducing regional inequalities.

On the opposite side of the spectrum, when comparing regions neighboring to Île-de-France (FR10), Bartkowska and Riedl (2012) found that they were members of the upper tier in terms of income per capita steady state. After almost 2 decades, we, along with Von Lyncker and Thoennessen (2017) and Pintera (2021), found that all those regions now converge to a middle-low tier steady state. This result is most pronounced in our results and raises many questions about the complex and region-specific nature of economic convergence within the EU most likely influenced by institutional and structural factors that will be discussed below.

It is important to note that our results suggest a higher positive elasticity of short-run economic growth in response to ESIF expenditures-to-GDP and regional economic growth compared to other studies (Mohl and Hagen 2010; Ederveen, De Groot, and Nahuis 2006; Bouayad-Agha, Turpin, and Védrine 2013). Our comparisons align closely with the upper bounds of estimates in Bouvet (2005) and Esposti and Bussoletti (2008), but are lower than those in Fidrmuc, Hulényi, and Zajkowska (2019). To the best of our knowledge, Fidrmuc, Hulényi, and Zajkowska (2019) is the only study that produces elasticity estimates of ESIF on short-run economic growth above one, despite some differences in regional and time samples across studies. Our results indicate that incorporating the perspective of convergence clubs into beta-growth regressions helps to mitigate some of the negative biases inherent in club-specific elasticity estimates of short-run economic growth in response to ESIF expenditures-to-GDP and to population size. Specifically, we observe that the estimated elasticities specific to these clubs are consistently higher than the average elasticity across the EU28. Nevertheless, we can only assert with limited certainty that this effect represents the true impact, which is likely to be the lower bound and may potentially be even greater.

There are two objectively concerning findings. Firstly, the impact of ESIF expenditures-to-GDP on short-term economic growth is statistically weakly significant for regions belonging to the third (periphery) convergence club. Secondly, the effects of EU funds on economic growth are much stronger in the second (core) convergence club compared to peripheral ones, possibly due to structural and institutional factors or differences in policy preferences. These findings resemble those in Di Caro and Fratesi (2022) and partly align with Cerqua and Pellegrini (2018).

The explanations as to why the returns of additional ESIF in the periphery convergence club may not have lived up to expectations vary. Crescenzi, Di Cataldo, and Rodríguez-Pose (2016) demonstrate that under conditions of weak government quality, new public investments in infrastructure may prioritize political and individual interests over economic and collective ones. Institutional failures often lead to a preference for large-scale projects that appeal to incumbent politicians seeking re-election, at the expense of more ordinary investments. These mega-projects frequently carry higher risks, with common occurrences of cost overruns and delays exacerbated by the inability of legal institutions to enforce procurement contracts. Such issues are typically more severe in the European periphery compared to the core (Crescenzi, Di Cataldo, and Rodríguez-Pose 2016). Despite controlling for some differences in institutional quality, institutions are a multifaceted phenomenon that extends beyond the rule of law and may not be fully captured by this measure. Other institutional factors contributing to the weak link between ESIF and regional economic growth in the peripheral convergence club include bureaucratic inefficiencies, mismanagement, or corruption (Rodríguez-Pose and Garcilazo 2015); political cycles (Rodríguez-Pose 2000); mismatches between cohesion policy allocation and regional needs (Crescenzi and Giua 2020); dependency on external investment funding inhibiting regional initiative and innovation (Ferry and McMaster 2013); or a lack of complementary reforms to investment (Mohl and Hagen 2010).

Furthermore, the sectoral composition of a region—whether industrial, service-oriented, or agricultural—can also influence how ESIF funds are utilized and their subsequent impact. Regions with diversified economies and a strong tertiary sector are typically better positioned to benefit from these funds compared to regions that primarily invest in hard infrastructure and the energy sector, which are not unequivocally associated with greater economic growth (Darvas, Mazza, and Midões 2019). In addition, regions with regional development strategies closely aligned with EU cohesion objectives can better leverage ESIF to address their unique economic challenges (Rodríguez-Pose and Fratesi 2004). Moreover, regions suffering from significant out-migration of skilled workers often lack the necessary expertise and innovation capacity to design and implement complex projects typically funded by ESIF (Gagliardi 2015; Fratesi and Percoco 2014). Not just the level of human capital but also the quality of human capital is another crucial factor determining among others also ESIF effective use. Studies consistently show that regions with well-educated populations are more likely to benefit from public investments like ESIF, as they have the necessary knowledge and capabilities to maximize these opportunities (Antunes et al. 2020; Pinho, Varum, and Antunes 2015; Barro and Lee 1994, 1996; Benhabib and Spiegel 1994). However, due to data constraints, we are unable to differentiate the quality of educational outcomes that shapes human capital across European regions, though this could be another key factor determining the short-run economic performance gained from ESIF expenditure.

Nevertheless, Cerqua and Pellegrini (2018) provide valuable insight into why non-significant results should be interpreted with great caution. They emphasize that ESIF transfers may serve additional social objectives beyond fostering regional growth. Consequently, regions with high ESIF intensity may allocate portions of these funds to fulfill diverse objectives, potentially compromising the observed relationship between ESIF intensity and economic growth.

6 | Conclusions

This paper aimed to address the seemingly straightforward question of whether EU cohesion funds stimulate regional economic growth. Despite the expectation that these funds should enhance economic growth, several previous studies have found insignificant or even negative effects. Our primary contribution to resolving this puzzle lies in mitigating unobserved negative biases, such as the structural lock-in of regions or the presence of regions with a high level of economic development by empirically identifying and clustering the steady-state equilibria each region converges to (convergence clubs) making use of methodology developed by Phillips and Sul (2007). We identified three convergence clubs: the first convergence club primarily encompassing regions housing the country's capital or large metropolitan areas, often situated along the so-called "Blue Banana," which is the most developed club in terms of per capita output; the second convergence club, to which more than half of the sample belongs, primarily encompasses Central and Northern Europe, along with some newly accessed countries such as the Baltic countries, Western Poland, Romania, and Slovakia; and the third convergence club comprises Southern Europe, central France, Hungary, Czechia, and other geographically peripheral regions.

In examining spatial spillovers, we found that ESIF has a purely positive local average effect on short-run economic growth. Whereas, when considering the spatially lagged ESIF expenditures-to-GDP variable, we observed a negative but weakly significant relationship, suggesting that higher ESIF expenditures-to-GDP in neighboring regions are associated with a slight decrease in economic growth in the focal region. This might be related to structural lock-in effects across a broader set of regions, underscoring the complexity of regional economic interactions and the influence of broader structural and institutional factors.

Based on strong evidence supporting the club convergence hypothesis rather than overall convergence, our secondary contribution is the exogenous identification of the ESIF expenditures-to-GDP variable to accurately identify its relationship in club-specific beta-convergence regressions. In our main IV identification strategy, we instrumented ESIF expenditures-to-GDP with the spatial lag of expenditures-to-GDP and the distance to Brussels. This set of instruments was properly identified and relevant, enabling us to estimate the impact of ESIF on economic growth while controlling for serious endogeneity issues.

Our findings suggest that ESIF, as a key instrument of EU cohesion policy, exert short-term positive and significant effects on economic growth, particularly benefiting less but not least affluent regions. However, this effect is unevenly distributed among convergence clubs, with the second (core) convergence club demonstrating a higher elasticity of economic growth to ESIF expenditures-to-GDP than the third (periphery) convergence club. This difference, however, is not present when estimating ESIF expenditures-to-population, although the effect remains strongly significant.

Despite this, we also observe persistent polarization in terms of income per capita among regions, due to a lack of convergence in levels, as documented by Bartkowska and Riedl (2012), Von Lyncker and Thoennessen (2017), and Pintera (2021). Overall, our findings suggest that while EU cohesion funds are effective in promoting relative convergence in growth rates, they are less successful in mitigating regional inequalities in income (output) per capita. This indicates that although cohesion funds are necessary for convergence, they alone are not sufficient to achieve equal levels of income per capita across regions.

However, our research leaves the question of the conditioning factors that influence a region's membership in the convergence club more open than closed. We treated it more as an exogenous measure rather than an endogenous outcome of broader structural factors that, along with EU cohesion policy, ultimately determine the long-term level of income per capita for the region. This crucial aspect that should be addressed in future research, should encompass a comprehensive set of structural factors, including industrial and production structure path-dependence (Hassink 2010), offshoring (Castellani and Pieri 2013), technological lock-in (Crespo, Suire, and Vicente 2014), the quality of educational outcomes (Mason 2014), knowledge production (Parent and LeSage 2012), institutional transformation (Acemoglu, Johnson, and Robinson 2005), green transition (Lockwood 2015), or variations in social preferences for regional growth-fostering policies (Cerqua and Pellegrini 2018), alongside the standard Solow-Swan variables and cohesion funds expenditures. Moreover, future researchers could for example use a similar identification strategy and convergence clubs' perspective that is in line with endogenous growth approach and as also customary in the scholarly literature (e.g., Crescenzi and Rodríguez-Pose 2012; Parent and LeSage 2012; Capello and Lenzi 2014, Crescenzi, Di Cataldo, and Rodríguez-Pose 2016).

This highlights the strong imperative to exercise great caution when extrapolating our findings, especially those that are not significant, to policy. This caution is warranted for two primary reasons. Firstly, our analysis of the average impact of ESIF expenditures-to-GDP across European regions does not preclude the existence of idiosyncratic factors (such as those discussed in the previous section) that could yield consistent or increasing returns on investment in specific regions. Secondly, ESIF transfers may serve additional objectives beyond fostering regional growth. Consequently, regions with high ESIF intensity may allocate portions of these funds to fulfill diverse objectives, potentially compromising the observed relationship between ESIF intensity and growth, particularly in Southern Europe and geographically peripheral regions.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data used in this analysis are publicly available, as stated in the Data section. The replication code and cleaned data could be made available to readers upon request.

Endnotes

[1] Slovakia, Latvia, Lithuania, Estonia, Western Poland, and Western Bulgaria.

[2] PL92, PL91, LT01, IE04, HU11, HU12, DED4.

[3] Our results are robust to second-order contiguity specification.

[4] We rely on the air distance between each region and the Région de Bruxelles-Capitale, rather than incorporating travel time from the most populated city to Région de Bruxelles-Capitale, as preferred in Dall'Erba and LeGallo (2008). This decision is primarily driven by the need to address exogeneity. Air distance serves as a reliable proxy for the geographical core-periphery pattern of ESIF expenditures, which is exogenously determined and not influenced by the economic growth and level of development of a region, as argued by Dall'Erba and LeGallo (2008). By exclusively using air distance, we ensure that our measure is not influenced by endogenous factors (such as road density, railway networks, or airports) that could potentially affect both the economic growth and level of development of a region.

[5] We compute the air distances using the R package *eudistance* created by Kurbucz and Katona (2022).

References

Acemoglu, D., S. Johnson, and J. A. Robinson. 2005. "Institutions as a Fundamental Cause of Long-Run Growth." *Handbook of Economic Growth* 1: 385–472.

Aghion, P., and P. Howitt. 1990. *A Model of Growth Through Creative Destruction*. NBER Working Paper Series, Working Paper No. 3223. Cambridge, MA: National Bureau of Economic Research.

Alexiandis, S. 2012. *Convergence Clubs and Spatial Externalities: Models and Applications of Regional Convergence in Europe*. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg which is a part of Springer Science & Business Media.

Antunes, M., M. Viegas, C. Varum, and C. Pinho. 2020. "The Impact of Structural Funds on Regional Growth: A Panel Data Spatial Analysis." *Intereconomics* 55, no. 5: 312–319. https://doi.org/10.1007/s10272-020-0921-1.

Barro, R. J., and J. W. Lee. 1994. "Sources of Economic Growth." *Carnegie-Rochester Conference Series on Public Policy* 40: 1–46. https://doi.org/10.1016/0167-2231(94)90002-7.

Barro, R. J., and J. W. Lee. 1996. "International Measures of Schooling Years and Schooling Quality." *American Economic Review* 86, no. 2: 218–223.

Barro, R. J., and X. Sala-i-Martin. 1992. "Convergence." *Journal of Political Economy* 100, no. 2: 223–251. https://doi.org/10.1086/261816.

Bartkowska, M., and A. Riedl. 2012. "Regional Convergence Clubs in Europe: Identification and Conditioning Factors." *Economic Modelling* 29, no. 1: 22–31. https://doi.org/10.1016/j.econmod.2011.01.013.

Basher, S. A., F. D. Iorio, and S. Fachin. 2024. "Regional Income Dynamics in Bangladesh." *Empirical Economics* 66, no. 3: 1125–1159. https://doi.org/10.1007/s00181-023-02495-7.

Baumol, W. 1986. "Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show." *American Economic Review* 76, no. 5: 1072–1085.

Baumont, C., C. Ertur, and J. Le Gallo. 2003. "Spatial Convergence Clubs and the European Regional Growth Process, 1980–1995." In *European Regional Growth*, edited by B. Fingleton, 131–158. Berlin, Heidelberg: Springer Berlin Heidelberg.

Becker, S. O., P. H. Egger, and M. Von Ehrlich. 2010. "Going Nuts: The Effect of EU Structural Funds on Regional Performance." *Journal of Public Economics* 94, no. 9–10: 578–590. https://doi.org/10.1016/j.jpubeco.2010.06.006.

Benhabib, J., and M. M. Spiegel. 1994. "The Role of Human Capital in Economic Development Evidence From Aggregate Cross-Country Data." *Journal of Monetary Economics* 34, no. 2: 143–173. https://doi.org/10.1016/0304-3932(94)90047-7.

Benos, N., S. Karagiannis, and S. Karkalakos. 2015. "Proximity and Growth Spillovers in European Regions: The Role of Geographical, Economic and Technological Linkages." *Journal of Macroeconomics* 43: 124–139. https://doi.org/10.1016/j.jmacro.2014.10.003.

Bernard, A. B., and S. N. Durlauf. 1996. "Interpreting Tests of the Convergence Hypothesis." *Journal of Econometrics* 71, no. 1–2: 161–173. https://doi.org/10.1016/0304-4076(94)01699-2.

Boldrin, M., and F. Canova. 2001. "Inequality and Convergence in Europe's Regions: Reconsidering European Regional Policies." *Economic Policy* 16, no. 32: 206–253. https://doi.org/10.1111/1468-0327.00074.

Bouayad-Agha, S., N. Turpin, and L. Védrine. 2013. "Fostering the Development of European Regions: A Spatial Dynamic Panel Data Analysis of the Impact of Cohesion Policy." *Regional Studies* 47, no. 9: 1573–1593. https://doi.org/10.1080/00343404.2011.628930.

Bouvet, F. 2005. "European Union Regional Policy: Allocation Determinants and Effects on Regional Economic Growth." PhD thesis, Department of Economics, University of California, Davis.

Capello, R., and C. Lenzi. 2014. "Spatial Heterogeneity in Knowledge, Innovation, and Economic Growth Nexus: Conceptual Reflections and Empirical Evidence." *Journal of Regional Science* 54, no. 2: 186–214. https://doi.org/10.1111/jors.12074.

Cappelen, A., F. Castellacci, J. Fagerberg, and B. Verspagen. 2003. "The Impact of EU Regional Support on Growth and Convergence in the European Union." *Journal of Communication and Media Studies: Journal of Common Market Studies* 41, no. 4: 621–644. https://doi.org/10.1111/1468-5965.00438.

Carlino, G. A., and L. O. Mills. 1993. "Are US Regional Incomes Converging?: A Time Series Analysis." *Journal of Monetary Economics* 32, no. 2: 335–346. https://doi.org/10.1016/0304-3932(93)90009-5.

Castellani, D., and F. Pieri. 2013. "R&D Offshoring and the Productivity Growth of European Regions." *Research Policy* 42, no. 9: 1581–1594. https://doi.org/10.1016/j.respol.2013.05.009.

Cavallaro, E., and I. Villani. 2021. "Club Convergence in EU Countries." *Journal of Economic Integration* 36, no. 1: 125–161. https://doi.org/10.11130/jei.2021.36.1.125.

Cerqua, A., and G. Pellegrini. 2018. "Are We Spending Too Much to Grow? The Case of Structural Funds." *Journal of Regional Science* 58, no. 3: 535–563. https://doi.org/10.1111/jors.12365.

Charron, N., S. Dahlberg, A. Sundström, et al. 2020. *The Quality of Government: EU Regional Dataset, Version Nov20*. University of Gothenburg: The Quality of Government Institute. https://www.gu.se/en/quality-government.

Crescenzi, R., M. Di Cataldo, and A. Rodríguez-Pose. 2016. "Government Quality and the Economic Returns of Transport Infrastructure Investment in European Regions." *Journal of Regional Science* 56, no. 4: 555–582. https://doi.org/10.1111/jors.12264.

Crescenzi, R., and M. Giua. 2020. "One or Many Cohesion Policies of the European Union? On the Differential Economic Impacts of Cohesion Policy Across Member States." *Regional Studies* 54, no. 1: 10–20. https://doi.org/10.1080/00343404.2019.1665174.

Crescenzi, R., and A. Rodríguez-Pose. 2012. "Infrastructure and Regional Growth in the European Union." *Papers in Regional Science* 91, no. 3: 487–513. https://doi.org/10.1111/j.1435-5957.2012.00439.x.

Crespo, J., R. Suire, and J. Vicente. 2014. "Lock-In or Lock-Out? How Structural Properties of Knowledge Networks Affect Regional Resilience." *Journal of Economic Geography* 14, no. 1: 199–219. https://doi.org/10.1093/jeg/lbt006.

Cuaresma, J. C., G. Doppelhofer, and M. Feldkircher. 2014. "The Determinants of Economic Growth in European Regions." *Regional Studies* 48, no. 1: 44–67. https://doi.org/10.1080/00343404.2012.678824.

Dall'Erba, S., and F. Fang. 2017. "Meta-Analysis of the Impact of European Union Structural Funds on Regional Growth." *Regional Studies* 51, no. 6: 822–832. https://doi.org/10.1080/00343404.2015.1100285.

Dall'Erba, S., and J. Le Gallo. 2008. "Regional Convergence and the Impact of European Structural Funds Over 1989–1999: A Spatial Econometric Analysis." *Papers in Regional Science* 87, no. 2: 219–244. https://doi.org/10.1111/j.1435-5957.2008.00184.x.

Darvas, Z., J. Mazza, and C. Midões. May 2019. *How to Improve European Union Cohesion Policy for the Next Decade*. Policy Contribution, Issue no. 8. Brussel: Bruegel.

De Siano, R., and M. D'Uva. 2006. "Club Convergence in European Regions." *Applied Economics Letters* 13, no. 9: 569–574. https://doi.org/10.1080/13504850600733473.

Di Caro, P., and U. Fratesi. 2022. "One Policy, Different Effects: Estimating the Region-Specific Impacts of EU Cohesion Policy." *Journal of Regional Science* 62, no. 1: 307–330. https://doi.org/10.1111/jors.12566.

Du, K. 2017. "Econometric Convergence Test and Club Clustering Using Stata." *STATA Journal* 17, no. 4: 882–900. https://doi.org/10.1177/1536867x1801700407.

Durlauf, S. N., and P. A. Johnson. 1995. "Multiple Regimes and Cross-Country Growth Behaviour." *Journal of Applied Econometrics* 10, no. 4: 365–384. https://doi.org/10.1002/jae.3950100404.

Durlauf, S. N., P. A. Johnson, and J. R. Temple. 2005. "Growth Econometrics." *Handbook of Economic Growth* 1: 555–677.

Ederveen, S., H. L. F. De Groot, and R. Nahuis. 2006. "Fertile Soil for Structural Funds? A Panel Data Analysis of the Conditional Effectiveness of European Cohesion Policy." *Kyklos* 59, no. 1: 17–42. https://doi.org/10.1111/j.1467-6435.2006.00318.x.

Ederveen, S., J. Gorter, R. De Mooij, and R. Nahuis. 2002. "Funds and Games. The Economics of European Cohesion Policy." *CPB Special Publication* 41.

Esposti, R., and S. Bussoletti. 2008. "Impact of Objective 1 Funds on Regional Growth Convergence in the European Union: A Panel-Data

Approach." *Regional Studies* 42, no. 2: 159–173. https://doi.org/10.1080/00343400601142753.

European Commission. 2018. "Ex Post Evaluation of Major Projects Supported by the European Regional Development Fund (ERDF) and Cohesion Fund Between 2000 and 2013 (Lot Transport)." European Commission – Final Report, DG Region, Brussels.

European Commission. 2020. "Historic EU Payments – Regionalised and Modelled." https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv.

European Commission, Joint Research Centre. 2024. ARDECO Database. Directorate General for Regional and Urban Policy. June 9. https://knowledge4policy.ec.europa.eu/territorial/ardeco-database_en.

European Investment Bank. 2019. "Study in Response to ECA Recommendation 5: Improving the Geographical Spread of EFSI Supported Investment." https://www.eib.org/attachments/covid19-financing-multiple-underlying-operations-under-iiw.pdf.

Ferry, M., and I. McMaster. 2013. "Cohesion Policy and the Evolution of Regional Policy in Central and Eastern Europe." *Europe-Asia Studies* 65, no. 8: 1502–1528. https://doi.org/10.1080/09668136.2013.832969.

Fiaschi, D., A. M. Lavezzi, and A. Parenti. 2018. "Does EU Cohesion Policy Work? Theory and Evidence." *Journal of Regional Science* 58, no. 2: 386–423. https://doi.org/10.1111/jors.12364.

Fidrmuc, J., M. Hulényi, and O. Zajkowska. 2019. "The Elusive Quest for the Holy Grail of an Impact of EU Funds on Regional Growth." CESifo Working Paper.

Fratesi, U., and M. Percoco. 2014. "Selective Migration, Regional Growth and Convergence: Evidence From Italy." *Regional Studies* 48, no. 10: 1650–1668. https://doi.org/10.1080/00343404.2013.843162.

Fujita, M., and J.-F. Thisse. 1996. "Economics of Agglomeration." *Journal of the Japanese and International Economies* 10, no. 4: 339–378. https://doi.org/10.1006/jjie.1996.0021.

Gagliardi, L. 2015. "Does Skilled Migration Foster Innovative Performance? Evidence From British Local Areas." *Papers in Regional Science* 94, no. 4: 773–795. https://doi.org/10.1111/pirs.12095.

Grossman, G. M., and E. Helpman. 1991. "Trade, Knowledge Spillovers, and Growth." *European Economic Review* 35, no. 2–3: 517–526. https://doi.org/10.1016/0014-2921(91)90153-a.

Hassink, R. 2010. "Locked in Decline? On the Role of Regional Lock-Ins in Old Industrial Areas." In *The Handbook of Evolutionary Economic Geography*, edited by R. Boschma and R. Martin, 450–468. Cheltenham: Edward Elgar Publishing.

Hospers, G. J. 2003. "Beyond the Blue Banana? Structural Change in Europe's Geo-Economy." *Intereconomics* 38, no. 2: 76–85. https://doi.org/10.1007/bf03031774.

Kaufmann, D., A. Kraay, and M. Mastruzzi. 2011. "The Worldwide Governance Indicators: Methodology and Analytical Issues." *Hague Journal on the Rule of Law* 3, no. 2: 220–246. https://doi.org/10.1017/s1876404511200046.

Krugman, P. 1991. "Increasing Returns and Economic Geography." *Journal of Political Economy* 99, no. 3: 483–499. https://doi.org/10.1086/261763.

Kurbucz, M. T., and A. I. Katona. 2022. "Eudistance: Distance Calculator for the Different Levels of European NUTS Regions." *Software Impacts* 13: 100327. https://doi.org/10.1016/j.simpa.2022.100327.

Lockwood, M. 2015. "The Political Dynamics of Green Transformations: Feedback Effects and Institutional Context." In *The Politics of Green Transformations*, edited by I. Scoones, M. Leach, and P. Newell, 104–119. London: Routledge.

Magrini, S. 2004. "Regional (Di)Convergence." In *Handbook of Regional and Urban Economics*, edited by J. V. Henderson and J. Thisse, Vol. 4, 2741–2796. Amsterdam: Elsevier.

Mankiw, N. G., D. Romer, and D. N. Weil. 1992. "A Contribution to the Empirics of Economic Growth." *Quarterly Journal of Economics* 107, no. 2: 407–437. https://doi.org/10.2307/2118477.

Manski, C. F. 1993. "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies* 60, no. 3: 531–542. https://doi.org/10.2307/2298123.

Mason, M. 2014. "Complexity Theory and Systemic Change in Education Governance." In *Governing Education in a Complex World*, edited by T. Burns and F. Köster. Paris: OECD Publishing.

Mazzola, F., and P. Pizzuto. 2020. "Great Recession and Club Convergence in Europe: A Cross-Country, Cross-Region Panel Analysis (2000–2015)." *Growth and Change* 51, no. 2: 676–711. https://doi.org/10.1111/grow.12369.

Mohl, P., and T. Hagen. 2010. "Do EU Structural Funds Promote Regional Growth? New Evidence From Various Panel Data Approaches." *Regional Science and Urban Economics* 40, no. 5: 353–365. https://doi.org/10.1016/j.regsciurbeco.2010.03.005.

Monfort, M., J. C. Cuestas, and J. Ordonez. 2013. "Real Convergence in Europe: A Cluster Analysis." *Economic Modelling* 33: 689–694. https://doi.org/10.1016/j.econmod.2013.05.015.

Parent, O., and J. P. LeSage. 2012. "Determinants of Knowledge Production and Their Effects on Regional Economic Growth." *Journal of Regional Science* 52, no. 2: 256–284. https://doi.org/10.1111/j.1467-9787.2011.00732.x.

Phillips, P. C., and D. Sul. 2007. "Transition Modeling and Econometric Convergence Tests." *Econometrica* 75, no. 6: 1771–1855. https://doi.org/10.1111/j.1468-0262.2007.00811.x.

Pinho, C., C. Varum, and M. Antunes. 2015. "Structural Funds and European Regional Growth: Comparison of Effects Among Different Programming Periods." *European Planning Studies* 23, no. 7: 1302–1326. https://doi.org/10.1080/09654313.2014.928674.

Pintera, J. 2021. "Regional Convergence in the European Union: What Are the Factors of Growth?." IES Working Paper (No. 20/2021).

Polverari, L., and Bachtler, J. 2014. "Balance of Competences Cohesion Review: Literature Review on EU Cohesion Policy." European Policies Research Centre Report – Report.

Ramajo, J., M. A. Marquez, G. J. Hewings, and M. M. Salinas. 2008. "Spatial Heterogeneity and Interregional Spillovers in the European Union: Do Cohesion Policies Encourage Convergence Across Regions?." *European Economic Review* 52, no. 3: 551–567. https://doi.org/10.1016/j.euroecorev.2007.05.006.

Rodríguez-Pose, A. 2000. "Economic Convergence and Regional Development Strategies in Spain: The Case of Galicia and Navarre." *EIB Papers* 5: 89–115.

Rodríguez-Pose, A., and U. Fratesi. 2004. "Between Development and Social Policies: The Impact of European Structural Funds in Objective 1 Regions." *Regional Studies* 38, no. 1: 97–113. https://doi.org/10.1080/00343400310001632226.

Rodríguez-Pose, A., and E. Garcilazo. 2015. "Quality of Government and the Returns of Investment: Examining the Impact of Cohesion Expenditure in European Regions." *Regional Studies* 49, no. 8: 1274–1290. https://doi.org/10.1080/00343404.2015.1007933.

Rüttenauer, T. 2022. "Spatial Regression Models: A Systematic Comparison of Different Model Specifications Using Monte Carlo Experiments." *Sociological Methods & Research* 51, no. 2: 728–759. https://doi.org/10.1177/0049124119882467.

Sala-i-Martin, X. X. 1996. "Regional Cohesion: Evidence and Theories of Regional Growth and Convergence." *European Economic Review* 40, no. 6: 1325–1352. https://doi.org/10.1016/0014-2921(95)00029-1.

Schnurbus, J., H. Haupt, and V. Meier. 2017. "Economic Transition and Growth: A Replication." *Journal of Applied Econometrics* 32, no. 5: 1039–1042. https://doi.org/10.1002/jae.2544.

Solow, R. M. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70, no. 1: 65–94. https://doi.org/10.2307/1884513.

Tomal, M. 2023. "A Review of Phillips-Sul Approach-based Club Convergence Tests." *Journal of Economic Surveys* 38, no. 3: 899–930. https://doi.org/10.1111/joes.12563.

Vickerman, R., K. Spiekermann, and M. Wegener. 1999. "Accessibility and Economic Development in Europe." *Regional Studies* 33, no. 1: 1–15. https://doi.org/10.1080/00343409950118878.

Vignetti, S., F. Giffoni, C. Pancotti, and F. Pagliara. 2020. "Analytical Framework for Ex-Post Evaluation of Transport Projects: Lessons Learnt on Retrospective CBA." *Papers in Regional Science* 99, no. 3: 683–703. https://doi.org/10.1111/pirs.12501.

Von Lyncker, K., and R. Thoennessen. 2017. "Regional Club Convergence in the EU: Evidence From a Panel Data Analysis." *Empirical Economics* 52, no. 2: 525–553. https://doi.org/10.1007/s00181-016-1096-2.

White, H. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48, no. 4: 817–838. https://doi.org/10.2307/1912934.

Appendix A

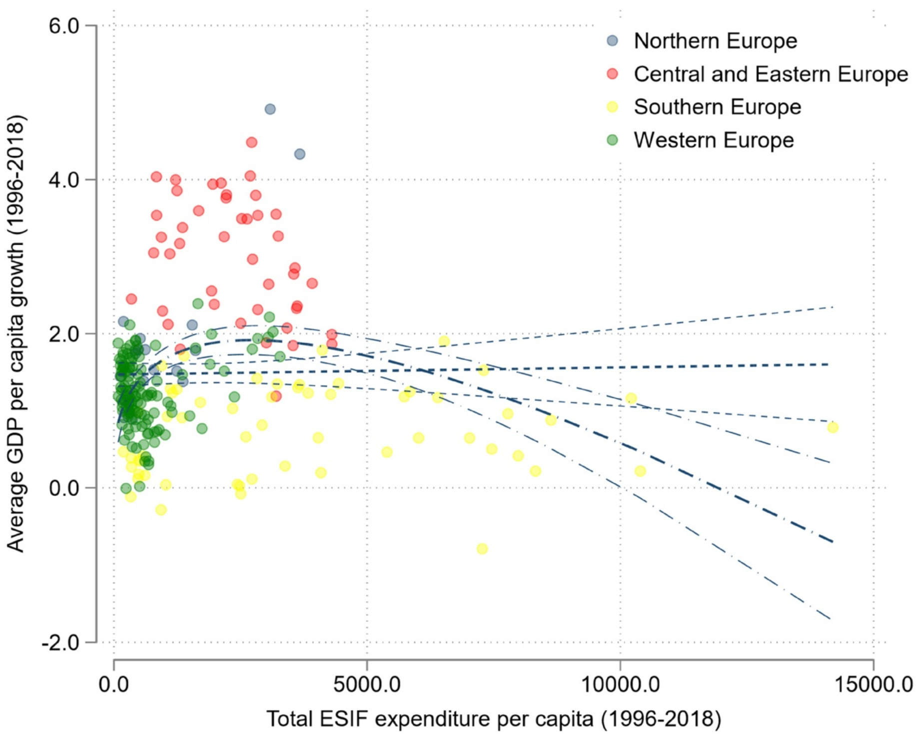

FIGURE A1 | Scatter plot of mean growth rate and total ESIF expenditures per capita in EU28 regions between 1996 and 2018 period. *Source:* Authors' calculations based on ARDECO and European Commission (2020) databases. The dash-dotted line represents an unweighted cubic polynomial fit; the dashed line represents a linear fit. Countries are classified into subregions as defined by EuroVoc in the 7206 Europe: Concept Scheme.

TABLE A1 | Descriptive statistics in levels for 1996–2019 period.

	(1) Mean	(2) p50	(3) sd	(4) p1	(5) p99	(6) N
Human capital	25.18	24.80	9.58	8	50.90	4687
Rule of law	1.24	1.43	0.57	−0.15	1.98	5439
GDP p.c. growth	0.02	0.02	0.03	−0.08	0.10	6216
Capital stock p.c.	78.23	80.23	39.05	8.372	176.4	6216
$(n + g + \delta)$	0.05	0.05	0.01	0.03	0.08	6215
ESIF/GDP	0.0043	0.0006	0.0086	0	0.04	6216
ESIF/population	65.42	19.68	111.86	0	528.12	6216

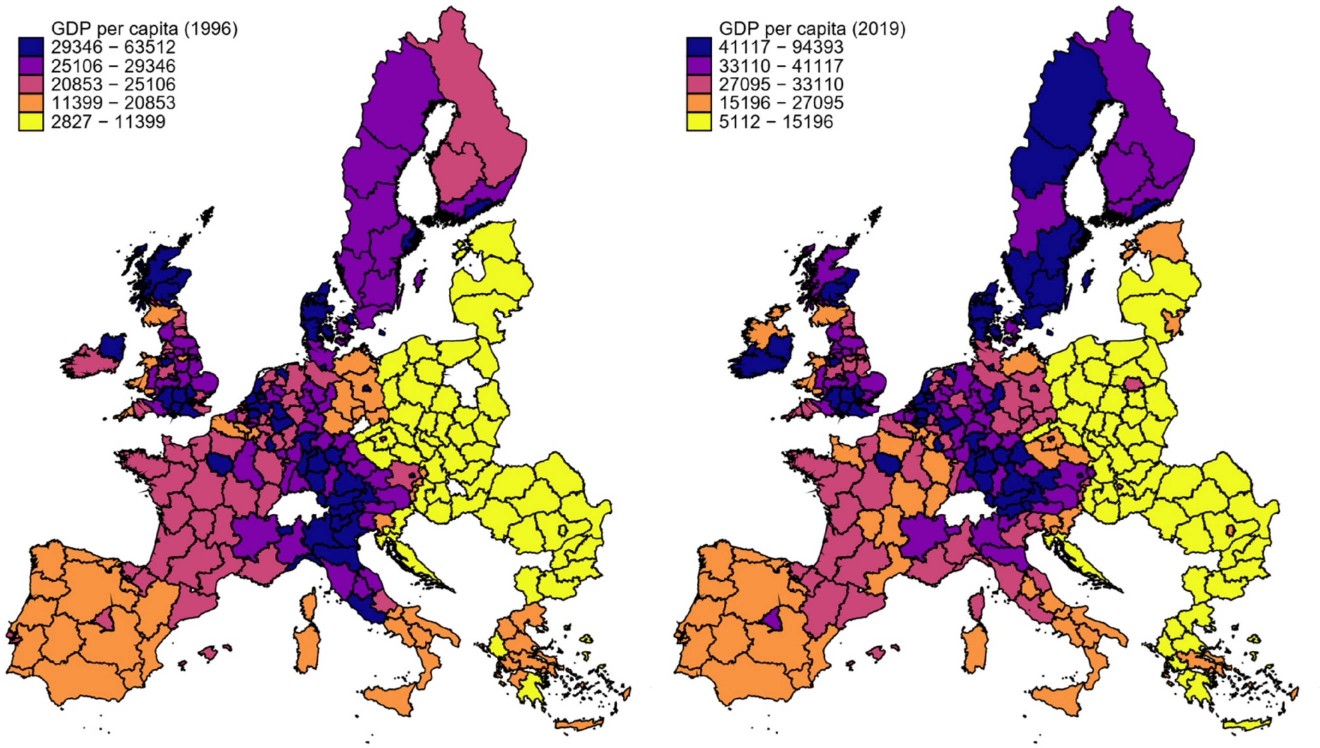

FIGURE A2 | Quintile map of GDP per capita between 1996 and 2019 in EU28 panel. *Source:* Authors' calculations based on ARDECO database.

TABLE A2 | Results of ESIF impact on economic growth: Panel data OLS model and GNS model.

	(1) $\Delta \ln y_{ijt}^{EU28}$	(2) $\Delta \ln y_{ijt}^{EU28}$
$\ln (ESIF_t/GDP_t)$	−0.2914***	0.1175**
	(0.0710)	(0.0532)
$\ln y_{t-1}$	−0.0000***	−0.0000***
	(0.0000)	(0.0000)
$\ln k_t$	0.0382***	0.1230***
	(0.0060)	(0.0072)
$\ln (n + 0.05)_t$	0.0005	0.0017
	(0.0030)	(0.0039)
ln Rule law_t	0.0117***	−0.0053***
	(0.0014)	(0.0012)
ln Human $capital_t$	−0.0070*	0.0078
	(0.0041)	(0.0053)
$W \times \ln(y_{it+1}/y_{it})$		0.8643***
		(0.0064)
$e \times W \times \ln(y_{it+1}/y_{it})$		−0.8707***
		(0.0103)
$W \times \ln (ESIF_t/GDP_t)$		−0.1097*
		(0.0603)
$W \times \ln y_t$		0.0000***
		(0.0000)
$W \times \ln k_t$		−0.1219***
		(0.0074)
$W \times \ln (n + 0.05)_t$		−0.0062
		(0.0046)
$W \times$ ln Rule law_t		0.0049***
		(0.0013)
$W \times$ ln Human $capital_t$		0.0089
		(0.0061)
Constant	0.0018	
	(0.0262)	
σ_e		0.0078***
		(0.0001)
Observations	4687	4921
R^2	0.3727	—
Number of regions	259	259
Time FE	Yes	—
Country FE	Yes	—

Note: W matrix for the spatial lag of all variables and error is based on contiguous neighbors. The standard error estimates hold under the homoscedasticity of errors assumption. Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Authors' calculations based on ARDECO and European Commission (2020) databases.

TABLE A3 | Results of ESIF impact on economic growth among convergence clubs: Cross-sectional IV model.

	(1) $\Delta \ln y_{ijt}^{EU28}$	(2) $\Delta \ln y_{ijt}^{Club\ 1}$	(3) $\Delta \ln y_{ijt}^{Club\ 2}$	(4) $\Delta \ln y_{ijt}^{Club\ 3}$
$\ln(\text{ESIF}_t/\text{Population}_t)$	0.0013**	0.0006	0.0020***	0.0019*
	(0.0006)	(0.0021)	(0.0008)	(0.0011)
$\ln y_{t-1}$	−0.1344***	−0.3998***	−0.1287***	−0.1338***
	(0.0070)	(0.0289)	(0.0094)	(0.0121)
$\ln k_t$	0.1319***	0.3834***	0.1175***	0.1303***
	(0.0072)	(0.0301)	(0.0098)	(0.0122)
$\ln (n + 0.05)_t$	0.0009	0.0258**	0.0041	−0.0120*
	(0.0031)	(0.0104)	(0.0037)	(0.0062)
$\ln \text{Rule law}_t$	0.0014	0.0254***	0.0043	−0.0117**
	(0.0013)	(0.0077)	(0.0023)	(0.0017)
$\ln \text{Human capital}_t$	0.0083***	−0.0190	0.0009	0.0187***
	(0.0021)	(0.0157)	(0.0027)	(0.0044)
Constant	0.7712***	2.4693***	0.8054***	0.7342***
	(0.0427)	(0.1842)	(0.0577)	(0.0753)
Observations	4687	415	2505	1767
R^2	0.4586	0.5591	0.5097	0.5049
First stage F-stat	825.3	260.9	511.2	254
Sargan–Hansen p-value	0.139	0.264	0.0695	0.650
Sargan–Hansen	2.190	1.247	3.294	0.206

Note: Instrumental variable: spatial lag of ESIF expenditures-to-population and distance to Brussels. W matrix for the spatial lag instrumental variable is based on contiguous neighbors. The distance to Brussels is calculated from the centroid of each region to the centroid of Région de Bruxelles-Capitale (BE10). Standard errors in parentheses.

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Source: Authors' calculations based on ARDECO and European Commission (2020) databases.