Received: 25 September 2021 | Revised: 13 April 2023 | Accepted: 28 July 2023

DOI: 10.1111/jors.12665

RESEARCH ARTICLE

JOURNAL OF REGIONAL SCIENCE WILEY

Premature exit from and delayed entrance into the less developed status: An empirical appraisal of the structural funds allocation criterion

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Abstract

This paper investigates the impact of the main criterion employed by the European Commission for the allocation of the largest portion of Structural Funds, based on the threshold of the 75% of European Union (EU) average gross domestic product (GDP) per capita. We focus on the 2014–2020 programming period and on EU-15 regions to analyze if this criterion has penalized some of them, as a consequence of the 2004 EU enlargement, which has represented an exogenous shock in the allocation process, due to the economic backwardness of new member states. Through the application of Synthetic Control Methods and Difference-in-Differences estimators at different geographical scales, we show that regions that did not obtain the less developed status in both the programming period 2007–2013 and 2014–2020, but that would have obtained it in the period 2014–2020 without the 2004 EU enlargement, experienced a significantly lower GDP per capita growth between −10.5% and −5.7%. Conversely, territories that in the period 2014–2020 lost the less developed status, previously obtained in the time frame 2007–2013, were not characterized by a significantly lower economic growth, providing some evidence of the effectiveness of the safety net.

KEYWORDS
cohesion policy, difference-in-differences, economic growth, EU enlargement, less developed regions, structural funds, synthetic control method

1 | INTRODUCTION

The Cohesion Policy—accounting for almost a third of the total European Union (EU) budget (European Commission, 2014)—is a cornerstone of the EU investment policies and a pillar of the process of economic convergence and reduction of social disparities.

Since the start of this regional policy in the late 1980s, socioeconomic differences among EU regions have fallen, thanks to a successful catching-up path experienced by lagging regions with respect to more developed areas. However, the economic crisis that broke out in 2008 has stopped this convergence process and, since then, regional disparities have remained stable. In particular, as recently outlined by Monfort (2020), this stability is the result of the opposite dynamics of two groups of countries: disparities have increased significantly in EU-15 old member states at both national and regional levels, while the convergence process has continued for the group of countries that have joined the EU since 2004. This evidence overshadows the impact of the Cohesion Policy on economic convergence.

Structural Funds (SFs) are the main instrument employed to foster sustainable development, especially in the least-favoured regions, within the Cohesion Policy framework (European Union, 2016).

With the term SFs we refer to the sum of two EU funds: the European Regional Development Fund (ERDF) and the European Social Fund (ESF) (Cerqua & Pellegrini, 2018, 2022; Lo Piano et al., 2017).[1] The ERDF is the main fund of the Cohesion Policy with 187.7 and 199.1 billion € in the programming periods 2007–2013 and 2014–2020, respectively, and targets a set of initiatives in different thematic areas, such as mobility, energy, environment and innovation. The ESF focuses on EU's employment, social, education and skills policies with 74.3 and 83.9 billion € in the time frames 2007–2013 and 2014–2020, respectively.

Among a wide set of purposes, such funds aim to promote socioeconomic development in recipient regions and to induce a structural convergence process between less developed and wealthier territories (Beugelsdijk & Eijffinger, 2005; Boldrin & Canova, 2001; Cappelen et al., 2003). Coherently, the criterion having the biggest effect on funds allocation is relative wealth. In particular, the largest portion of these funds is allocated to the most-disadvantaged regions[2] (namely, *Objective 1*, *Convergence* or *Less Developed* regions in the different programming periods[3]), which are territories identified at

[1]Other relevant programmes of financial support channelling the EU funding are the Cohesion Fund, allocated at the national level to countries whose gross national income per capita is below 90% of EU-27 average, the European Agricultural Fund for Rural Development (previously known as "European Agricultural Guidance and Guarantee Fund") and the European Maritime Fisheries Fund (previously known as "Financial Instrument for Fisheries Guidance"). These three funds together with the ERDF and ESF compose the "European Structural and Investment Funds". However, our study focuses only on SFs as these are the funds whose main allocation is based on the threshold of the 75% of the EU average gross domestic product (GDP) per capita.

[2]In the programming period 2000–2006, Objective 1 regions received 213 billion €, corresponding to the 71.6% of the SFs (Bachtler et al., 2009), while this percentage was increased to 82% for the time frame 2007–2013 (European Commission, 2008). In the period 2014–2020, about 182 billion €—equivalent to 52% of the SFs—was allocated to Less Developed regions (European Commission, 2015).

[3]Most-disadvantaged regions considered eligible for the allocation of the largest portion of SFs according to the threshold of the 75% of EU average GDP per capita were defined as *Objective 1* regions in the programming periods 1989–1993, 1994–1999 and 2000–2006, *Convergence* regions in the programming period 2007–2013, and *Less Developed* regions in the programming period 2014–2020. In the remaining we use the terms *Objective 1*, *Convergence* or *Less Developed* regions in case we explicitly refer to the corresponding programming periods in which these terms were introduced. We employ the terms *least-favoured* and *most-disadvantaged* regions also in case we mention areas receiving the largest portion of SFs without explicitly making reference to a precise programming period.

NUTS-2 level through a criterion based on a single indicator, that is, an average GDP per capita below the 75% of EU average in the three initial years of the previous programming period.[4]

Besides a broad literature aiming to study the effectiveness of SFs (see, among others, Crescenzi & Giua, 2020; Dall'Erba & Fang, 2017; Dall'Erba & Le Gallo, 2008; Mohl & Hagen, 2010; Rodríguez-Pose & Fratesi, 2004; Scotti et al., 2022), there is a parallel debate involving both academics and policymakers that questions different aspects of the Cohesion Policy, including this allocation criterion. While some scholars especially focus on its allocation efficiency (Becker et al., 2012; Crescenzi, 2009), according to the "Conference of Peripheral Maritime Regions of Europe" (CPMR, 2014b, 2015) this criterion does not provide a robust classification of EU regions since the average GDP per capita of the three initial years of the previous programming period is a synthetic, static and outdated index, unable to capture all the socioeconomic characteristics of a territory and the growth dynamic of each EU region at the time the SFs become available.

Our paper contributes to this debate considering that the process of EU enlargement introduced some further complexity in the identification of the most-disadvantaged regions. Specifically, the 2004 enlargement concerned 10 countries (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) characterized by a GDP per capita ranging between 25% and 70% of the EU-15 average, sharply reducing the 75% of EU average GDP per capita threshold, and inducing an exogenous shock for the SFs allocation criterion (Bachtler & Downes, 2004; Dupuch et al., 2004; Popa, 2012). Regions with a GDP per capita higher than the 75% of "enlarged EU-25" average in the years 2000–2002 but lower than the 75% of the EU-15 average, should have exited from the group of the least-favoured regions in the programming period 2007–2013. Nonetheless, the European Commission (EC) identified a list of NUTS-2 admitted to receive Convergence funds on a transitional and specific basis between 2007 and 2013, represented by EU-15 regions that would have obtained the Convergence status without the EU enlargement (European Union, 2006). In the following programming period (2014–2020), less developed regions were identified according to the 75% of EU-27 average GDP per capita in the years 2007–2009. In this case, the EC just established a "safety net" for NUTS-2 that were classified as Convergence regions in the 2007–2013 period, but whose GDP per capita was above 75% of EU-27 average GDP per capita in the years 2007–2009 (European Commission, 2015; European Union, 2011). Thanks to the "safety net" these so-called transition regions were admitted to receive an amount of SFs around two-thirds of the 2007–2013 allocation. However, the EC did not consider the group of regions that would have entered into the less developed status without the EU enlargement.

Against this background and considering that, as anticipated, from 2009 disparities within the EU-15 have started to increase significantly,[5] this paper focuses on the 2014–2020 programming period and on EU-15 regions to investigate if, due to the EU enlargement, the criterion for the identification of the most-disadvantaged regions has penalized some of them. Two sets of EU-15 regions are analyzed.

The first group—that we call Not Treated Again (NTA henceforth) regions—is composed of EU-15 regions that were not classified in the group of the least-favoured regions both in the programming period 2007–2013 and 2014–2020, but whose average GDP per capita in the years 2007–2009 resulted below the 75% of EU-15 average, despite still above the 75% of EU-27 average. Considering this first group, our first research question is whether the criterion used to assign the less developed status risks to not phase into the treatment regions with a fragile economy, in a timely manner with respect to their need of additional financial support. Exploiting the discontinuity in the probability of receiving SFs around the 75% of EU average GDP per capita, extant literature has shown that

[4]More precisely, in the programming periods 2000–2006, 2007–2013 and 2014–2020, the time frame considered to compute the EU average GDP per capita have been, respectively, 1994–1996, 2000–2002, 2007–2009 and 2014–2016, thus corresponding to the three initial years of the immediately previous programming period. For the programming periods 1989–1993 and 1994–1999 the reference periods to identify the threshold to assign the *Objective 1* status were the years 1983–1985 and 1988–1990. For more details, please check the EU Council Regulations 2052/88, 2082/93, 502/1999, 595/2006, 347/2013.

[5]The coefficient of variation of the regional GDP per capita increased from 26.0% in 2006 to 31.1% in 2018 (Monfort, 2020).

treated regions tend to experience a higher economic growth with respect to NUTS-2 just above this threshold (Becker et al., 2010; Pellegrini et al., 2013).

Such impacts are not limited to GDP per capita growth but involve also better performances in terms of research, technological development, innovation and higher infrastructure endowments, with positive effects that are expected to be larger in regions characterized by skilled human capital, good quality institutions and in periods of expansion (Becker et al., 2013, 2018; Ferrara et al., 2017). As a consequence, EU-15 regions not receiving SFs due to the reduction of the 75% of EU average GDP per capita induced by the EU enlargement may have experienced a lower economic growth with respect to other NUTS-2 not penalized in the access to such funds. On the basis of such considerations we formulate our first research hypothesis:

RH1. NTA regions experienced a significantly lower GDP per capita growth over the time frame 2014–2020[6] with respect to comparable NUTS-2 in the same country whose financial support was not affected by the EU enlargement (i.e., regions that would have fallen in the same class in terms of allocation of SFs, both based on the 75% of EU-27 and EU-15 average GDP per capita).

The second group—that we call Lost Treatment (LT henceforth) regions—is represented by EU-15 NUTS-2 that lost the status of less developed regions in the programming period 2014–2020, previously obtained in the period 2007–2013, and received the safety net as transition regions, but would have been eligible as least-favoured NUTS-2 based on the pre-enlargement benchmark (the 75% of EU-15 average GDP per capita). Considering these regions, our second research question is whether the safety net has been an adequate financial cushion to support their growth path, or there was a premature exit of these NUTS-2 from the less developed status. Previous studies do not show a solid consensus on the impact of losing the status of less developed region. Barone et al. (2016) and Becker et al. (2018) highlight that SFs generate short-term positive impacts that tend to vanish as the treatment is stopped. Conversely, Cerqua and Pellegrini (2022) estimate long-term positive effects in terms of economic growth and employment, especially in the absence of recession. However, we still lack empirical evidence on the impact of phasing out strategies for NUTS-2 exiting from the less developed status. We can only note what happened in the previous programming periods. For example, no region in the phasing out class in the time frame 2000–2006 was classified as a Convergence NUTS-2 in the following period, and only two regions out of 16 transition NUTS-2 in the period 2007–2013 turned to be less developed regions over the time frame 2014–2020.[7] On the basis of such consideration, we postulate the second research hypothesis:

RH2. The safety net prevented LT regions from experiencing lower GDP per capita growth over the time frame 2014–2020 with respect to comparable NUTS-2 in the same country, whose financial support was not affected by the EU enlargement (i.e., regions that would have fallen in the same class in terms of allocation of SFs, both based on the 75% of EU-27 and EU-15 average GDP per capita).

Focusing on these two groups of EU-15 regions that could have been penalized in the access to SFs due to the EU enlargement, this is the first work—to the best of our knowledge—assessing the effect on the regional GDP per capita growth of the exogenous shock represented by the EU enlargement, which affects the allocation criterion of SFs.[8] This topic is relevant considering that the UK has recently left the EU and that other countries might leave or

[6]Although NTA regions did not receive the less developed status both in the programming period 2007–2013 and 2014–2020, we consider only the programming period 2014–2020 as our period of interest for the analysis. Indeed, over the time frame 2007–2013, the financial support of NTA regions was not affected by the EU enlargement (such regions would have fallen in the same class in terms of allocation of SFs, both based on the 75% of EU-25 and EU-15 average GDP per capita).

[7]The only two transition regions under the period 2007–2013 that were classified as less developed NUTS-2 over the time frame 2014–2020 are Kentriki Makedonia (EL52) and Basilicata (ITF5).

[8]Recently, Cerqua and Pellegrini (2022) focused on the EU regions that lost the convergence status to assess the impact on the GDP growth, showing that these regions did not suffer from the reduction of funds during an expansion phase, whereas this is not the case for periods of economic crisis. Although their aim is to test if there is a long-term positive effect of the Cohesion Policy on growth and did not question the SFs allocation criterion, these authors suggest a greater flexibility in the availability and use of these funds, to better adapt the policy to local and contextual conditions and also to the economic phase.

join the EU, thus inducing a variation of EU average GDP per capita and a new potential shock to the allocation of SFs.[9]

In this way, we contribute to the debate on the current criterion for the allocation of SFs, by analyzing whether it assigns to EU regions an amount of funds well aligned to their need of financial support or it risks to exclude some regions with a fragile local economy from the list of the less developed regions, quantifying the associated economic penalization in terms of lower GDP per capita growth.

We investigate these research questions by analyzing the GDP per capita of the two groups of EU-15 regions through the application of causal inference methods. Using Synthetic Control Methods (SCMs) and Difference-in-Differences (DiD) estimators (Arkhangelsky et al., 2021; Callaway & Sant'Anna, 2021; Cattaneo et al., 2021; Hazlett & Xu, 2018; Imai et al., 2021) supported by a large set of robustness checks, our results show that in the period 2014–2019[10] the NTA regions have experienced a significantly lower economic growth with respect to their counterfactual, with an aggregate average treatment effect on treated (ATT) between −10.5% and −5.7%. Furthermore, we show that this economic penalization tends to become significant after 2016, suggesting that the $n + 2$ rule—that allows regions to spend SFs until 2 years after the conclusion of the previous programming period—might have acted as a mitigating factor. It seems that the allocation of a lower amount of financial support due to the EU enlargement[11] may contribute to a progressively wider economic gap, since the difference in the GDP per capita growth between NTA regions and the control group has further increased over the years 2014–2019. Moreover, we show that such results are confirmed also at NUTS-3 level. These findings fuel the ongoing debate on the need to consider a broader set of data for a more effective allocation of SFs, complementing the current criterion with additional indicators able to provide a wider perspective on the real level of development of EU regions (CPMR, 2014b, 2015).

On the other hand, we highlight that LT regions do not tend to be characterized by statistically significant lower economic growth with respect to their counterfactual. Since these regions have received the safety net as a financial cushion to provide a softer transition towards lower economic support, we find evidence of the effectiveness of this adjustment in the allocation of SFs.

The paper is structured as follows. Section 2 provides a review of the most relevant studies questioning the criterion for the allocation of SFs. Then, Section 3 illustrates data and methods employed in the empirical analysis, while Section 4 presents the results and discusses the main policy implications. Finally, the paper concludes by summarizing its main contributions.

2 | LITERATURE REVIEW

Given the ambitious objective and the relevant share of the total EU budget, over the years the Cohesion Policy has been a matter of constant debate, with academics, practitioners and international organizations often criticizing different aspects of this fiscal equalization policy, including the allocation mechanism of SFs.[12]

[9]We remark that the entrance or exit of countries from the EU are not the only cases in which the 75% of the EU average GDP per capita might be subject to a strong variation, thus significantly affecting the allocation of SFs. For instance, this might happen due to local natural disasters which may trigger economic recession and significantly reduce the local GDP per capita for some years (Barone & Mocetti, 2014; Loayza et al., 2012; Noy, 2009; Panwar & Sen, 2019). More commonly, this takes place on the occasion of geographically asymmetric financial crises which might induce a strong economic reduction of GDP per capita in specific areas of the EU (Dornean et al., 2012; Terazi & Şenel, 2011).

[10]We exclude from our empirical analysis the year 2020 due to the COVID-19 pandemic. Indeed, the heterogeneous local economic resilience to the healthcare emergency may significantly affect the GDP per capita variation of EU regions, thus potentially introducing a relevant confounding factor to the results of our empirical analysis.

[11]We use the expression "allocation of a lower amount of SFs due to the EU enlargement" or "regions receiving an amount of SFs affected by the EU enlargement" in reference to NUTS-2 regions whose allocation class of SFs was affected by the EU enlargement (i.e., regions that would have fallen in the less developed class in terms of allocation of SFs based on the 75% of EU-27 average GDP per capita but not on EU-15 average GDP per capita).

[12]See Bachtler et al. (2017) for a broad review of the different points of criticism.

Within a relatively constant allocation methodology, the criterion having the biggest impact on the amount of funds that each region receives is its relative wealth. More specifically, the average GDP per capita of each NUTS-2 in the three initial years of the previous programming period is compared with the EU average. Following a logic of geographical concentration of financial support, the bulk of SFs is allocated to least-favoured regions that are those NUTS-2 whose GDP per capita is lower than the 75% of the EU average.[13]

However, since 1994 the interplay between least-favoured regions and the amount of SFs has progressively weakened, revealing the tendency of the Cohesion Policy to lose its spatial focus over time (Bachtler & Polverari, 2007; Baldwin & Wyplosz, 2019; Greenbaum & Bondonio, 2004). Indeed, the political bargaining power still significantly influences the allocation process of these financial resources (Bouvet & Dall'Erba, 2010; Carrubba, 1997; Kemmerling & Bodenstein, 2006), leading NUTS-2 with similar levels of income per capita to receive a heterogeneous amount of transfers redistribution (De la Fuente & Doménech, 2001; Evans, 1999). Therefore, not significant impacts of SFs on economic convergence are explained by weak spillovers effects due to an insufficient geographical concentration of SFs (Bradley, 2006; Canova, 2004; Dall'Erba, 2005; Fagerberg et al., 1999).

Moreover, the geography of SFs allocation should reflect the spatial distribution of socioeconomic variables strongly connected with economic development, such as the local labour force, capital formation, skills of human capital, demographic structure and change (Mairate, 2006; Rodriguez-Pose, 1998). Crescenzi (2009) critiques the SFs allocation criterion, observing an insufficient territorial concentration of the expenditure. In addition, the study provides evidence of a weak correlation between the absence of socioeconomic conditions stimulating development and the amount of funds allocated. More recently, Becker et al. (2012) analyze the allocation efficiency of the GDP per capita criterion, highlighting that around 36% of regions at NUTS-3 level has received an amount of SFs beyond the optimal transfer intensity that is the level at which one euro of funds generates exactly one euro of additional GDP.

Although many authors highlight that the current allocation of SFs is suboptimal, we still lack empirical studies that quantitatively analyze the impact of receiving an amount of financial support that is not aligned with the local development level. Our analysis aims to fill this gap, estimating the lower GDP per capita growth experienced by regions that do not promptly enter into the less developed status, despite being characterized by a fragile economy. Furthermore, we show the effect of a premature exit from the less developed status on the local development dynamics of regions that have not activated a self-sustaining growth process. Therefore, our work contributes to the literature that discusses the capability of the current SFs allocation criterion to correctly identify the set of most-disadvantaged regions to stimulate economic convergence.

In this direction, the CPMR shows that the criterion based on the average GDP per capita does not provide a robust classification of EU regions (CPMR, 2015). Indeed, although the GDP per capita is a synthetic index commonly used to illustrate the difference in economic development between countries, the CPMR argues that this criterion is not able to capture all the socioeconomic characteristics of a territory. Specifically, since the Cohesion Policy can be defined as a "do it all policy" addressing a wide set of thematic areas, the GDP per capita might be not a representative indicator of the full set of different policy objectives, and more comprehensive criteria encompassing the social, environmental and digital dimensions should be integrated in the methodology for the allocation of SFs. Moreover, the CPMR questions the temporal window of reference for the computation of the average GDP per capita, that is, the three initial years of the previous programming period, for a number of reasons.

First, in a simulation study the CPMR shows that, for a given programming period, this rigid criterion provides a classification of EU regions which is not robust over time (CPMR, 2014a). Shifting by only 1 year the 3-years temporal window—that is, using the years 2008–2010 (rather than 2007–2009) for the programming period

[13]Some adjustments have been progressively introduced for regions that lose this status, to provide a softer transition and prevent the risk that a large drop in the financial support rapidly vanishes the benefits generated by the SFs previously received (Barone et al., 2016).

2014–2020—the CPMR observes a change in the SFs allocation class for 18 regions, implying a significant variation in the allocation of SFs.

Second, this temporal window is between 5 and 7 years far from the beginning of the programming period in which SFs will be actually allocated, thus potentially introducing a misalignment between the class assigned for the allocation of SFs and the GDP per capita level once transfers will be actually available (CPMR, 2014b).

Third, the average GDP per capita in the three initial years of the previous programming period is a static indicator as it does not take into account patterns of economic growth or recession. Therefore, there might be regions just below the threshold of the 75% of the EU average but with a sustained growth pattern which are considered as less developed NUTS-2 and others, experiencing a long-term recession, being still just above this threshold and thus not being classified as less developed regions. The latter is the dynamic that has characterized some EU-15 countries since the start of the economic crisis in 2008, stopping or reversing their upward convergence path, whereas countries that joined the EU since 2004, have continued a process of catching up to the EU average (Goedemé & Collado, 2016; Monfort, 2020). Finally, as the EU 2004 enlargement demonstrated, the SFs allocation criterion is subject to exogenous shocks due to changes in the composition of the EU membership (Bachtler & Downes, 2004; Dupuch et al., 2004; Popa, 2012).

Our work complements this stream of literature that highlights different reasons why the threshold represented by the 75% of the EU average GDP per capita may penalize certain regions in the access to SFs. In particular, we offer a quantitative analysis of the economic growth of EU-15 regions that may have received a lower amount of SFs due to the EU enlargement, representing an exogenous shock to the allocation criterion of SFs.

3 | METHODOLOGY AND DATA

Our empirical strategy exploits the threshold constituted by the 75% of EU average GDP per capita to identify two groups of EU-15 regions that in the programming period 2014–2020 might have been penalized in the access to SFs due to the EU enlargement, as detailed in Section 3.1. Then, Section 3.2 introduces SCM and DiD approaches that we employ in our empirical analysis.

3.1 | Identification of potentially penalized regions and their control groups

To identify the two groups of EU-15 potentially penalized regions in the allocation of SFs, we compare the average GDP per capita[14] of each NUTS-2 against both the 75% of EU-15 and EU-27 average GDP per capita over the years 2007–2009, which was the temporal window of reference for the programming period 2014–2020. More specifically, we define potentially penalized regions as those NUTS-2 with two characteristics: (i) they were not classified as most-disadvantaged regions in the period 2014–2020, since their GDP per capita in the years 2007–2009 was above the 75% of EU-27 average; (ii) and, at the same time, their GDP per capita in the years 2007–2009 was below the 75% of EU-15 average, that means they would have obtained the less developed status in 2014–2020 without the EU enlargement. Looking also at how these regions were categorized in the previous

[14]Coherently with the EC regulation, we employ the GDP per capita at current prices expressed in Purchasing Power Standard, as disclosed by the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (Annual Regional Database of the European Commission) and available at the following link: https://knowledge4policy.ec.europa.eu/territorial/ardeco-online_en#labourmarket.

programming period (2007–2013), two groups of NUTS-2 potentially penalized in the access to SFs emerge, which constitute our two treated groups.[15]

The first is composed of regions that did not obtain the least-favoured status in the programming period 2007–2013 and that did not receive it neither in the time frame 2014–2020, although their average GDP per capita was below the EU-15 threshold in the years 2007–2009. We call this group of regions NTA regions (see Table 1 and Figure 1). Among these regions, the lowest GDP per capita is experienced by Dykiti Makedonia (EL53) that results 526 € higher than the threshold of EU-27, which is equal to 18,643 €, and 1300 € below the EU-15 threshold. The region with the closest average GDP per capita to the EU-15 threshold is the Italian NUTS-2 Sardinia (ITG2) with "only" 194 € of difference.

The second group of regions potentially penalized in the access to SFs is represented by NUTS-2 with an average GDP per capita below the EU-15 threshold in the years 2007–2009 that obtained the less developed status in the programming period 2007–2013 and exited from this status in the period 2014–2020, since their average GDP per capita in 2007–2009 was higher than the 75% of the EU-27 average. We call this NUTS-2, receiving the safety-net, LT regions (see Table 2 and Figure 2).[16] In this group, the Greek region Peloponnisos (EL65) is characterized by the lowest GDP per capita with a gap from the EU-15 threshold equal to 1609 €. The German region of Mecklenburg-Vorpommern (DE80) displays the smallest distance from the EU-15 threshold accounting for 463 €.

To have control groups that are as similar as possible to the treatment groups in terms of all relevant characteristics, we compare each potentially penalized region with all the NUTS-2 within the same country that fell within the same class in terms of allocation of SFs since the beginning of the Cohesion Policy in 1988 until 2013 and whose classification within or not the less developed regions over the period 2014–2020 was not affected by EU enlargement.[17] By restricting the control group to regions in the same country, we significantly reduce the risk that the different growth patterns experienced by NTA or LT regions are induced by heterogeneous country-specific factors that might confound the results, as demonstrated by Crescenzi and Giua (2020).

This higher robustness of the estimates comes at a price, that is, a reduction in the number of treated units. Specifically, we exclude Sardinia (ITG2) from the NTA group since there is no Italian NUTS-2 with the same class for the allocation of SFs during the pretreatment period 1989–2013. Since ITG2 was the only NTA Italian region, Italy is not covered in the NTA analysis.[18]

[15]Please see the appendices for some checks. Specifically, we verify in Appendix A that regions excluded from these two classes were either treated during the period 2014–2020 or experienced an average GDP per capita above the EU-15 threshold. Moreover, in Appendix B we reconstruct the amount of SFs received by each NUTS-2 in the countries where we identify potentially penalized regions to show that these NUTS-2 were actually recipients of lower financial support intensity in the period 2014–2020 with respect to NUTS-2 officially identified as most-disadvantaged regions.

[16]Although both NTA and LT regions may have received a lower amount of funds in the programming period 2014–2020, due to the EU enlargement, we distinguish them in two groups for different reasons. First, LT regions may have experienced some long-term benefits associated with SFs received in the time frame 2007–2013. Second, they received the "safety net", potentially mitigating the risk of providing an insufficient financial support to such *NUTS-2*.

[17]Notice that control units for NTA regions cannot include LT regions and viceversa. This is prevented by the fact that control units include regions whose classification in terms of allocation of SFs over the period 2014–2020 was not affected by the EU enlargement (and with the same pretreatment class in terms of allocation of SFs since the beginning of the Cohesion Policy in 1988–2013).

[18]There is no Italian NUTS-2 that in every programming period, that has taken place in the time frame 1988–2013, has the same class of Sardinia for the allocation of SFs. Even restricting the similarity to the period 2000–2013 it is not possible to find any NUTS-2 with the same pattern in terms of class for the allocation of SFs. As comparing the pattern of growth of Sardinia with other Italian regions might provide results which are significantly affected by the different levels of financial support received by that NUTS-2 and the control group, we decide to exclude Sardinia from the NTA group. In Belgium we rather include the NTA region BE32 and in the UK the NTA region UKE3 although the former was an Objective 1 region in the programming period 1994–1999, differently from other NTA and control regions in Belgium and the latter was an Objective 1 region during the programming period 2000–2006, differently from other NTA and control regions in the UK. Differently from ITG2, we include BE32 and UKE3 in our main empirical analysis since for these two NUTS-2 it is still possible to identify a pretreatment period where they have been classified in the same category in terms of allocation of SFs with respect to their control group (e.g., 2000–2013 and 2006–2013, respectively). Section 4.5 performs a robustness check where we exclude these regions from treated units.

TABLE 1 The average GDP per capita of *NTA* regions in the period 2007–2009.

NUTS-2 code	NUTS-2 name	Average GDPpc 2007–2009	Distance from EU-15	Distance from EU-27
BE32	Province Hainaut	19,371	−1098	728
BE34	Province Luxembourg	19,896	−573	1253
EL53	Dytiki Makedonia	19,169	−1300	526
ITG2	Sardinia	20,275	−194	1632
UKC1	Tees Valley and Durham	19,895	−574	1252
UKE3	South Yorkshire	19,921	−548	1278
UKF3	Lincolnshire	19,524	−945	881

Note: The threshold based on EU-15 average GDP per capita is equal to 20,469 €, while the threshold based on EU-27 average GDP per capita is equal to 18,643 €. Data on GDP per capita are expressed at current prices in PPS.

Abbreviations: EU, European Union; GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics; PPS, Purchasing Power Standard.

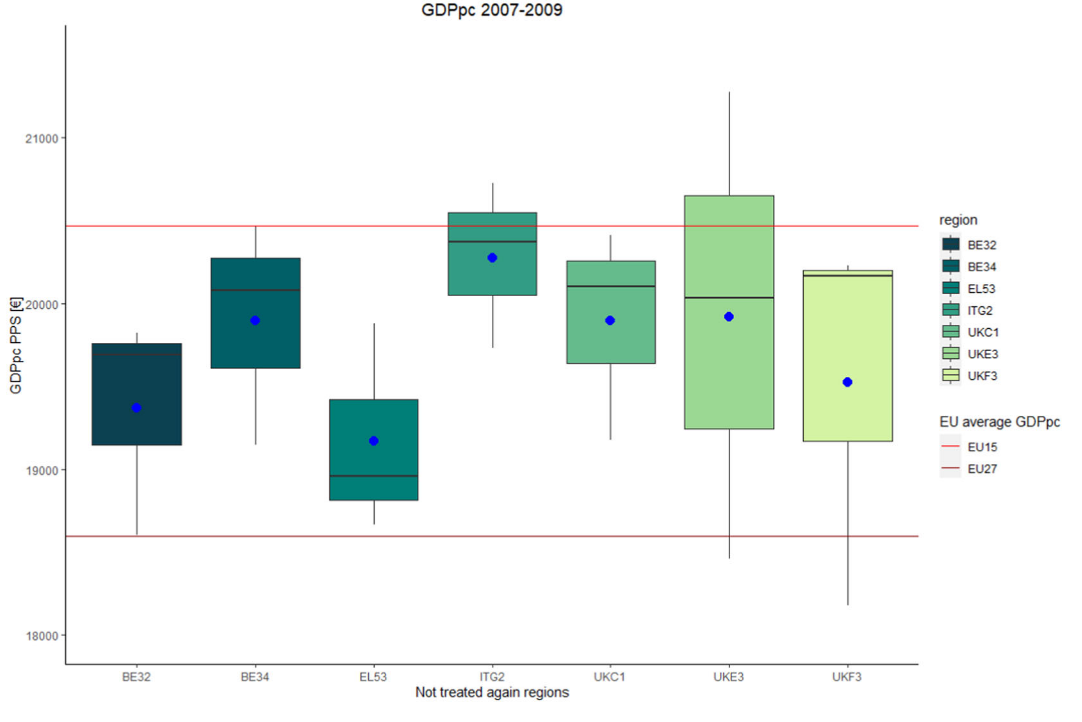

FIGURE 1 The distribution of GDP per capita of *NTA* regions in the period 2007–2009. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009. EU, European Union; GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; PPS, Purchasing Power Standard.

TABLE 2 The average GDP per capita of *LT* regions in the period 2007–2009.

NUTS-2 code	NUTS-2 name	Average GDPpc 2007–2009	Distance from EU-15	Distance from EU-27
DE80	Mecklenburg-Vorpommern	20,006	−463	1363
DEG0	Thüringen	19,784	−685	1141
EL41	Voreio Aigaio	19,055	−1414	412
EL65	Peloponnisos	18,860	−1609	217
ES61	Andalucía	19,800	−669	1157

Note: The threshold based on EU-15 average GDP per capita is equal to 20,469 €, while the threshold based on EU-27 average GDP per capita is equal to 18,643 €. Data on GDP per capita are expressed at current prices in PPS.

Abbreviations: EU, European Union; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics; PPS, Purchasing Power Standard.

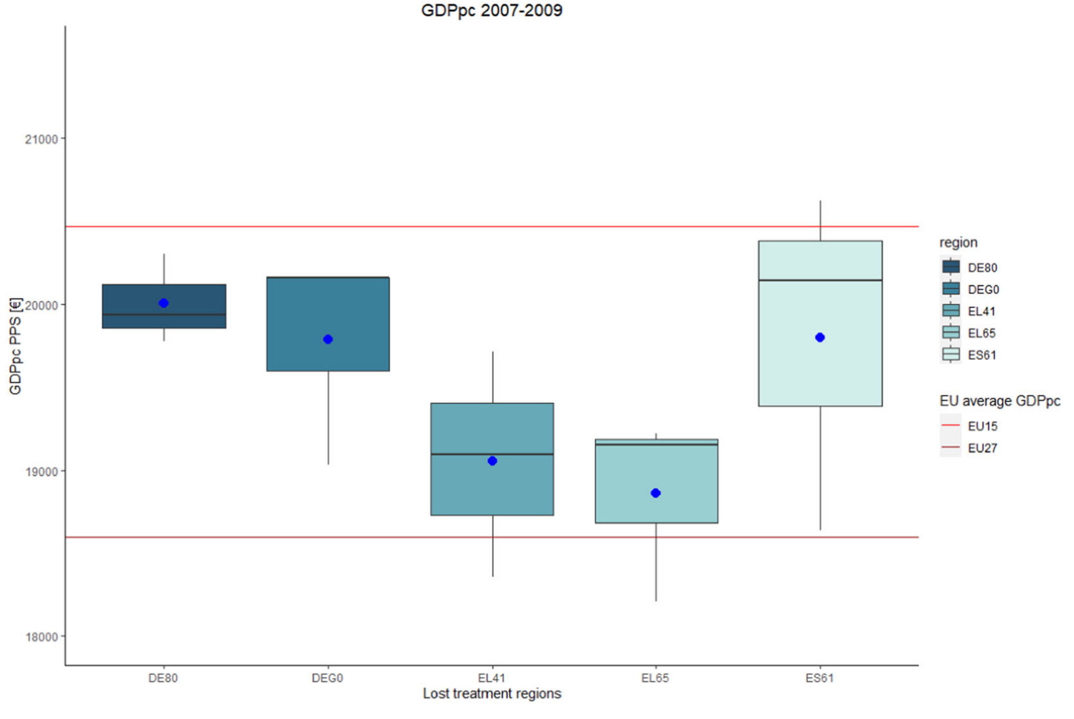

FIGURE 2 The distribution of GDP per capita of LT regions in the period 2007–2009. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009. EU, European Union; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; PPS, Purchasing Power Standard.

3.2 | Empirical methods

We rely on recent advancements in econometric models specifically suited for time-series-cross-sectional (TSCS) data to evaluate whether our NTA and LT regions were characterized by a significantly lower GDP per capita growth during the period 2014–2019. In particular, we apply complementary empirical methods that allow us to assess the consistency of our results and to perform a wide set of robustness checks at different geographical scales.

Section 3.2.1 describes alternative SCM approaches that we adopt at NUTS-2 level since they result particularly suitable to study a setting where a limited number of units is exposed to a treatment that cannot be considered as exogenous across units of analysis. These methods re-weight elements in the control group such that they can properly match the pre-exposure patterns of treated units, allowing to build a proper counterfactual scenario.

Section 3.2.2 introduces different DiD approaches that we employ for the analysis at NUTS-3 level. We rely on these methods since they provide a robust estimation of the causal impact of the treatment (e.g., enabling formal tests for the parallel trends assumption) in a setting with a larger number of treated units with respect to the one we have at NUTS-2 level. Furthermore, as the identification of most-disadvantaged regions is made at NUTS-2 level, the DiD analysis at NUTS-3 level allows us to compare units for which the allocation of the less developed status is mildly exogenous (Percoco, 2017).

3.2.1 | SCM approaches

SCM approaches are statistical methods aiming to estimate the impact of a treatment through the comparison of the outcome variable of the treated unit with that of a counterfactual (synthetic control) built as a weighted combination of the outcome variable of elements in the control group (the so-called donor pool). Weights are computed based on the similarity of a target set of observable characteristics between the treated unit and the control group in the pretreatment period. The difference between the outcome variable of the treated unit and of the synthetic control during the posttreatment period represents the ATT.

Among the several SCM approaches, we first apply a Synthetic Difference-in-Differences (SDID) estimator, recently developed by Arkhangelsky et al. (2021), which combines attractive features of SCMs and DiD approaches. Specifically, the SDID estimates the ATT ($\hat{\tau}^{sdid}$) through the following two-ways fixed effects regression:

$$(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \underset{\tau,\,\mu,\,\alpha,\,\beta}{argmin} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{i,t} - \mu - \alpha_i - \beta_t - W_{i,t}\tau)^2 \hat{w}_i^{sdid} \hat{\lambda}_t^{sdid} \right\}, \tag{1}$$

where $Y_{i,t}$ is the dependent variable, μ is a constant term, α_i and β_t are units and time fixed effects and $W_{i,t} \in \{0;\, 1\}$ is the binary exposure treatment variable. Furthermore, the parameters $\hat{w}_i^{sdid}$ and $\hat{\lambda}_t^{sdid}$ are units and time coefficients allowing to put more weight on units that on average are similar in terms of their past to the treated units, and on periods that are on average more similar to the time frame when the treatment is performed.

More specifically, we estimate units weights $\hat{w}_i^{sdid}$ by solving the following optimization equation, aiming to match the pretreatment trends of control units with those of treated elements:

$$(\hat{w}_0, \hat{w}^{sdid}) = \underset{w_0 \in R,\, w^{sdid} \in \Omega}{argmin} \left\{ \sum_{t=1}^{T_{pre}} \left(w_0 + \sum_{i=1}^{N_{co}} w_i Y_{i,t} - \frac{1}{N_{tr}} \sum_{i=N_{co}+1}^{N} Y_{i,t} \right)^2 + \zeta^2 T_{pre} \|w\|_2^2 \right\}, \tag{2}$$

$$\Omega = \left\{ w \in R_+^N : \sum_{i=1}^{N_{co}} w_i = 1,\, w_i = \frac{1}{N_{tr}} \text{ for all } i = N_{co} + 1, \dots, N \right\}, \tag{3}$$

where $N = N_{co} + N_{tr}$ is the total sample size, N_{co} is the number of control units, N_{tr} is the number of treated units, T_{pre} is the duration of the pretreatment period and ζ is a regularization parameter.[19] The main difference with respect to the seminal SCM introduced by Abadie and Gardeazabal (2003) and Abadie et al. (2010) is the presence of the

[19] $\zeta = (N_{tr} T_{post})^{\frac{1}{4}} \hat{\sigma}$.

weight w_0. Through such coefficient the weights w^{sdid} do not aim to make the pretrends of control units perfectly match those of treated elements, but they just point to make the trends parallel.

Furthermore, time weights ($\hat{\lambda}_t^{sdid}$) are computed so that the average outcome variable during the posttreatment period for each unexposed unit differs by a constant from the weighted average of the outcome variable for the same group of unexposed units during the pretreatment period. In particular, they are estimated based on the following optimization equation:

$$(\hat{\lambda}_0, \hat{\lambda}^{sdid}) = \underset{\lambda_0 \in R,\, \lambda^{sdid} \in \Lambda}{argimin} \left\{ \sum_{i=1}^{N_{co}} \left(\lambda_0 + \sum_{t=1}^{T_{pre}} \lambda_t Y_{i,t} - \frac{1}{T_{post}} \sum_{t=T_{pre}+1}^{T} Y_{i,t} \right)^2 \right\}, \tag{4}$$

$$\Lambda = \left\{ \lambda \in R_+^T : \sum_{t=1}^{T_{pre}} \lambda_t = 1, \lambda_t = \frac{1}{T_{post}} \text{ for all } t = T_{pre} + 1, \ldots, T \right\}, \tag{5}$$

where $T = T_{pre} + T_{post}$ and T_{post} is the total number of years of exposure to the treatment. Time weights are introduced as they can both reduce bias and improve precision by adjusting the weight of time periods based on their similarity with respect to posttreatment years.

Although this method presents various advantages, it provides only an aggregate ATT for the whole treatment period, without the possibility to investigate how the impact unfolds over time. Furthermore, units and time weights are estimated without taking into account other observable socioeconomic characteristics during the pretreatment period. For these reasons, we further analyze the impact of the current criterion for the allocation of SFs on the economic growth of NTA and LT regions through the application of the SCM recently developed by Cattaneo et al. (2021).

This approach estimates the ATT for each year of the treatment period providing more transparent and informative results on the dynamic impact of the current SFs allocation criterion. Moreover, based on previous works by Vershynin (2018), Wainwright (2019) and Chernozhukov et al. (2021), yearly ATT estimates are associated with conditional prediction intervals taking into account two different sources of randomness. The first accounts for the uncertainty associated with the construction of the SCM weights in the pretreatment period that might be misspecified. The second includes the unobservable stochastic error in the posttreatment period when the treatment effect is analyzed. Finally, this method incorporates preintervention covariates in the construction of the SC weights allowing to assess treatment unconfoundedness given observed characteristics of analyzed units.

Specifically, following different insights from the regional growth theory, we include into the model as control variables the *GDP per capita lagged* by 1 year to account for the level of wealth (Dall'Erba & Le Gallo, 2008; Mohl & Hagen, 2010; Rodríguez-Pose & Crescenzi, 2008) and the *Employment* percentage in five macrosectors (according to NACE rev.2 classification) with respect to the overall number of employees in the corresponding region as a proxy of the local market structure. Moreover, we consider the variable *Population*, representing the number of residents in each region to take into account differences in the dimension of NUTS-2 and *Education*, computed as the percentage of citizens with tertiary schooling level over the total population between 35 and 64 years to account for heterogeneity in the availability of skilled human capital (Esposti & Bussoletti, 2008; Pinho et al., 2015). We include also *Capital Formation*, expressed as a percentage of GDP at NUTS-2 level, to consider the net capital accumulated within an accounting period and invested in capital goods, such as equipment, tools, transportation and production assets (Mohl & Hagen, 2010; Pinho et al., 2015). Finally, following Cerqua and Pellegrini (2018) and Cerqua and Pellegrini (2022) we exploit a crucial piece of information made available by the EC only in 2018, concerning yearly *expenditures of SFs* at NUTS-2 level, to check that control and treated units are characterized by a comparable amount of financial support over the pretreatment period.[20]

[20]Data related to SFs are disclosed by the European Commission at the following link: https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv. Additional details about the yearly breakdown of SFs expenditure are provided by Lo Piano et al. (2017). We remark that due to the absence of precise data on SFs expenditures, previous studies analyzing the impact of losing the less developed status relied on counterfactual scenarios characterized by significantly different SFs expenditures with respect to treated units (Barone et al., 2016; Di Cataldo, 2017).

In this way, we ensure that the treatment effect we estimate is not confounded by long-term effects induced by heterogeneous levels of SFs expenditures. Since different programmes of financial support target distinct thematic areas, we disaggregate the amount of SFs expenditures with respect to the different funds employed by the EC to stimulate regional development. In particular, we consider the ERDF and the ESF.

As outcome variable, coherently with Barone et al. (2016), we use the *GDP per capita index*, computed as the ratio between the annual regional GDP per capita and the GDP per capita in the corresponding NUTS-2 in 2007. This index has two main advantages compared with the GDP per capita. First, we aim to analyze the heterogeneity in economic growth between penalized regions in the access to SFs and the control group and the GDP per capita index well represents differences in GDP per capita growth. Second, penalized regions tend to have a GDP per capita that is higher than those of any other less developed region and lower than any other region not receiving the less developed status in the donor pool. Thus, it would be unfeasible to match the level of the GDP per capita with the SCM developed by Cattaneo et al. (2021).

Table 3 summarizes definitions and sources of our dependent variable and controls used in the empirical analysis.

3.2.2 | DiD approaches

At NUTS-3 level, we first apply a panel event study with two-ways fixed effects, based on the recent work of Callaway and Sant'Anna (2021). This approach allows us to solve some shortcomings of more traditional DiD methods where the parameters estimation might be particularly sensitive to the group size, treatment timing and number of analyzed time periods (Athey & Imbens, 2022; De Chaisemartin & d'Haultfoeuille, 2020;

TABLE 3 Variables definitions and sources.

Variable name	Description	Source
$Y_{i,t}$	GDP per capita Index with reference to the year 2007. It is computed as the ratio between GDP per capita in region *i* in year *t* and the GDP per capita in the corresponding region in the year 2007	Annual Regional Database of the European Commission (ARDECO)
GDP per capita lagged	Natural logarithm of regional GDPpc lagged by 1 year	ARDECO
Employment	The ratio between the number of employees in macrosectors A, B–E, F, G–J, K–N (according to NACE rev.2) and the overall number of employees in the region	ARDECO
Population	Number of residents in the underlying region	ARDECO
Education	Percentage of citizens with tertiary education over the total population between 35 and 64 years	ARDECO
Capital formation	Investments in capital goods expressed as a percentage of regional GDP	ARDECO
SCFs expenditures	Expenditures of SCFs expressed as a percentage of regional GDP. We disaggregate SCFs across different types of funds targeting distinct thematic areas. In particular, we consider the ERDF and ESF	European Commission

Abbreviations: ERDF, European Regional Development Fund; ESF, European Social Fund; GDP, gross domestic product; GDPpc, GDP per capita; SCFs, Survey of Consumer Finances.

Goodman-Bacon, 2021). Furthermore, it properly deals with the “negative weight problem” of a traditional DiD linear regression, where the estimated treatment effect is the weighted average of some underlying treatment effect parameters whose weights can be negative, meaning that the overall estimated impact might be negative although underlying treatment effects parameters are all positive (Goodman-Bacon, 2021; Sun & Abraham, 2021).

Following Callaway and Sant'Anna (2021), we define G_i as the year in which unit i is treated for the first time, $G_{i,g} = 1\{G_i = g\}$, and we estimate the ATT based on the following equation:

$$ATT(g,t) = \mathbb{E}\left[\frac{G_g}{\mathbb{E}(G_g)} * (Y_t - Y_{g-1} - m_{g,t}(X))\right], \tag{6}$$

where $Y_{i,t}$ is our dependent variable for region i in year t, $m_{g,t}(X) = \mathbb{E}[Y_t - Y_{g-1}|X, C = 1]$ with C being a binary variable equal to 1 for never treated units. $X_{i,t}$ corresponds to a vector of control variables (see Section 3.2.1 for additional details).

As the EU enlargement had an impact on the allocation of SFs only in the programming period 2014–2020, and all regions enter the treatment in the same year, corresponding to the beginning of the new programming period, we have only one group (g) starting the treatment (misaligned allocation of SFs due to the EU enlargement) in 2014. Moreover, assessing the $ATT(g, t)$ for t corresponding to years before the start of the treatment allows us to test for the parallel trend assumption. In this way, we evaluate whether the different economic growth experienced by treated and control units is either associated with the change of the policy framework, or the two groups were on different development trajectories even before the start of the treatment.

We estimate also a more aggregated average of the treatment effect across all groups and years ($\theta_{aggregate}$):

$$\theta_{aggregate} = \sum_{g \in G} \sum_{t=2}^{T} w(g,t) * ATT(g,t), \tag{7}$$

where $w(g, t)$ are weighting functions representing the size of each set of units observed in a specific year t and belonging to group g.

Despite the robustness of the DiD method proposed by Callaway and Sant'Anna (2021), we complement its estimates with two other DiD approaches explicitly dealing with covariates balancing issues between the treated and control group. Here, we follow the suggestion by Cerqua and Pellegrini (2022) that in their analysis on the long-term effect of the Cohesion Policy emphasize the need to build counterfactuals with observable socioeconomic characteristics that are sufficiently similar to those of treated units.

The first additional approach is the generalized DiD introduced by Hazlett and Xu (2018). Its main advantage is the relaxing of the linearity assumption and the proposal of a kernel balancing to seek approximate balance not only on the mean of outcome and covariates, but on a kernel-based feature expansion of the pretreatment outcome and covariates. While the mean balancing just focuses on balancing the average value of the pretreatment trajectory of outcome and covariates for treated and untreated units neglecting higher-order features, such as “variance”, “skewness”, “kurtosis”, the kernel-based feature expansion ensures that a vector of features similarities are properly balanced in a multidimensional space. According to this method the average treatment effect can be estimated with the following formula:

$$\hat{ATT}_t = \frac{1}{N_{tr}} \sum_{G_i=1} Y_{i,t} - \sum_{G_i=0} w_i Y_{i,t}, \tag{8}$$

where control units weights w_i are estimated such that

$$\frac{1}{N_{tr}} \sum_{G_i=1} \phi(Y_{i,pre}) = \sum_{G_i=0} w_i \phi(Y_{i,pre}) \tag{9}$$

with $\sum_{G_i=0} w_i = 1$ and $w_i > 0$ for all i in the control group. More specifically, N_{tr} is the number of treated units, G_i is the group indicator, equal to 1 if unit i belongs to the treated group and equal to 0 otherwise, $Y_{i,t}$ is the outcome variable of unit i at time t, $Y_{i,pre}$ is the dependent variable over pretreatment years, and $\phi(\cdot)$ is the kernel function allowing to achieve the covariates balance on a higher dimensional order features.

Finally, we complete our analysis through the DiD approach proposed by Imai et al. (2021). Such method is particularly suitable for casual inference with TSCS data, as it enables to estimate control units weights based on a set of different flexible approaches, such as the Mahalanobis distance, propensity score matching or inverse weight score methods (Hirano et al., 2003), supporting the identification of a control group with an adequate covariate balance with respect to treated units. This method provides estimates of the ATT for a set of F years after the start of the treatment with robust confidence intervals, based on the following formula:

$$\hat{\delta}(F, L) = \frac{1}{\sum_{i=1}^{N}\sum_{t=L+1}^{T-F} D_{i,t}} \sum_{i=1}^{N}\sum_{t=L+1}^{T-F} D_{i,t}\left\{(Y_{i,t+F} - Y_{i,t-1}) - \sum_{i'\in M_{i,t}} w_{i,t}^{i'}\left(Y_{i',t+F} - Y_{i',t-1}\right)\right\}, \quad (10)$$

where L is the set of years in the pretreatment history lag period, $D_{i,t}$ is an indicator equal to 1 only if unit i starts the treatment in year t whereas it was not exposed to the treatment in year $t-1$ and displays at least one matched control, $M_{i,t}$ is the set of control units after the application of a matching procedure, $Y_{i,t}$ is the outcome variable and $w_{i,t}^{i'}$ are control units weights for untreated observations i'.

4 | RESULTS

In this section we present and discuss the findings of the empirical analysis about the economic growth of regions potentially penalized in the access to SFs due to the EU enlargement. We show the results of a set of complementary analyses at different geographical scales and robustness checks, aiming to assess the validity of our findings.

In particular, Section 4.1 highlights the impact of the current allocation criterion of SFs on NTA and LT regions at NUTS-2 level. Section 4.2 checks that the lower economic growth of these EU regions is experienced in correspondence with the last programming period starting in 2014 and is not triggered by different events that occurred in previous years, such as the financial crisis that started in 2008. Section 4.3 investigates whether the economic gap experienced by these NUTS-2 with respect to their counterfactual is significantly larger than that of other regions in the same country not penalized in the access to SFs.

Sections 4.4–4.6 perform further analyses at NUTS-3 level. In particular, we study whether the current criterion for the allocation of SFs may hamper the convergence process, comparing the economic development pattern of NTA and LT regions with that of territories with a comparable or higher level of development in the same country. Finally, we discuss the robustness of the estimated magnitude of the lower economic growth of EU regions receiving a smaller amount of SFs with respect to their need of financial support.

4.1 | The economic growth of NTA and LT NUTS-2

Focusing on our first research question about the NTA regions, we first investigate whether the criterion used to allocate the less developed status risks to penalize regions with an already fragile economy from a timely treatment. We present the results of the SDID developed by Arkhangelsky et al. (2021) and of the SCM introduced by Cattaneo et al. (2021) described in Section 3.2.1 (see also Appendix C for additional details on such estimated models). In this analysis the treated units are the NTA regions identified in Section 3.1, while the donor pool is composed of NUTS-2 located in the same country of the underlying NTA regions with the same pretreatment characteristics in terms of allocation class of SFs in the period 1989–2013, and whose classification within or not the less developed regions was not affected by the EU enlargment.[21] Results are reported in Table 4 for every NTA region and then graphically represented in different figures.

Figure 3 focuses on NTA regions in Belgium and shows that they are subject to a significantly lower economic growth with respect to their control group: the aggregate ATT for the whole period is equal to −5.7% and statistically significant at a confidence level of 99.9% ($\alpha = 0.1\%$). More specifically, over the period 2014–2019, the ATT ranges between −8.0% and −2.7% for region BE32 and between −12.3% and −7.0% for BE34. Notice that the magnitude of economic penalization tends to grow over time, suggesting that in medium–long term the lack of financial support produces stronger negative effects.

We find an even stronger gap in terms of economic growth in Greece, where the NTA region EL53 is subject to an aggregate lower GDP per capita growth by −10.5% over the period 2014–2019, with an ATT comprised between −24.1% and −3.1% starting being significant only since 2016 (see also Figure 4). Such result is in line with the $n + 2$ rule for the allocation of SFs. Indeed during the first 2 years of the time frame 2014–2020, the NTA region EL53 may have benefited from the possibility to spend financial resources allocated in the previous programming period (2007–2013), when this region was admitted to receive Convergence funds on a transitional basis.

Such patterns are confirmed when we focus on the UK, where in aggregate NTA NUTS-2 are subject to an ATT equal to −5.7% (see also Figure 5). Furthermore, the impact of a lower allocation of SFs ranges between −10.7% and −1.0% for UKC1, between −8.1% and −2.4% for UKE3 and between −8.4% and −1.8% for UKF3.

These results confirm our *RH1* and provide preliminary evidence that—due to the exogenous shock represented by the EU enlargement—the current criterion to assign the less developed status induces a penalization for NTA regions in terms of regional GDP per capita growth. Without the EU enlargement, these regions could have received a higher amount of SFs able to better support their growth. This evidence is coherent with previous critiques about the inability of the allocation criterion of SFs to assign a treatment intensity well aligned with the local level of development (CPMR, 2014b, 2015). In addition, our findings are consistent with other studies, highlighting how the current approach for the distribution of the EU budget risks to not induce additional growth in less developed regions with respect to more advanced economies (Crescenzi, 2009; Mairate, 2006).

Moving to our second research question about the LT regions, we analyze whether the current criterion for the allocation of SFs induced their premature exit from the less developed status or if instead the safety net constituted an adequate financial cushion to support the growth path of such regions. Table 5 exhibits the results of the SDID developed by Arkhangelsky et al. (2021) and of the SCM introduced by Cattaneo et al. (2021). Units exposed to the treatment are the LT regions identified in Section 3.1, while the donor pool is composed of NUTS-2 located in the same country of the underlying LT region with the same pretreatment characteristics in terms of allocation class of SFs in the period 1989–2013, but receiving an amount of SFs not affected by the EU enlargement over the time frame 2014–2019.

Figure 6 highlights that, in aggregate, German LT regions did not experience a lower economic growth over the period 2014–2019. Such result is the combined effect of a slightly lower economic development in NUTS-2 DE80 (especially over the years 2016–2019) and a slightly larger GDP per capita growth in DEG0. The aggregate ATT is positive (7.9%), but not statistically significant.

A similar pattern is observed in Greece, where we find evidence of a positive, but not statistically significant aggregate ATT equal to 3.2% (see Figure 7). Also in this case, such result is the compound effect of heterogeneous impacts of the allocation of lower SFs in the NUTS-2 EL41 and EL65. Indeed, the former is subject to a slightly

[21]Regions BE32 and UKE3 received Objective 1 SFs, respectively, in the programming period 1994–1999 and 2000–2006 and they do not have regions with the same pretreatment characteristics in terms of allocation class of SFs in the period 1989–2013. In this case, for BE32 we employ the same donor pool used for BE34, while for UKE3 we use the same donor pool used for UKC1 and UKF3. We remark that in this way the donor pool is constituted by regions receiving a lower amount of funds with respect to these two NTA regions, therefore we even underestimate the evidence of economic penalization of these NUTS-2, due to potential long-term benefits induced by SFs. We perform a robustness check of our results in Section 4.5 where we exclude from treated units territories within the BE32 and UKE3 NUTS-2.

TABLE 4 The upper part of the table shows the ATT estimated with the SCM proposed by Cattaneo et al. (2021) for *NTA* regions BE32, BE34, EL53, UKC1, UKE3, UKF3.

ATT Cattaneo et al. (2021)						
	BE32	BE34	EL53	UKC1	UKE3	UKF3
2014	−0.027	−0.070	−0.031	−0.016	−0.029	−0.018
2015	−0.046**	−0.085**	−0.071	−0.010	−0.024	−0.031
2016	−0.049***	−0.098***	−0.122***	−0.069***	−0.062***	−0.065***
2017	−0.049***	−0.104***	−0.128***	−0.087***	−0.062**	−0.046*
2018	−0.062***	−0.112***	−0.179***	−0.092***	−0.074***	−0.059**
2019	−0.080***	−0.123***	−0.241***	−0.107***	−0.081***	−0.084***

ATT Arkhangelsky et al. (2021)		
Belgium	Greece	The UK
−0.0568*** [−0.0955; −0.0181]	−0.1046*** [−0.1588; −0.0504]	−0.0566*** [−0.0658; −0.0474]

Note: We show results for each year after the start of the treatment (2014–2019). The lower part of the table shows the ATT (point estimates and prediction intervals in parentheses) based on the SDID developed by Arkhangelsky et al. (2021) for NTA NUTS-2 in Belgium, Greece and the UK, respectively.

Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

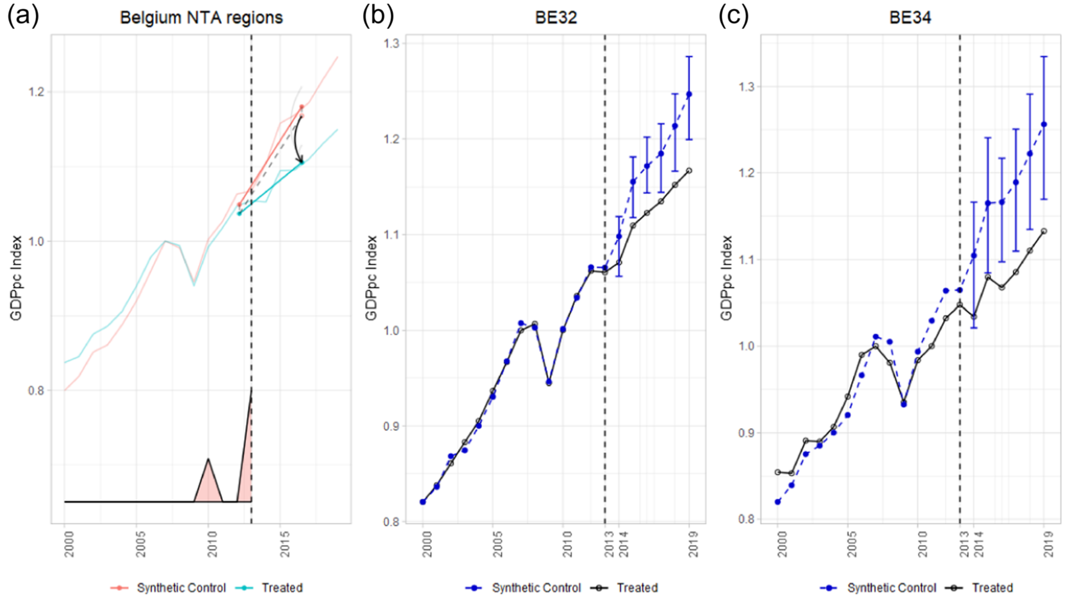

FIGURE 3 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for NTA NUTS-2 in Belgium. Panels B (centre) and C (right) show the SCM proposed by Cattaneo et al. (2021) for NTA regions BE32 and BE34, respectively. Prediction intervals are estimated with a confidence level equal to 0.95 (α = 0. 05). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics; SDID, Synthetic Difference-in-Differences.

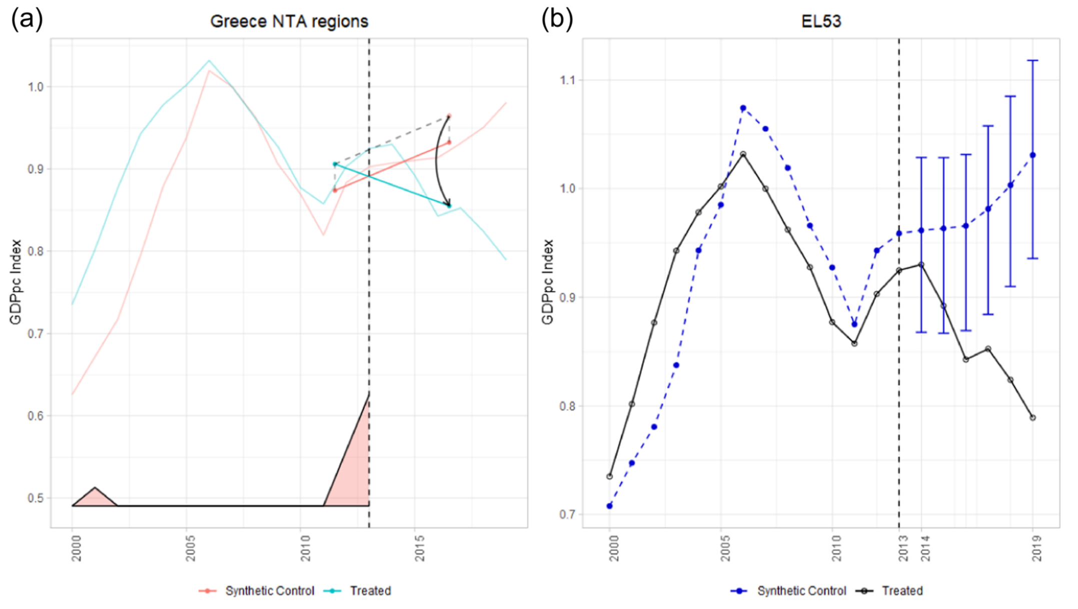

FIGURE 4 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for NTA NUTS-2 in Greece. Panel B (right) shows the SCM proposed by Cattaneo et al. (2021) for NTA region EL53. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

higher growth over the period 2014–2016 and a lower economic development between 2017 and 2019, in line with a mitigation role of the $n + 2$ rule. The latter is subject to an even significant higher GDP per capita growth over the analyzed time frame, suggesting the absence of economic penalization induced by their exit from the less development status due to the EU enlargement.

Finally, in Spain we observe the absence of a relevant gap in terms of economic growth between the LT region ES61 and its control group, with an aggregate impact equal to −0.8% with ATT coefficients ranging between −2.3% and 1.3% without being never statistically significant (see also Figure 8).

Overall, the analysis of the LT regions provides evidence that NUTS-2 receiving the safety net did not experience strong economic downturn, in line with our *RH2*. We remark that the absence of economic penalization in these regions is not due to possible long-term benefits induced by SFs in the previous programming periods. Indeed, regions in the control group exhibit the same pretreatment characteristics of treated units in terms of SFs allocation, thus they should share the same long-term benefits eventually experienced by LT regions. Consequently, our results show a positive effect generated by the safety net that may have prevented a lower economic growth in LT regions, thus suggesting the effectiveness of a flexible allocation of these funds, and supporting the introduction of diversified safety nets and caps for a more effective distribution of the EU budget, as currently discussed for the Cohesion Policy 2021–2027 (Bachtler et al., 2019).

4.2 | In-time placebo

In this section we perform two in-time placebo tests to verify whether the different economic development pattern experienced by the NTA regions compared with the control group is actually induced by the absence of treatment in the

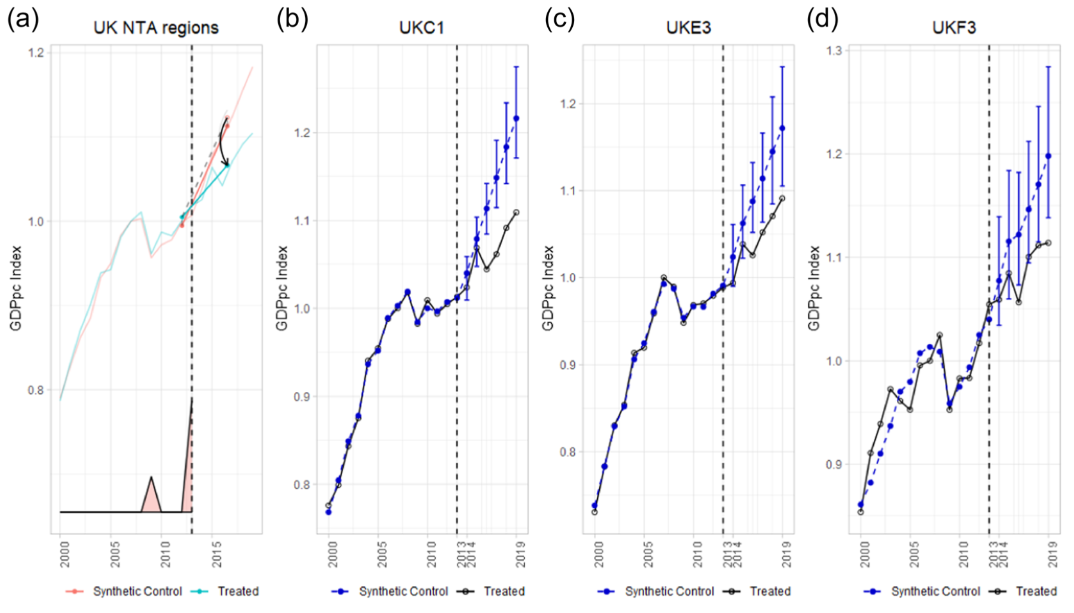

FIGURE 5 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for NTA NUTS-2 in the UK. Panels B (centre-left), C (centre-right) and D (right) show the SCM proposed by Cattaneo et al. (2021) for NTA regions UKC1, UKE3 and UKF3, respectively. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

TABLE 5 The upper part of the table shows the ATT estimated with the SCM proposed by Cattaneo et al. (2021) for *LT* regions DE80, DEG0, EL41, EL65, ES61.

ATT Cattaneo et al. (2021)					
	DE80	**DEG0**	**EL41**	**EL65**	**ES61**
2014	0.027	0.087*	0.034	0.038	0.013
2015	0.008	0.077	0.021	0.050**	0.008
2016	−0.027	0.064	0.016	0.054***	−0.006
2017	−0.018	0.070	−0.016	0.074***	−0.009
2018	−0.039	0.066	−0.053	0.087***	−0.017
2019	−0.041	0.068	−0.087	0.107***	−0.023
ATT Arkhangelsky et al. (2021)					
Germany		**Greece**		**Spain**	
0.0794 [−0.0159; 0.1747]		0.0322 [−0.0597; 0.1242]		−0.0082 [−0.0410; 0.0246]	

Note: We show results for each year after the start of the treatment (2014–2019). The lower part of the table shows the ATT (point estimates and prediction intervals in parentheses) based on the SDID developed by Arkhangelsky et al. (2021) for LT NUTS-2 in Germany, Greece and Spain, respectively.

Abbreviations: ATT, average treatment effect on treated; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

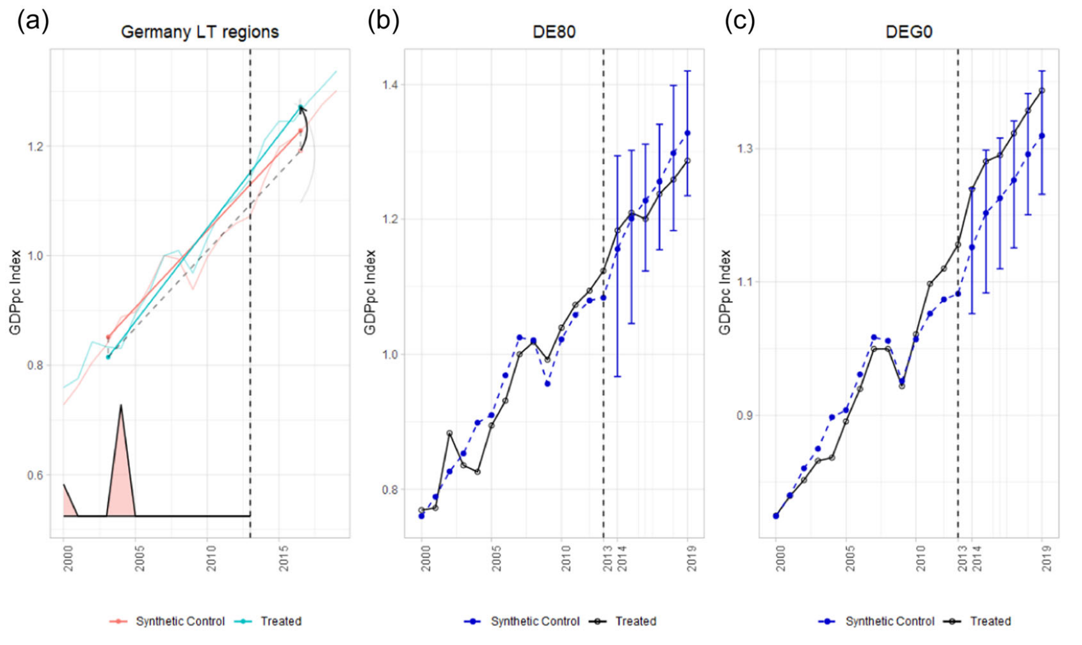

FIGURE 6 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for LT NUTS-2 in Germany. Panels B (centre) and C (right) show the SCM proposed *by* Cattaneo et al. (2021) for LT regions DE80 and DEG0, respectively. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

programming period 2014–2020 or if instead a lower economic growth was experienced by these NUTS-2 even in the previous years, thus suggesting the presence of other potential causes determining the economic penalization.[22] Such analysis allows us to further investigate our *RH1*, highlighting the extent to which the current criterion for the allocation of SFs risks not to phase into the treatment territories with a fragile economy, inducing a significant economic gap in terms of local development. To do this, we apply the SCM, following Cattaneo et al. (2021).

The fake treatment years are 2006 and 2009 to verify whether the economic penalization starts, respectively, during the programming period 2007–2013 or in correspondence of the financial crisis that might have contributed to generate diverse economic development patterns (Kolev, 2012; Welch, 2011).

In Table 6 we observe that across the majority of observed NTA regions, the divergence between the economic pattern of the underlying NUTS-2 and the synthetic control starts after 2013 (see also Appendix D for other details on the economic penalization of NTA regions). In particular, we find that for BE32, UKC1, UKE3 and UKF3 the gap in the GDP per capita growth is observed over the period 2016–2019. In EL53 the economic penalization starts to be significant even 1 year before (2015), while in BE34 it is observed over the whole time frame 2014–2019. Furthermore, with the exception of BE34, EL53 and UKF3, where we find a relevant difference in the development pattern of NTA regions and the control group also for some years in the period 2007–2012, we do not observe significant ATTs before 2014. Such findings suggest that the economic penalization should have started during the last programming period (2014–2020), with no evidence of divergence in the GDP per capita index of the analyzed regions with respect to their control group in previous years.

[22]We do not perform the same placebo analysis for LT regions, since in Section 4.1 we do not find evidence of significant lower GDP per capita growth of such regions with respect to their counterfactual.

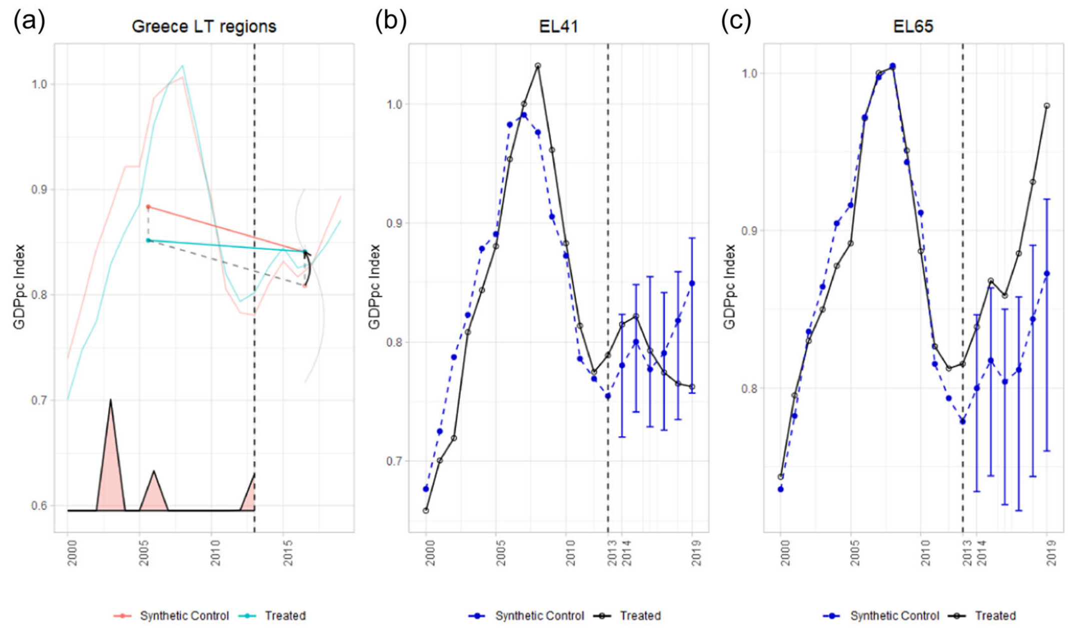

FIGURE 7 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for LT NUTS-2 in Greece. Panels B (centre) and C (right) show the SCM proposed by Cattaneo et al. (2021) for LT regions EL41 and EL65, respectively. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

Table 7 shows that considering 2009 as the treatment year, the ATT tends to increase its negative size after 2013. Notice how estimated coefficients are never significant over the period 2010–2013 (except for UKC1 in 2010, but with a positive coefficient), with only some years between 2015 and 2019 displaying significant economic penalization across the observed NTA regions. This suggests that the economic penalization observed in NTA regions is not triggered by the financial crisis started in 2008.

Overall, such results tend to confirm that the NTA regions and the control group experienced a similar economic development pattern before 2013, with the gap in the GDP per capita index becoming significant only during the last programming period (2014–2020). This finding is in favour of an economic penalization induced by the EU enlargement, reducing the amount of SFs allocated to this set of regions, consistently with our *RH1*.

4.3 | The GDP per capita gap of placebo versus NTA regions

To further investigate the relevance of the economic penalization of NTA regions with respect to other NUTS-2 in the same country, we perform an additional placebo test, where we virtually consider as treated also control regions whose SFs allocation class in the programming period 2014–2020 was not affected by the 2004 EU enlargement. In this way based on Cattaneo et al. (2021), we also estimate a synthetic control for each region receiving an amount of SFs not affected by the EU enlargement. The comparison of the difference between the GDP per capita index of these NUTS-2 and their counterfactual and the corresponding value obtained for NTA regions offers a further evidence of the economic penalization faced by NTA regions.

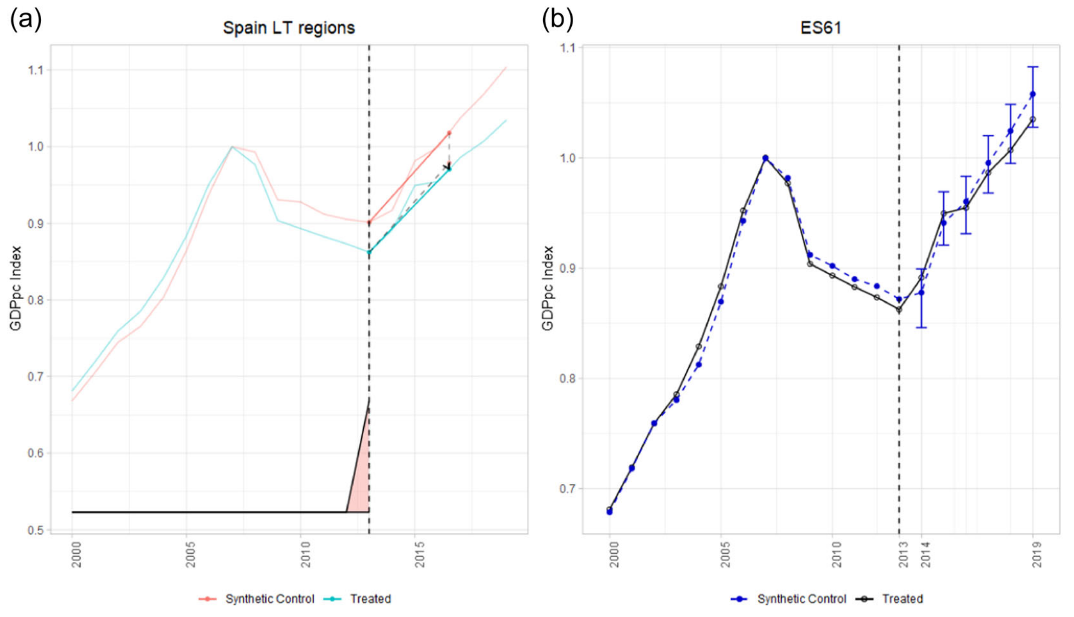

FIGURE 8 Panel A (left) shows the ATT based on the SDID developed by Arkhangelsky et al. (2021) for LT NUTS-2 in Spain. Panel B (right) shows the SCM proposed by Cattaneo et al. (2021) for LT region ES61. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics; SCM, Synthetic Control Method; SDID, Synthetic Difference-in-Differences.

TABLE 6 Yearly ATT estimated with the SCM introduced by Cattaneo et al. (2021) for *NTA* regions.

	BE32	BE34	EL53	UKC1	UKE3	UKF3
2007	−0.068	−0.022	−0.101**	0.005	0.025	−0.040
2008	−0.057	−0.039*	−0.103**	0.018	0.022	−0.021
2009	−0.023	−0.035*	−0.080*	0.017	0.001	−0.068**
2010	−0.052	−0.037	−0.093**	0.041	0.007	−0.053*
2011	−0.073	−0.057***	−0.063	0.016	0.010	−0.051
2012	−0.094	−0.053***	−0.082*	0.011	0.004	−0.038
2013	−0.094	−0.036	−0.079	0.006	0.008	0.001
2014	−0.137	−0.079**	−0.078	−0.018	−0.017	−0.024
2015	−0.185	−0.087**	−0.120***	−0.012	−0.013	−0.026
2016	−0.187*	−0.123***	−0.172***	−0.067***	−0.054**	−0.084*
2017	−0.195*	−0.109***	−0.180***	−0.081***	−0.058**	−0.080*
2018	−0.221*	−0.109***	−0.228***	−0.081***	−0.073**	−0.104**
2019	−0.256***	−0.119***	−0.293***	−0.089***	−0.080***	−0.150***

Note: Results are referred to an in-time placebo analysis where the fake treatment year is 2006.
Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; SCM, Synthetic Control Method.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

TABLE 7 Yearly ATT estimated with the SCM introduced by Cattaneo et al. (2021) for *NTA* regions.

	BE32	BE34	EL53	UKC1	UKE3	UKF3
2010	−0.004	−0.022	−0.065	0.023*	0.008	0.004
2011	0.001	−0.043	−0.033	−0.004	0.014	0.0001
2012	−0.005	−0.042	−0.054	−0.004	0.001	0.002
2013	−0.006	−0.026	−0.049	0.002	0.001	0.026
2014	−0.029	−0.074	−0.048	−0.014	−0.028	−0.020
2015	−0.046	−0.085	−0.088	−0.011	−0.023	−0.032
2016	−0.049**	−0.110**	−0.140***	−0.074***	−0.059***	−0.074
2017	−0.050	−0.104*	−0.147***	−0.092***	−0.057**	−0.060
2018	−0.062*	−0.107*	−0.196***	−0.100***	−0.071**	−0.077
2019	−0.080**	−0.118**	−0.260***	−0.112***	−0.078***	−0.109**

Note: Results are referred to an in-time placebo analysis where the fake treatment year is 2009.
Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; SCM, Synthetic Control Method.
$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

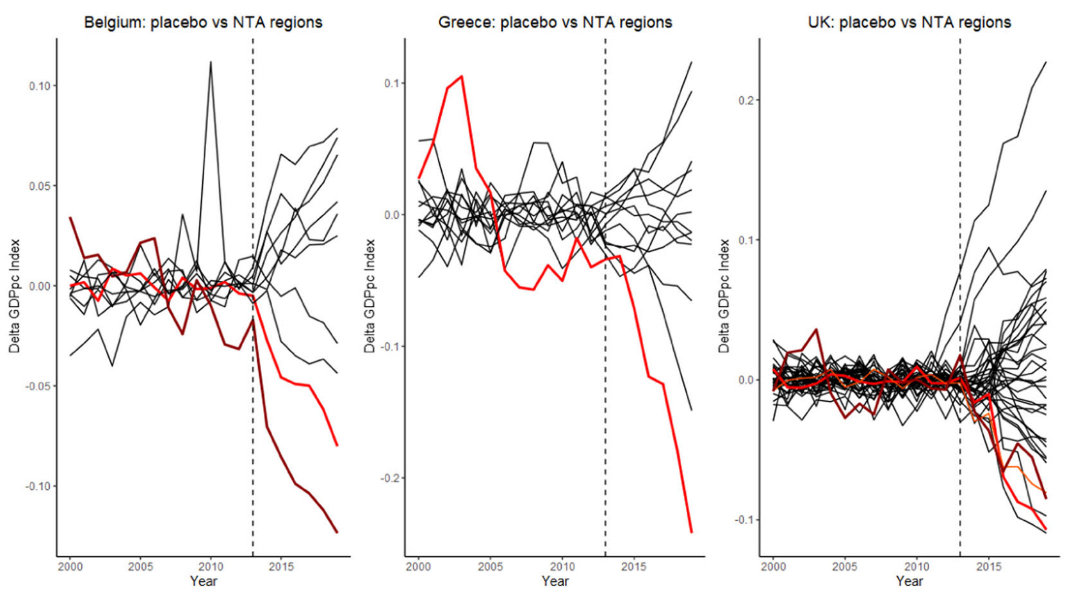

FIGURE 9 Placebo correctly treated versus NTA regions. The graph reports the differences, in terms of GDP per capita index (2007 = 100), between the NTA regions in Belgium, Greece and the UK and their synthetic control (coloured lines), as well as the same differences for all other regions in the same countries (black lines). Estimates are based on the SCM introduced by Cattaneo et al. (2021). GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; SCM, Synthetic Control Method.

Figure 9 shows that in Belgium, regions BE32 and BE34 are the NUTS-2 with the largest gap in terms of GDP per capita index with respect to the synthetic control over the period 2014–2019. In particular, the economic penalization of these two NTA regions fluctuates between −12.3% and −2.7% over the time frame 2014–2019, with an average equal to −7.5%, compared to 2.2% for NUTS-2 in the control group. Similarly in Greece, region

EL53 experiences a GDP per capita loss which is by far larger than in other placebo regions with an average loss over the period 2014–2019 equal to −12.9%, while for the control group the corresponding value accounts for 0.0%. In the UK, region UKC1 is subject to the second largest gap which reaches −10.7% in terms of GDP per capita index in 2019. UKE3 and UKF3 display an average loss in the period 2014–2019 by, respectively, −5.5% and −5.1% and are in the bottom tail of the distribution, while the mean economic gap for the control group is equal to 0.1%.

Finally, notice how the economic penalization of NTA regions is not significantly different from the control group before 2013, while it becomes relevant during the last programming period 2014–2020. Such results corroborate the relevance of the economic gap experienced by the identified NTA regions due to the EU enlargement that reduced the amount of SFs allocated to these NUTS-2.

4.4 | The economic growth of NTA and LT NUTS-3

We further investigate the impact of the EU enlargement on the allocation of SFs and economic development dynamics of recipient regions at NUTS-3 level to assess whether our results hold even at a more granular geographical scale. Given the larger number of treated units, we can use a set of different DiD methods to verify the robustness of findings obtained at NUTS-2 level (Callaway & Sant'Anna, 2021; Hazlett & Xu, 2018; Imai et al., 2021) (see Appendix E for additional details on such estimated models).

We initially focus on our first research question, analyzing the set of NTA regions, to understand whether the criterion used to assign the less developed status risks to not phase into the treatment regions with an already fragile economy. In Belgium, we find that NTA NUTS-3 regions experience a significantly lower economic growth over the years 2016 and 2019 according to the Callaway and Sant'Anna (2021) method (see Table 8 and Figure 10). Such result confirms that the economic penalization tends to become relevant after 2 years since the stop of the previous programming period (2007–2013). Following Imai et al. (2021), we find an immediate GDP per capita index gap since 2014, while based on Hazlett and Xu (2018) the penalization starts to be significant “only” in 2017. However, according to all applied methods, the size of the impact of the misaligned allocation of SFs due to the EU enlargement tends to increase over time, suggesting that a longer exposition to a lower level of financial support risks to further exacerbate economic development dynamics. Overall, the ATT ranges between −7.4% and −1.0% over the time frame 2014–2019.

In Greece, we confirm that based on Callaway and Sant'Anna (2021) the economic gap between NTA regions at NUTS-3 level and the control group is significant over the time frame 2016–2019, while based on Imai et al. (2021) the economic penalization starts being relevant since 2014. We cannot identify confidence intervals for the Hazlett and Xu (2018) method due to the limited number of treated units. Again, we identify a growth in the magnitude of the impact of the lower allocation of SFs to NTA regions over the years 2014–2019, ranging between −11.6% and −0.5%.

Similar findings hold also for the UK. In this case the ATT is negative and significant for all the three methods over the time frame 2016–2019, while coefficients are not significant in the years 2014 and 2015. Such results corroborate the idea that a further exposure to a misaligned amount of financial support has progressively contributed to a stronger economic gap. The size of the economic penalization fluctuates between −10.2% and −4.1% over the period 2016–2019.

Overall, the absence of significant ATT coefficients in the years before the start of the treatment (2008–2013, the only exception is Belgium in 2011 according to Hazlett & Xu, 2018) suggests that the parallel trend assumption holds, with no significantly different development dynamic between treated and control units. Such finding corroborates our *RH1* and provides robustness to our results that should be due to the misaligned allocation of SFs induced by the EU enlargement and not to other confounding factors already affecting the economic growth of analyzed regions in the previous programming period.

In a second step, we replicate this analysis on the group of LT regions at NUTS-3 level. In this way, we focus on our second research question analyzing the extent to which the safety net adequately supported the economic growth path of these regions after the exit from the less developed status.

TABLE 8 The following table reports estimates of ATT at NUTS-3 level for *NTA* regions.

	Belgium			Greece			The UK		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2007	−0.014	0.000	NA	−0.001	−0.025	NA	0.007	0.000	NA
	(0.008)	(0.011)	NA	(0.014)	NA	NA	(0.006)	(0.005)	NA
2008	0.007	−0.002	NA	0.000	−0.005	NA	−0.007	0.000	NA
	(0.008)	(0.014)	NA	(0.010)	NA	NA	(0.008)	(0.003)	NA
2009	−0.010	0.000	NA	0.000	0.001	NA	0.013	0.001	NA
	(0.017)	(0.015)	NA	(0.009)	NA	NA	(0.008)	(0.007)	NA
2010	0.000	0.016	NA	0.015	0.018	NA	0.002	0.004	NA
	(0.007)	(0.009)	NA	(0.019)	NA	NA	(0.008)	(0.005)	NA
2011	0.003	0.013**	NA	0.009	0.014	NA	−0.006	0.000	NA
	(0.009)	(0.005)	NA	(0.016)	NA	NA	(0.004)	(0.006)	NA
2012	−0.023	−0.013	NA	0.007	0.006	NA	−0.006	−0.001	NA
	(0.019)	(0.009)	NA	(0.010)	NA	NA	(0.005)	(0.006)	NA
2013	0.003	−0.012	NA	−0.009	0.005	NA	−0.006	0.000	NA
	(0.005)	(0.007)	NA	(0.009)	NA	NA	(0.008)	(0.008)	NA
2014	−0.012	−0.015	−0.012***	−0.005	−0.008	−0.006***	−0.009	−0.010	−0.009
	(0.007)	(0.013)	(0.004)	(0.007)	NA	(0.002)	(0.011)	(0.018)	(0.020)
2015	−0.016	−0.010	−0.016***	−0.014	−0.013	−0.014***	−0.029	−0.037	−0.029
	(0.009)	(0.011)	(0.005)	(0.009)	NA	(0.005)	(0.024)	(0.025)	(0.057)
2016	−0.032***	−0.018	−0.031***	−0.032**	−0.029	−0.034***	−0.044***	−0.042***	−0.045***
	(0.010)	(0.014)	(0.010)	(0.013)	NA	(0.012)	(0.017)	(0.017)	(0.017)

(Continues)

TABLE 8 (Continued)

	Belgium			Greece			The UK		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2017	−0.045***	−0.030*	−0.045***	−0.043***	−0.044	−0.047***	−0.050***	−0.041	−0.051***
	(0.013)	(0.016)	(0.018)	(0.013)	NA	(0.018)	(0.017)	(0.024)	(0.021)
2018	−0.059***	−0.042***	−0.059***	−0.074***	−0.075	−0.080***	−0.078***	−0.057**	−0.080***
	(0.016)	(0.017)	(0.022)	(0.021)	NA	(0.032)	(0.017)	(0.026)	(0.032)
2019	−0.073***	−0.058***	−0.074***	−0.108***	−0.111	−0.116***	−0.099***	−0.066*	−0.102***
	(0.019)	(0.023)	(0.029)	(0.024)	NA	(0.039)	(0.018)	(0.034)	(0.031)
Number of observations	585	585	585	221	221	221	2106	2106	2106

Note: Columns 1–3 refer to Belgium, columns 4–6 to Greece and columns 7–9 to the UK. In columns 1, 4 and 7 the ATT is estimated based on Callaway and Sant'Anna (2021) (CSA), in columns 2, 5 and 8 we use Hazlett and Xu (2018) (HAZ), in columns 3, 6 and 9 we apply the method proposed by Imai et al. (2021) (IMA). In the Hazlett and Xu (2018) method we employ the kernel balancing estimator. Standard errors are computed based on a bootstrap procedure with 200 replications. In the Imai et al. (2021) method we employ the Mahalanobis distance as a refinement method to match treated and control units. Standard errors are computed based on a bootstrap procedure with 200 replications. Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

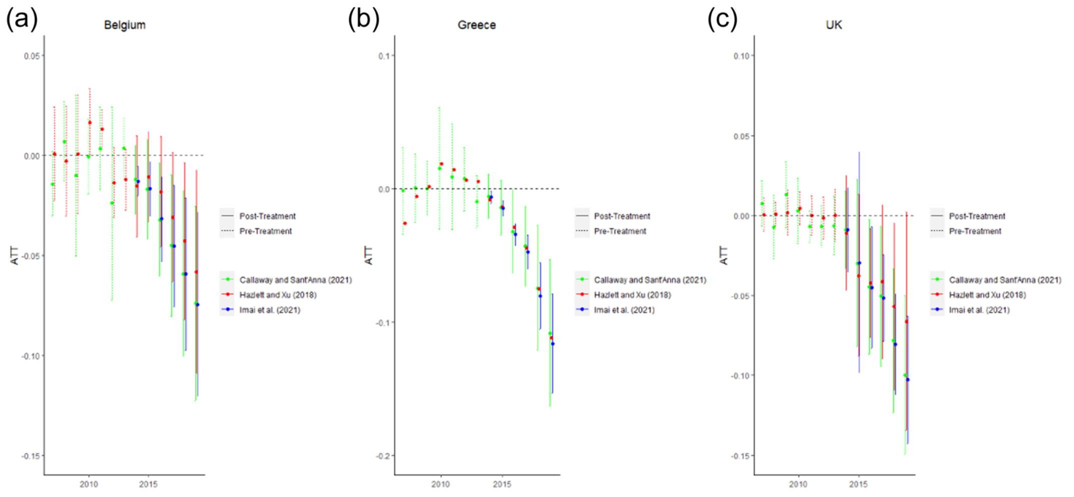

FIGURE 10 The following graph shows estimates of ATT at NUTS-3 level for NTA regions. Panel A (left) refers to Belgium, panel B (centre) to Greece and panel C (right) to the UK. ATT coefficients are estimated based on Callaway and Sant'Anna (2021) (green line), Hazlett and Xu (2018) (red line), and Imai et al. (2021) (blue line). Confidence intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics.

In Germany, we find the absence of economic penalization of NUTS-3 regions over the period 2014–2019. Indeed, we find only a weakly positive ATT in 2014 according to Hazlett and Xu (2018) and Imai et al. (2021), suggesting that LT territories may have experienced a slightly higher economic growth with respect to their counterfactual (see Table 9 and Figure 11).

We corroborate this result for Greece and Spain, where the economic gap between LT regions and the control group tends to be negative over the period 2014–2019, but almost never statistically significant (the only exception is Greece in years 2014 and 2015 based on Hazlett & Xu, 2018; Imai et al., 2021). Furthermore, we confirm the presence of the parallel trend between treated units and the counterfactual, as ATT coefficients do not tend to be statistically significant in the years before 2014, suggesting that analyzed regions experienced comparable development patterns in the period before the start of the misalignment in the allocation of SFs for LT regions. Overall, such findings confirm our *RH2* providing evidence that the safety net prevented lower economic growth in recipient regions.

4.5 | Economic convergence

In this section we perform a robustness check on the main results obtained at NUTS-3 level. More specifically we investigate whether these NUTS-3 do not only experience a lower GDP per capita index variation with respect to their control group, but also when we restrict the control group to a set of regions with a comparable or higher level of development according to the classification made by the EC for the allocation of SFs. In this way, we check whether treated units display statistically significant lower growth with respect to regions receiving a similar or lower amount of SFs, in contrast with the economic convergence objective. To do this, we apply the DiD estimators described in Section 3.2.2, where treated units are those NUTS-3 receiving a penalization in the access to SFs due to the EU enlargement and not treated units are all the other NUTS-3 in the same country that over the analyzed period were classified in the same or in a higher development class for the allocation of SFs. In Belgium and the UK, NUTS-3 belonging to the NTA class were mainly classified as more developed regions in the pretreatment period 1989–2013. Consequently, the counterfactual employed

TABLE 9 The following table reports estimates of ATT at NUTS-3 level for *LT* regions.

	Germany			Greece			Spain		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2007	0.004	−0.014	NA	0.027	0.021	NA	0.002	0.010**	NA
	(0.009)	(0.009)	NA	(0.017)	(0.016)	NA	(0.009)	(0.005)	NA
2008	0.002	−0.015	NA	0.007	0.003	NA	−0.010	0.005	NA
	(0.015)	(0.013)	NA	(0.012)	(0.027)	NA	(0.007)	(0.007)	NA
2009	0.005	−0.017***	NA	−0.004	−0.008	NA	−0.021	−0.017*	NA
	(0.011)	(0.007)	NA	(0.012)	(0.010)	NA	(0.012)	(0.009)	NA
2010	0.012	−0.005	NA	0.001	−0.014	NA	0.002	0.004	NA
	(0.008)	(0.004)	NA	(0.011)	(0.024)	NA	(0.012)	(0.004)	NA
2011	0.017	0.007	NA	0.000	0.008	NA	−0.002	0.000	NA
	(0.010)	(0.007)	NA	(0.013)	(0.027)	NA	(0.009)	(0.005)	NA
2012	0.006	0.010	NA	−0.004	−0.011	NA	0.000	−0.006	NA
	(0.009)	(0.016)	NA	(0.012)	(0.024)	NA	(0.005)	(0.007)	NA
2013	0.011	0.019	NA	−0.009	−0.002	NA	−0.006	−0.001	NA
	(0.006)	(0.021)	NA	(0.016)	(0.013)	NA	(0.005)	(0.006)	NA
2014	0.011	0.030*	0.009*	−0.007	−0.025***	−0.013	0.008	−0.004	0.007***
	(0.010)	(0.016)	(0.042)	(0.009)	(0.006)	(0.012)	(0.009)	(0.007)	(0.002)
2015	−0.003	0.018	−0.002	−0.009	−0.031**	−0.017*	0.008	0.014	0.007
	(0.013)	(0.015)	(0.040)	(0.011)	(0.014)	(0.009)	(0.012)	(0.010)	(0.030)
2016	−0.016	0.003	−0.018	0.000	−0.027	−0.007	−0.006	0.005	−0.007
	(0.015)	(0.014)	(0.059)	(0.009)	(0.017)	(0.013)	(0.010)	(0.008)	(0.049)
2017	−0.007	0.011	−0.009	−0.004	−0.031	−0.012	−0.011	0.007	−0.012
	(0.016)	(0.014)	(0.076)	(0.015)	(0.018)	(0.026)	(0.011)	(0.009)	(0.076)
2018	−0.012	0.005	−0.016	−0.013	−0.046	−0.021	−0.021	0.004	−0.022
	(0.019)	(0.015)	(0.095)	(0.027)	(0.030)	(0.045)	(0.014)	(0.010)	(0.098)
2019	−0.008	0.008	−0.013	−0.019	−0.053	−0.027	−0.030	0.004	−0.031
	(0.020)	(0.016)	(0.110)	(0.036)	(0.039)	(0.067)	(0.019)	(0.011)	(0.120)
Number of observations	533	533	533	312	312	312	247	247	247

Note: Columns 1–3 refer to Germany, columns 4–6 to Greece and columns 7–9 to Spain. In columns 1, 4 and 7 the ATT is estimated based on Callaway and Sant'Anna (2021) (CSA), in columns 2, 5 and 8 we use Hazlett and Xu (2018) (HAZ), in columns 3, 6 and 9 we apply the method proposed by Imai et al. (2021) (IMA). In the Hazlett and Xu (2018) method we employ the kernel balancing estimator. Standard errors are computed based on a bootstrap procedure with 200 replications. In the Imai et al. (2021) method we employ the Mahalanobis distance as a refinement method to match treated and control units. Standard errors are computed based on a bootstrap procedure with 200 replications. Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

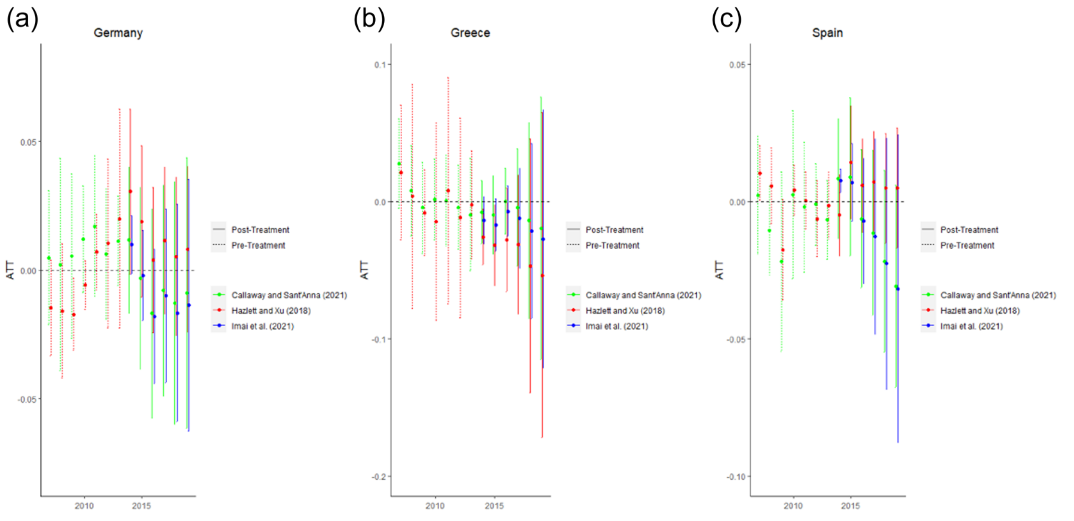

FIGURE 11 The following graph shows estimates of ATT at NUTS-3 level for LT regions. Panel A (left) refers to Germany, panel B (centre) to Greece and panel C (right) to Spain. ATT coefficients are estimated based on Callaway and Sant'Anna (2021) (green line), Hazlett and Xu (2018) (red line), and Imai et al. (2021) (blue line). Confidence intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). ATT, average treatment effect on treated; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics.

in Sections 4.1 and 4.4 for NTA regions in these countries is already constituted by more developed regions. For this reason, our robustness analysis in these two countries just restricts the set of treated NUTS-3, excluding those territories included in NUTS-2 BE32 and UKE3, since they were, respectively, classified as Objective 1 regions in the programming period 1994–1999 and 2000–2006, differently from the other NTA regions and control units.

In Belgium, based on the Callaway and Sant'Anna (2021) method we identify significant ATTs ranging between −9.7% and −1.5% between 2014 and 2019 with the size of the negative coefficient increasing over time (see Table 10). Coherent results are obtained according to the Imai et al. (2021) method, with a similar magnitude of the estimated economic gap between NTA NUTS-3 and the control group and the ATT being not statistically significant only in 2014 after the start of the treatment.

In Greece, consistently with the $n + 2$ rule, we observe a lower economic growth of NTA NUTS-3 since 2016 with respect to regions with a similar or higher level of development. The Hazlett and Xu (2018) method does not provide standard errors due to the limited number of treated units, but exhibits point estimates for the ATT that tends to be higher than those obtained with Imai et al. (2021) and Callaway and Sant'Anna (2021) in 2018 and 2019.

We show similar findings for the UK, where we highlight that NTA regions experienced a significantly lower economic growth over the period 2016–2019, with an economic gap ranging between −10.7% and −6.1%.

Such results suggest that NTA regions were subject to a lower economic growth also with respect to territories with the same or a higher level of economic development, thus potentially hampering the process of economic convergence. This is reasonable, considering that for these regions the EC did not establish any financial cushion to increase the level of financial support, and that without the EU enlargement, these regions would have been likely to obtain the status of most-disadvantaged territories (European Commission, 2015; European Union, 2011).

The only exception among NTA regions is represented by Italy, where for the region of Sardinia we obtain negative, but not statistically significant ATT coefficients. A potential explanation of this pattern might be that this region was very close to the EU-15 GDP per capita threshold as shown in Table 1, thus it might have suffered less in terms of GDP per capita from not receiving the status of less developed region. Moreover, it achieved an increase

TABLE 10 The following table reports estimates of ATT at NUTS-3 level for *NTA* regions.

	Belgium			Greece			The UK			Italy		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2007	−0.028	−0.007	NA	0.008	0.000	NA	0.016	0.015	NA	−0.002	−0.024	NA
	(0.025)	NA	NA	(0.012)	NA	NA	(0.011)	NA	NA	(0.006)	(0.041)	NA
2008	−0.007	0.009	NA	−0.009	−0.001	NA	−0.016	−0.007	NA	−0.005	−0.022	NA
	(0.015)	NA	NA	(0.011)	NA	NA	(0.017)	NA	NA	(0.027)	(0.015)	NA
2009	0.000	0.015	NA	0.007	0.005	NA	0.000	−0.005	NA	0.025	−0.009	NA
	(0.034)	NA	NA	(0.008)	NA	NA	(0.010)	NA	NA	(0.017)	(0.030)	NA
2010	−0.004	0.022	NA	0.014	0.017	NA	0.007	0.000	NA	−0.005	−0.013	NA
	(0.006)	NA	NA	(0.021)	NA	NA	(0.007)	NA	NA	(0.010)	(0.036)	NA
2011	−0.005	0.008	NA	0.012	0.014	NA	−0.002	−0.002	NA	0.003	0.004	NA
	(0.007)	NA	NA	(0.022)	NA	NA	(0.002)	NA	NA	(0.013)	(0.022)	NA
2012	−0.037	−0.038	NA	0.007	0.012	NA	−0.002	0.009	NA	0.008	0.026	NA
	(0.040)	NA	NA	(0.008)	NA	NA	(0.004)	NA	NA	(0.010)	(0.015)	NA
2013	0.001	−0.029	NA	−0.011	0.007	NA	0.001	0.011	NA	−0.015	0.013	NA
	(0.006)	NA	NA	(0.009)	NA	NA	(0.008)	NA	NA	(0.015)	(0.015)	NA
2014	−0.015*	−0.048	−0.022	−0.002	0.011	−0.002	−0.012	0.000	−0.012	−0.012	−0.049	−0.020
	(0.007)	NA	(0.015)	(0.007)	NA	(0.011)	(0.008)	NA	(0.069)	(0.016)	(0.048)	(0.017)
2015	−0.020**	−0.043	−0.018**	−0.014	−0.002	−0.014	−0.071***	−0.074	−0.071	−0.021	−0.062	−0.027
	(0.009)	NA	(0.008)	(0.009)	NA	(0.012)	(0.025)	NA	(0.184)	(0.016)	(0.053)	(0.022)
2016	−0.048***	−0.060	−0.044***	−0.034***	−0.030	−0.035**	−0.061**	−0.065	−0.061***	−0.009	−0.042	0.000
	(0.010)	NA	(0.017)	(0.012)	NA	(0.016)	(0.030)	NA	(0.023)	(0.018)	(0.063)	(0.032)

TABLE 10 (Continued)

	Belgium			Greece			The UK			Italy		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2017	−0.062***	−0.076	−0.064***	−0.048***	−0.050	−0.052*	−0.067**	−0.061	−0.066***	−0.012	−0.044	−0.001
	(0.013)	NA	(0.023)	(0.012)	NA	(0.028)	(0.032)	NA	(0.017)	(0.018)	(0.070)	(0.044)
2018	−0.078***	−0.085	−0.081***	−0.082***	−0.092	−0.087***	−0.088***	−0.078	−0.088***	−0.033	−0.031	−0.015
	(0.018)	NA	(0.028)	(0.020)	NA	(0.027)	(0.033)	NA	(0.028)	(0.024)	(0.077)	(0.054)
2019	−0.097***	−0.100	−0.103***	−0.119***	−0.136	−0.126***	−0.107***	−0.088	−0.107***	−0.041	−0.027	−0.020
	(0.022)	NA	(0.036)	(0.023)	NA	(0.047)	(0.032)	NA	(0.038)	(0.026)	(0.082)	(0.056)
Number of observations	572	572	572	384	384	384	2093	2093	2093	996	996	996

Note: Columns 1–3 refer to Belgium, columns 4–6 to Greece, columns 7–9 to the UK, and columns 10–12 to Italy. In Belgium we exclude from treated regions NUTS-3 included in the NUTS-2 BE 32 as it was classified as Objective 1 region in the programming period 1994–1999, differently from units in the control group that have never received the less developed status. In Greece, the control group is constituted by regions in the same country classified as most advanced or transition regions. Less developed regions are excluded from the control group. In the UK we exclude from treated regions NUTS-3 included in the NUTS-2 UKE3 as it was classified as Objective 1 regions in the programming period 2000–2006, differently from units in the control group that have never received the less developed status. In columns 1, 4, 7 and 10 the ATT is estimated based on Callaway and Sant'Anna (2021) (CSA), in columns 2, 5, 8 and 11 we use Hazlett and Xu (2018) (HAZ), in columns 3, 6, 9 and 12 we apply the method proposed by Imai et al. (2021) (IMA). Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

by almost 40% in terms of SFs with respect to the previous programming period, suggesting that the higher amount of financial support, combined with a lower financial fragility led to a lower economic penalization.

On the other hand, we observe a different pattern for LT NUTS-3, as across the considered countries, we find a not statistically relevant economic gap for regions that did not keep the status of most-disadvantaged regions for the period 2014–2020 due to the EU enlargement in Greece and Spain (see Table 11). Moreover, for Germany the ATT coefficients are even positive over the period 2014–2019, suggesting that the safety net allowed these regions to stay in a pattern of economic convergence with respect to more advanced territories.

Furthermore, the absence of statistically significant ATT coefficients over the time frame 2008–2013 suggests that the parallel trend assumption holds and results should not be driven by different economic patterns experienced by LT NUTS-3 before the start of the most recent programming period (2014–2020). Overall, these findings corroborate the idea that regions benefiting from the safety net did not suffer in terms of economic development in the period 2014–2019 even at a finer geographical scale.

4.6 | The magnitude of the economic penalization

Finally, we perform a robustness check to corroborate the validity of our estimates in Section 4.4 also in terms of the magnitude of the economic penalization of NTA regions. More specifically we estimate the DiD models introduced in Section 3.2.2 with a bootstrap procedure with 1000 replications. At each iteration we consider a sample without replacement of the same size of the available data set for the considered country and we randomly assign at each observation the covariates contained in the vector $X_{i,t}$, corresponding to another randomly sampled observation of our data set. We rather keep the real observed values for each unit in terms of the dependent and treatment variables. In this way, we assign to control variables of NTA regions and control units random values sampled from the distribution of both NTA regions and control units. This allows us to verify whether the ATT coefficients are affected by specific values of the covariates of NTA regions and control units, or if instead the results are stable and not confounded by potentially different values in the observable characteristics of NTA regions and control units. Table 12 reports the average values of the estimated ATT coefficients and of the associated standard errors in relation to the 1000 replications.

Overall, these results are in line with those in Table 8. For instance, in Belgium NTA NUTS-3 display a significant economic gap with respect to the control group over the time frame 2016–2019, with an ATT ranging between −8.1% and −3.6%. We confirm that the strongest economic penalization is experienced by Greece, with the ATT coefficient starting being significant in 2015 and with a magnitude of the economic gap that is higher than −11% in 2019 according to all the Hazlett and Xu (2018), Imai et al. (2021) and Callaway and Sant'Anna (2021) methods, consistently with results shown in Section 4.4. We finally confirm evidence of a significantly lower GDP per capita growth in the UK over the time frame 2016–2019 with the ATT fluctuating between −9.8% and −3.8% during these years.

To assess the similarity of the size of ATT coefficients estimated, respectively, in Sections 4.4 and 4.6 we use a *t* test. *p*-values shown in Table F1 tend to accept the null hypothesis of the absence of statistical difference among such coefficients (for additional details see Appendix F). These results corroborate the idea that the economic penalization we identify can be explained by the misalignment in the allocation of SFs due to the EU enlargement and that the magnitude of the economic gap is not significantly affected by pre-existing local socioeconomic characteristics.

5 | CONCLUSION

In this paper, we analyzed the main criterion guiding the allocation of SFs, assigning EU NUTS-2 the status of less developed regions, in case they experience an average GDP per capita below the 75% of the EU average in the three initial years of the previous programming period. In particular, we focus on two groups of EU-15 regions that

TABLE 11 The following table reports estimates of ATT at NUTS-3 level for *LT* regions.

	Germany			Greece			Spain		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2007	0.009	0.000	NA	0.018	0.021	NA	0.018	0.010	NA
	(0.005)	(0.003)	NA	(0.013)	(0.016)	NA	(0.018)	(0.015)	NA
2008	−0.002	0.000	NA	0.009	0.021	NA	0.006	0.005	NA
	(0.012)	(0.002)	NA	(0.013)	(0.013)	NA	(0.005)	(0.007)	NA
2009	0.012	0.001	NA	−0.001	0.006	NA	−0.014	−0.017	NA
	(0.007)	(0.003)	NA	(0.012)	(0.004)	NA	(0.011)	(0.010)	NA
2010	0.003	0.001	NA	0.016**	0.016**	NA	0.020	0.004	NA
	(0.006)	(0.014)	NA	(0.007)	(0.007)	NA	(0.016)	(0.004)	NA
2011	0.005	0.002	NA	−0.021	0.004	NA	0.000	0.002	NA
	(0.005)	(0.014)	NA	(0.013)	(0.007)	NA	(0.009)	(0.005)	NA
2012	0.006	0.007	NA	0.002	−0.008	NA	−0.001	−0.006	NA
	(0.007)	(0.009)	NA	(0.011)	(0.007)	NA	(0.006)	(0.020)	NA
2013	0.009	0.004	NA	−0.015	−0.025	NA	−0.001	−0.001	NA
	(0.006)	(0.016)	NA	(0.015)	(0.006)	NA	(0.008)	(0.022)	NA
2014	0.027***	0.020**	0.027**	−0.001	−0.027	−0.002	−0.005	−0.004	0.000
	(0.008)	(0.009)	(0.012)	(0.008)	(0.014)	(0.012)	(0.008)	(0.007)	(0.009)
2015	0.026***	0.015**	0.025***	−0.004	−0.029	−0.004	0.007	0.014	0.014
	(0.010)	(0.007)	(0.008)	(0.009)	(0.016)	(0.013)	(0.009)	(0.010)	(0.027)
2016	0.026**	0.021***	0.024***	−0.001	−0.028	−0.003	−0.003	0.005	0.001
	(0.013)	(0.007)	(0.010)	(0.008)	(0.026)	(0.011)	(0.009)	(0.008)	(0.049)
2017	0.035***	0.025***	0.033***	−0.013	−0.044	−0.019	0.000	0.007	0.000
	(0.013)	(0.007)	(0.014)	(0.015)	(0.031)	(0.033)	(0.008)	(0.009)	(0.078)
2018	0.040***	0.030***	0.037***	−0.032	−0.066	−0.041	−0.003	0.004	−0.006
	(0.015)	(0.012)	(0.012)	(0.026)	(0.051)	(0.068)	(0.010)	(0.010)	(0.102)
2019	0.048***	0.032***	0.045***	−0.046	−0.085	−0.059	−0.001	0.004	−0.009
	(0.016)	(0.009)	(0.014)	(0.036)	(0.069)	(0.105)	(0.011)	(0.011)	(0.124)
Number of observations	4308	4308	4308	372	372	372	576	576	576

Note: Columns 1–3 refer to Germany, columns 4–6 to Greece and columns 7–9 to Spain. In all countries the control group is constituted by regions in the same country classified as most advanced or transition regions. Less developed regions are excluded from the control group. In columns 1, 4 and 7 the ATT is estimated based on Callaway and Sant'Anna (2021) (CSA), in columns 2, 5 and 8 we use Hazlett and Xu (2018) (HAZ), in columns 3, 6 and 9 we apply the method proposed by Imai et al. (2021) (IMA). Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; LT, Lost Treatment; NUTS, Nomenclature of Territorial Units for Statistics.

$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

TABLE 12 Difference-in-differences models at NUTS-3 level for *NTA* regions.

	Belgium			Greece			The UK		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2014	−0.003	−0.004	−0.005	−0.003	−0.006	−0.015	−0.012	−0.004	−0.004
	(0.008)	(0.022)	(0.004)	(0.003)	NA	(0.013)	(0.011)	(0.010)	(0.010)
2015	−0.007	−0.006	−0.004	−0.022*	−0.016	−0.019*	−0.029	−0.035	−0.023
	(0.011)	(0.022)	(0.003)	(0.013)	NA	(0.009)	(0.024)	(0.022)	(0.020)
2016	−0.036***	−0.043***	−0.037***	0.030***	−0.033	−0.030***	−0.043***	−0.046***	−0.038***
	(0.013)	(0.012)	(0.012)	(0.010)	NA	(0.009)	(0.012)	(0.012)	(0.011)
2017	−0.053***	−0.057***	−0.047***	−0.098***	−0.086	−0.090***	−0.051***	−0.045***	−0.044***
	(0.007)	(0.022)	(0.013)	(0.033)	NA	(0.033)	(0.014)	(0.012)	(0.011)
2018	−0.066***	−0.073***	−0.068***	−0.099***	−0.107	−0.106***	−0.070***	−0.066***	−0.070***
	(0.012)	(0.023)	(0.024)	(0.033)	NA	(0.033)	(0.018)	(0.022)	(0.021)
2019	−0.077***	−0.081***	−0.076***	−0.118***	−0.123	−0.127***	−0.098***	−0.079***	−0.089***
	(0.010)	(0.023)	(0.025)	(0.043)	NA	(0.043)	(0.033)	(0.028)	(0.032)
Number of observations	585	585	585	221	221	221	2106	2106	2106

Note: The estimates are obtained through a bootstrap procedure with 1000 replications, where we sample the full data set without replacement. At each replication we randomly assign at each observation the covariates $X_{i,t}$ described in Table 3 corresponding to another randomly sampled observation of our data set. The dependent and treatment variables keep instead the real observed values. In columns 1, 4 and 7 the ATT is estimated based on Callaway and Sant'Anna (2021) (CSA), in columns 2, 5 and 8 we use Hazlett and Xu (2018) (HAZ), in columns 3, 6 and 9 we apply the method proposed by Imai et al. (2021) (IMA). Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; NTA, Not Treated Again; NUTS, Nomenclature of Territorial Units for Statistics.

$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

could have been penalized in the access to SFs in the programming period 2014–2020 due to the EU enlargement, which has constituted an exogenous shock for this criterion substantially reducing the EU average GDP per capita.

The first group is represented by NTA regions that are NUTS-2 that did not obtain the status of most-disadvantaged regions both in the programming period 2007–2013 and 2014–2020, and whose GDP per capita was below the EU-15 average. Our empirical analysis provides clear evidence that NTA regions suffered from a not timely recognition of their economic fragility. Not receiving an amount of SFs in line with less developed regions has meant a strong economic penalization, since NTA regions resulted to grow less than their counterfactual in all the considered countries, with a lower economic growth between −10.5% and −5.7%. Moreover, at NUTS-3 level such regions were subject to a significantly lower GDP per capita index variation even if compared with NUTS-3 with a similar or higher development level. This provides evidence that a not timely recognition of the need of financial support according to the current criterion applied for the assignment of the most-disadvantaged regions status might lead to a low GDP per capita growth in these NTA regions, with a negative impact also on the catching-up process towards the most advanced regions. Using for the EU-15 regions an allocation criterion of SFs based on the EU-27 GDP per capita average might induce a lower growth of these EU-15 regions, affecting their convergence process.

Furthermore, we observe that the magnitude of the economic penalization tends to increase over time, suggesting that a longer exposition to a lower amount of financial support due to the EU enlargement may progressively increase the penalization in terms of economic development experienced by such regions. In addition, the estimated ATT coefficients tend to become significant after 2016, providing evidence that the $n+2$ rule, allowing regions to spend SFs until 2 years after the conclusion of the previous programming period, might have mitigated the lower GDP per capita index variation experienced by NTA regions. Such findings are consistent across analyses performed at different geographical scales and are confirmed by a large set of robustness checks performed both at NUTS-2 and NUTS-3 level.

More in general, these results confirm critiques made to the allocation criterion of SFs by different scholars (Bachtler & Downes, 2004; Dupuch et al., 2004; Popa, 2012), who observe that any change in the composition of the EU membership—for example, the 2004 EU enlargement—should be considered as an exogenous shock for the threshold represented by the 75% of the EU average GDP per capita.

The second group is represented by LT regions that are EU-15 NUTS-2 that in the period 2014–2020 have received the safety net as transition regions but that would have been eligible as less developed regions based on the pre-enlargement benchmark (the 75% of EU-15 average GDP per capita). For this group, empirical outcomes suggest a slightly lower growth with respect to their control group, but the difference is not statistically significant. Moreover, NUTS-3 located in Greece and Spain experienced a change in their GDP per capita index comparable, or even higher in case of Germany, with that of other more developed NUTS-3 in the same country. These results seem to suggest that the safety net has been an adequate financial cushion to support their growth path, providing an effective mechanism of exit from the less developed status.

Overall, these findings show limitations of the threshold corresponding to the 75% of EU average GDP per capita for selecting the regions with the highest need of financial support to achieve the convergence objective of the Cohesion Policy. Our evidence about NTA regions offers some food for thought to reform the SFs allocation criterion considering the stop or reverse in the convergence path that has affected some EU-15 countries since the start of the economic crisis in 2008 (Goedemé & Collado, 2016; Monfort, 2020).

In this sense, policymakers might need to consider to complement the current criterion for the allocation of SFs through the integration of heterogeneous data sources at the intersection between the economic, social, environmental and innovation dimensions to provide a more representative overview of the local level of development of EU regions. Specifically, for the Cohesion Policy allocation criterion, it might be considered the adoption of a precision policy approach (Arena et al., 2022; Azzone, 2018), exploiting the growing availability of more granular and frequently updated data on a relevant number of variables at NUTS-2 level and taking advantage of the technological advances for effectively managing large data sets.

The current main allocation criterion might be improved in two dimensions: first from a time perspective in terms of the update frequency of data exploited for the identification of less developed regions and second from a width perspective, in terms of comprehensiveness of variables taken into account to assess the level of development of NUTS-2.

On the time dimension, prompt data means the possibility to reduce the temporal window between the reference years for computing the regional GDP per capita and the start of the new programming period, currently between 5 and 7 years, allowing to better calibrate the allocation of SFs with the local level of development. Furthermore, it also allows one to enlarge the number of reference years, to better evaluate patterns of growth or recession.

On the width perspective, increasing the number and range of indicators enables a more detailed measurement of the characteristics of the EU regions that the Cohesion Policy targets, promoting a more efficient and effective usage of public resources, aligning SFs allocation with local fragility of NUTS-2 in specific sectors and thematic areas. In this direction, composite indexes may support a more complete identification of the need of financial support of EU regions, fostering a more precise and tailored criterion for the distribution of the EU budget.

Recent examples of synthetic indexes combining several dimensions are the European Regional Competitiveness Index,[23] aggregating more than 70 indicators to measure and compare the ability of EU regions to offer an attractive and sustainable environment for firms and residents to live and work, and the European Regional Innovation Scoreboard,[24] assessing the innovation performance of EU regions using 21 NUTS-2 level indicators. Moreover, the adoption of a precision policy approach, with a continuous updating of data and forecasts about the growth dynamics of the regions, allows one to better support member states during the final stage of the allocation process, that is, the political negotiations between the EU and every single member. Finally, considering that the programming periods have a long time horizon of 7 years (plus 2 years considering the "$n + 2$" rule), this approach could be adopted during the policy implementation to support the systematic monitoring, ensuring timely access to relevant data and statistics, to suggest, design and take corrective actions, if needed.

To summarize, *precision policy* may represent a suitable approach to overcome most of the critiques to the main allocation criterion, both from previous literature and emerging from our empirical evidence. Nonetheless, advanced recommendations for different approaches in the distribution of the EU budget should be based on formal comparative studies that may demonstrate the higher effectiveness of such alternative allocation strategies. The identification of an alternative criterion to distribute SFs is out of the scope of this paper. However, future research works connected with this study may propose and assess, through robust empirical analyses, the effectiveness of specific indicators based on a precision policy approach, that may be adopted by the EC to improve the allocation process of SFs.

Overall, our research features some limitations and has to deal with some econometric issues that influenced the perimeter of the analysis, although we perform a large set of robustness checks to show the validity of our results. First, to guarantee a high internal validity and the absence of confounding factors that might bias our results, we were forced to estimate country-specific models with a limited number of observations. We analyze separately 6 different countries and this might reduce the possibility to generalize our findings to other EU countries in Europe. Second, it was not possible to identify for all regions a control group composed of NUTS-2 with exactly the same pretreatment allocation characteristics. This forced us to exclude these regions from some analyses, preventing the possibility to perform a complete study in certain cases, as for Italy, where we can provide only limited evidence.

ACKNOWLEDGEMENTS

We are grateful to the European Regional Science Association (ERSA) 2021, the organization committee and related participants for the useful suggestions and comments to improve this research.

[23]Details are available at https://ec.europa.eu/regionalpolicy/en/information/maps/regionalcompetitiveness/.

[24]Details are available at https://research-and-innovation.ec.europa.eu/statistics/performanceindicators/regional-innovation-scoreboarden.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Scotti, F., Dell'Agostino, L., Flori, A., & Pammolli, F. (2024). Premature exit from and delayed entrance into the less developed status: An empirical appraisal of the structural funds allocation criterion. *Journal of Regional Science*, *64*, 5–59. https://doi.org/10.1111/jors.12665

APPENDIX A: NUTS-2 GDP PER CAPITA 2007–2009

In this section we provide evidence that regions not included, respectively, in the NTA and LT classes were either treated during the period 2014–2020 or experienced an average GDP per capita above the EU-15 threshold in the time frame 2007–2009.

More in detail, in Figures A1 and A2 we identify regions that were correctly not treated both in the programming periods 2007–2013 and 2014–2020 and that were characterized by an average GDP per capita in the years 2007–2009 above the EU-15 threshold. Coherently, in Figure A3, we identify those NUTS-2 that obtained the Convergence status in the programming period 2007–2013, but lost it correctly for the time frame 2014–2020, as their average GDP per capita overcame the EU-15 threshold in the period 2007–2009. Finally, in Figure A4, we show the distribution of GDP per capita of regions treated in the programming period 2014–2020. Interestingly, although the vast majority of these regions experienced an average GDP per capita in the years 2007–2009 below the EU-27 average, there are some NUTS-2 obtaining the status of less developed regions, even if their GDP per capita was above the EU-27 threshold. This set of regions is summarized in Table A1 and confirms that the criterion of the 75% of EU average GDP per capita is not deterministic for the identification of the most-disadvantaged regions, since some exceptions could occur as already previously noticed by Pellegrini et al. (2013), Crescenzi et al. (2016), Gagliardi and Percoco (2017) and Becker et al. (2018).

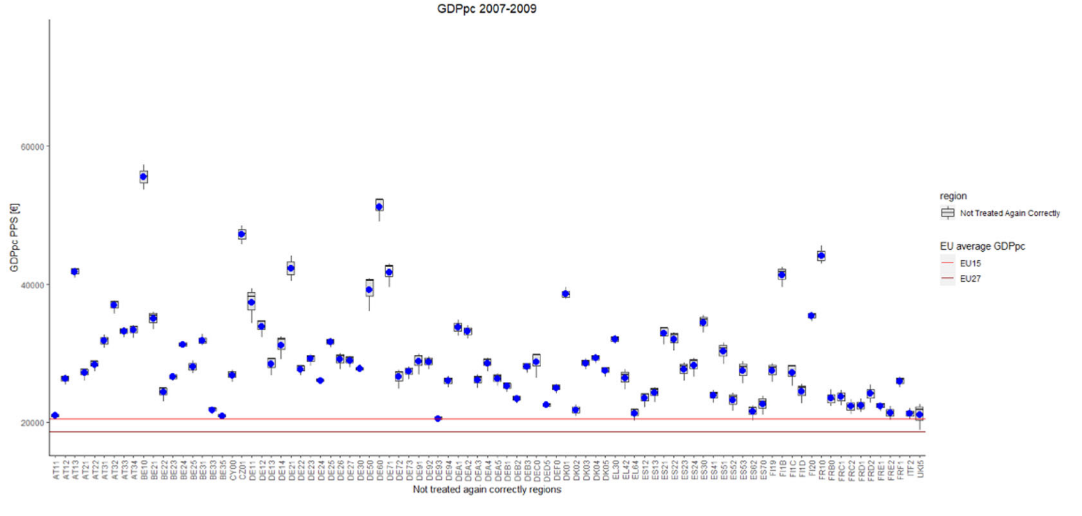

FIGURE A1 The distribution of GDP per capita of regions correctly NTA in the period 2007–2009. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009 (Part I). EU, European Union; GDP, gross domestic product; NTA, Not Treated Again; PPS, Purchasing Power Standard.

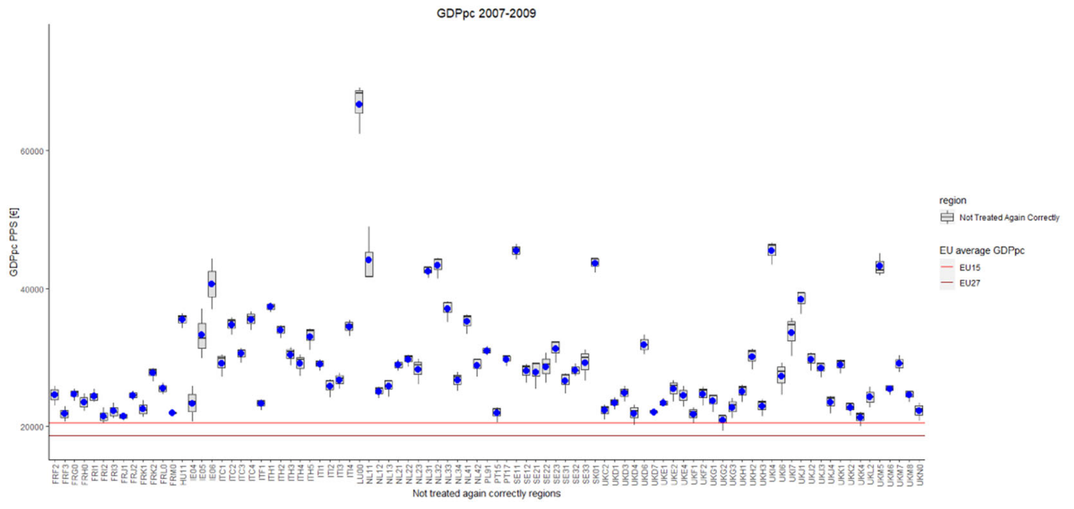

FIGURE A2 The distribution of GDP per capita of regions correctly NTA in the period 2007–2009. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009 (Part II). EU, European Union; GDP, gross domestic product; NTA, Not Treated Again; PPS, Purchasing Power Standard.

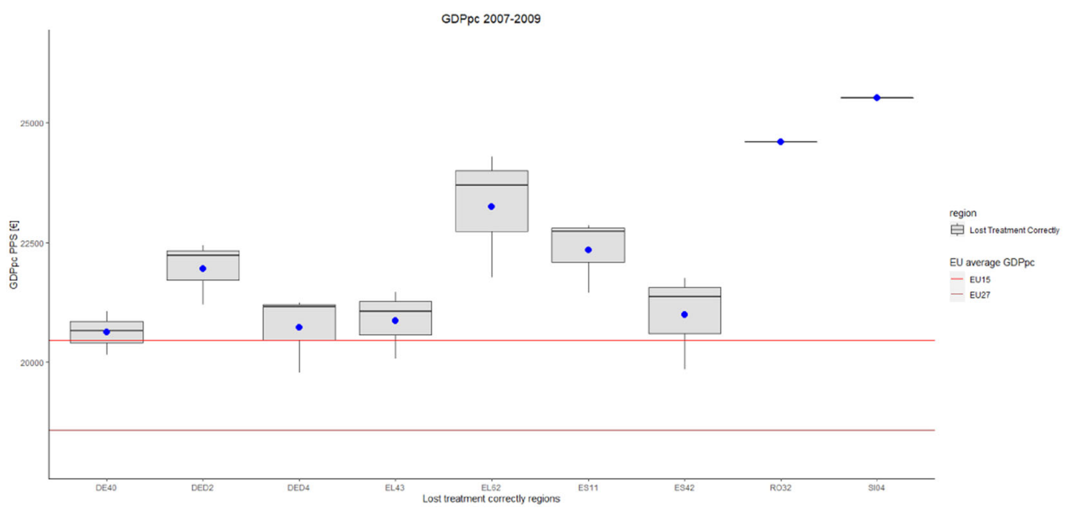

FIGURE A3 The distribution of GDP per capita of regions that correctly lost the treatment in the period 2014–2020. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009. EU, European Union; GDP, gross domestic product; PPS, Purchasing Power Standard.

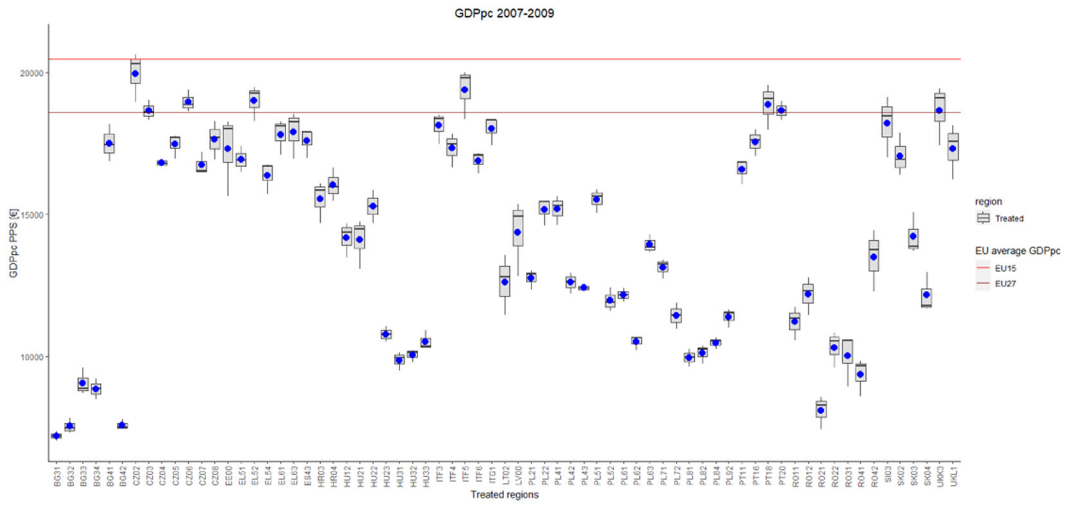

FIGURE A4 The distribution of GDP per capita of treated regions in the period 2007–2009. The blue point represents the average value of the considered time frame. The light red line represents the threshold corresponding to the 75% of EU-15 average GDP per capita, while the dark red line represents the threshold corresponding to the 75% of EU-27 average GDP per capita in the years 2007–2009. EU, European Union; GDP, gross domestic product; PPS, Purchasing Power Standard.

TABLE A1 The average GDPpc of treated regions above the threshold in the period 2007–2009.

NUTS-2 code	NUTS-2 name	Average GDPpc 2007–2009	Distance from EU-15	Distance from EU-27
CZ02	Strední Cechy	19,967	−502	1324
CZ03	Jihozápad	18,655	−1814	12
CZ06	Jihovýchod	18,958	−1511	315
EL52	Kentriki Makedonia	19,009	−1460	366
ITF5	Basilicata	19,396	−1073	753
PT18	Alentejo	18,869	−1600	226
PT20	Região Autónoma dos Açores	18,653	−1816	10
UKK3	Cornwall and Isles of Scilly	18,667	−1802	24

Note: EU-15 average GDP per capita is equal to 20,469 €, while EU-27 average GDP per capita is equal to 18,643 €. Data on GDP per capita are expressed at current prices in PPS.

Abbreviations: EU, European Union; GDP, gross domestic product; GDPpc, GDP per capita; NUTS, Nomenclature of Territorial Units for Statistics; PPS, Purchasing Power Standard.

APPENDIX B: THE ALLOCATION OF SFs

In this section we reconstruct the amount of SFs received by each NUTS-2 in the countries where we identify potentially penalized regions to verify whether these NUTS-2 were actually recipients of lower financial support intensity in the period 2014–2020. To compute the amount of transfers received, we rely on SFs allocation and payments data available at the programme level for each country.[25]

As funds are not always directly allocated to a single region, we adopt an approach similar to Fiaschi et al. (2018) to approximate the real amount of transfers received by each NUTS-2 over the time frame 2014–2020. More in detail:

- If the programme is directly allocated to a single region, we associate the full amount of SFs to the underlying region.
- If the programme is allocated to a group of regions, we assign the funds to single NUTS-2 in an amount inversely proportional to the GDP per capita of the involved set of regions in the first year of the programming period 2014–2020. In case the programme explicitly states whether it targets a specific class of regions (i.e., more developed, transition or less developed NUTS-2), we restrict the pool of recipient regions of the considered programme to the NUTS-2 belonging to the underlying class.

In the following, we show the results for NUTS-2 in Belgium, Germany, Greece, Italy, Spain and the UK, which constitute the pool of countries where we identified the presence of NTA and LT regions.

Belgium: Potentially penalized regions in the access to EU transfers are Provinces of Hainaut (BE32) and Luxembourg (BE34). They are regions in the class of NTA NUTS-2. The former received the highest overall amount of SFs in Belgium with 142 million € in the period 2014–2020. However, when we consider the value of financial support in relative terms (as a percentage of regional GDP, to avoid that the dimension of the NUTS-2 significantly affects the results), we observe that this region was subject to a lower fund intensity with respect to the transition province of Namur (BE35). Moreover, it received significantly lower SFs with respect to the previous programming period 2007–2013. Similarly, BE34 obtained less SFs than BE35 in relative terms and experienced a lower growth in the amount of SFs received with respect to the other transition regions BE33 and BE35.

Overall, both regions BE32 and BE34 did not receive significantly higher amount of transfers in the period 2014–2020 with respect to the other country regions, suggesting that actually also in terms of allocation of SFs the EC did not consider these regions among the most-disadvantaged areas.

Germany: We focus on Mecklenburg-Vorpommern (DE80) and Thüringen (DEG0) NUTS-2 that are LT regions. Both the two regions received a lower amount of SFs with respect to the programming period 2007–2013, coherently with the fact that they lost the status of most-disadvantaged regions. However, they both received an amount of financial transfers higher than two-thirds of the previous period in compliance with the safety net designed by the EC. Moreover, Mecklenburg-Vorpommern was the recipient of the second-highest amount of transfers in relative terms (1.6% with respect to the local GDP) after Sachsen-Anhalt (DEE0).[26] Similarly, Thüringen experienced a relative large amount of SFs, being also overcome only by Braunschweig (DE91) in terms of relative allocation of SFs.

[25]Differently from previous sections, in this case we cannot rely on the precise data about yearly SFs expenditures at NUTS-2 level, recently disclosed by the EC (Lo Piano et al., 2017). Indeed, such data set covers SFs expenditures over the period 1989–2018, thus excluding the amount of financial support spent by EU regions in the years 2019 and 2020 and not enabling a fair comparison of SFs expenditures over the two last programming periods (e.g., 2007–2013 vs. 2014–2020). For this reason, we rely on SFs allocation and payments data available at the programme level for each country covering the whole time frame 2014–2020 (we rather rely on data disclosed by the EC for the programming period 2007–2013, Lo Piano et al., 2017). The data we use for the period 2014–2020 are publicly disclosed by the EC platform and are available at the following link: https://cohesiondata.ec.europa.eu/countries. Consistently with Cerqua and Pellegrini (2018) and Cerqua and Pellegrini (2022) we consider only the budget by EU regions within the Cohesion Policy framework, thus focusing on SFs including financial support from the ERDF and ESF.

[26]The region Sachsen-Anhalt was characterized by the presence of two NUTS-3, namely, Dessau (DEE1) and Magdeburg (DEE3) which received the Convergence status in the programming period 2007–2013 and lost it for the years 2014–2020. As only two NUTS-3 out of seven, composing the Sachsen-Anhalt region lost the Treatment in the period 2014–2020, we did not consider this NUTS-2 as an LT. However, it is reasonable that it still received a large portion of SFs, as the NUTS-3 losing the treatment benefited from the safety net, guaranteeing at least two-thirds of transfers with respect to the time frame 2007–2013.

Greece: We observe the contemporary presence of an NTA (Dytiki Makedonia, EL53) and two LT regions (Voreio Aigaio, EL41, and Peloponnisos, EL65). Dytiki Makedonia was not classified in the category of most-disadvantaged regions both in the programming period 2007–2013 and 2014–2020. Coherently, the amount of funds allocated to this NUTS-2 was similar in the two periods, with a slight growth of 12% in the latter time frame. However, it received a relative amount of SFs still lower with respect to NUTS-2 classified as less developed regions (2.9% with respect to an average of 4.0%). On the other hand, LT regions received around two-thirds of the SFs obtained in the programming period 2007–2013, coherently with the safety-net financial cushion implemented by the EC.

Italy: The only potentially penalized region is Sardinia (ITG2) in the category of NTA regions. The region, that was not classified as a most-disadvantaged NUTS-2 both in the programming periods 2007–2013 and 2014–2020, experienced a growth in terms of SFs by 38%. However, it received a relative amount of SFs with respect to GDP equal to 0.5% which was significantly lower with respect to the amount allocated to less developed regions (on average 1.1%).

Spain: We focus on Andalucia (ES61) that lost the status of most-disadvantaged region in the programming period 2014–2020. Coherently with the safety net, it received 65% of SFs obtained in the previous programming period. However, it received a significantly lower amount of funds in relative terms with respect to Extradamura (ES43), the only region of Spain in the category of less developed NUTS-2 and also with respect to other transition regions.

The UK: We observe three regions in the class of NTA, namely, Tees Valley and Durham (UKC1) South Yorkshire (UKE3) and Lincolnshire (UKF3). Tees Valley and Durham and Lincolnshire experienced a growth of received SFs by 51% and 42% with respect to the time frame 2007–2013, while South Yorkshire obtained only 81% of transfers allocated in the previous programming period. However, all of them received significantly lower SFs (in relative terms) than less developed regions (Tables B1–B6).

TABLE B1 The allocation of SFs for the period 2014–2020 in Belgium NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
BE10	More Developed	4.4e + 07	0.0004	1.65
BE21	More Developed	5.9e + 07	0.0005	0.68
BE22	More Developed	8.7e + 07	0.0025	1.20
BE23	More Developed	6.4e + 07	0.0011	1.11
BE24	More Developed	6.6e + 07	0.0013	1.51
BE25	More Developed	5.6e + 07	0.0011	0.96
BE31	More Developed	1.4e + 08	0.0157	1.85
BE32	**Transition**	**1.4e + 08**	**0.0038**	**0.69**
BE33	Transition	4.5e + 07	0.0013	1.78
BE34	**Transition**	**1.6e + 07**	**0.0018**	**1.15**
BE35	Transition	7.2e + 07	0.0045	2.11

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).
Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

TABLE B2 The allocation of SFs for the period 2014–2020 in Germany NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
DE11	More Developed	9.8E + 07	0.0004	1.28
DE12	More Developed	7.9E + 07	0.0006	1.26
DE13	More Developed	6.9E + 07	0.0008	1.47
DE14	More Developed	6.0E + 07	0.0006	1.30
DE21	More Developed	8.5E + 07	0.0003	1.34
DE22	More Developed	7.6E + 07	0.0013	1.07
DE23	More Developed	1.2E + 08	0.0025	1.43
DE24	More Developed	1.3E + 08	0.0027	1.50
DE25	More Developed	7.6E + 07	0.0009	1.34
DE26	More Developed	8.5E + 07	0.0014	1.67
DE27	More Developed	5.2E + 07	0.0007	1.18
DE30	More Developed	5.6E + 08	0.0032	1.43
DE40	Transition	6.2E + 08	0.0081	0.60
DE50	More Developed	1.4E + 08	0.0044	0.98
DE60	More Developed	7.0E + 07	0.0005	0.90
DE71	More Developed	9.8E + 07	0.0005	0.78
DE72	More Developed	1.6E + 08	0.0037	1.80
DE73	More Developed	1.4E + 08	0.0031	1.12
DE80	**Transition**	**8.7E + 08**	**0.0164**	**0.85**
DE91	More Developed	4.9E + 08	0.0157	1.26
DE92	More Developed	6.6E + 07	0.0008	1.15
DE93	More Developed	2.6E + 08	0.0047	0.67
DE94	More Developed	6.4E + 07	0.0007	1.12
DEA1	More Developed	1.7E + 08	0.0007	0.78
DEA2	More Developed	1.9E + 08	0.0010	0.82
DEA3	More Developed	1.9E + 08	0.0021	1.43
DEA4	More Developed	1.8E + 08	0.0020	1.61
DEA5	More Developed	2.4E + 08	0.0019	1.02
DEB1	More Developed	7.4E + 07	0.0013	1.15
DEB2	More Developed	6.2E + 07	0.0037	1.84
DEB3	More Developed	6.7E + 07	0.0008	0.76
DEC0	More Developed	4.8E + 07	0.0012	0.65
DED2	Transition	5.8E + 08	0.0099	0.80

(Continues)

TABLE B2 (Continued)

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
DED4	More Developed	5.0E + 08	0.0108	0.76
DED5	More Developed	4.3E + 08	0.0106	0.97
DEE0	Transition	1.4E + 09	0.0224	1.03
DEF0	More Developed	3.0E + 08	0.0030	1.16
DEG0	**Transition**	**9.3E + 08**	**0.0132**	**0.77**

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).

Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

TABLE B3 The allocation of SFs for the period 2014–2020 in Greece NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
EL30	More Developed	8.7E + 08	0.0075	0.78
EL41	**Transition**	**1.1E + 08**	**0.0377**	**0.66**
EL42	More Developed	1.2E + 08	0.0149	0.85
EL43	Transition	2.7E + 08	0.0202	0.72
EL51	Less Developed	1.7E + 09	0.0222	1.25
EL52	Less Developed	5.0E + 08	0.0150	2.35
EL53	**Transition**	**1.3E + 08**	**0.0295**	**1.12**
EL54	Less Developed	3.0E + 08	0.0548	1.55
EL61	Less Developed	6.6E + 08	0.0523	1.03
EL62	Transition	1.6E + 08	0.0462	0.72
EL63	Less Developed	6.2E + 08	0.0554	1.04
EL64	Transition	2.7E + 08	0.0249	0.71
EL65	**Transition**	**3.1E + 08**	**0.0269**	**0.62**

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).

Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

TABLE B4 The allocation of SFs for the period 2014–2020 in Italy NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
ITC1	More Developed	2.0E + 08	0.0014	0.75
ITC2	More Developed	2.1E + 07	0.0041	1.38
ITC3	More Developed	1.1E + 08	0.0021	1.19
ITC4	More Developed	2.6E + 08	0.0006	1.14
ITF1	Transition	6.1E + 07	0.0017	1.16
ITF2	Transition	4.6E + 07	0.0065	1.38
ITF3	Less Developed	5.9E + 08	0.0050	0.62
ITF4	Less Developed	1.0E + 09	0.0120	0.84
ITF5	Less Developed	2.6E + 08	0.0188	1.37
ITF6	Less Developed	4.7E + 08	0.0127	0.81
ITG1	Less Developed	7.2E + 08	0.0072	0.63
ITG2	**Transition**	**2.2E + 08**	**0.0057**	**1.38**
ITH1	More Developed	4.0E + 07	0.0015	1.34
ITH2	More Developed	4.6E + 07	0.0019	1.22
ITH3	More Developed	1.4E + 08	0.0008	0.91
ITH4	More Developed	7.7E + 07	0.0018	1.18
ITH5	More Developed	1.9E + 08	0.0011	0.93
ITI1	More Developed	1.8E + 08	0.0015	0.90
ITI2	More Developed	8.9E + 07	0.0036	1.26
ITI3	More Developed	9.8E + 07	0.0021	1.35
ITI4	More Developed	2.2E + 08	0.0010	0.91

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).

Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

TABLE B5 The allocation of SFs for the period 2014–2020 in Spain NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
ES11	More Developed	6.8E + 08	0.0093	0.67
ES12	More Developed	4.0E + 08	0.0148	0.91
ES13	More Developed	1.6E + 08	0.0105	1.98
ES21	More Developed	2.6E + 08	0.0031	1.42
ES22	More Developed	1.2E + 08	0.0050	1.95
ES23	More Developed	1.3E + 08	0.0125	1.91
ES24	More Developed	1.9E + 08	0.0042	1.21
ES30	More Developed	3.8E + 08	0.0015	1.17
ES41	More Developed	8.3E + 08	0.0121	1.12
ES42	Transition	9.5E + 08	0.0208	0.92
ES43	Less Developed	1.2E + 09	0.0500	1.23
ES51	More Developed	4.5E + 08	0.0017	1.19
ES52	More Developed	1.1E + 09	0.0092	1.38
ES53	More Developed	1.6E + 08	0.0045	1.94
ES61	**Transition**	**2.0E + 09**	**0.0107**	**0.65**
ES62	Transition	4.8E + 08	0.0128	1.13
ES70	Transition	1.0E + 09	0.0227	1.95

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).
Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

TABLE B6 The allocation of SFs for the period 2014–2020 in the UK NUTS-2.

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
UKC1	**Transition**	**1.6E + 08**	**0.0069**	**1.51**
UKC2	More Developed	1.2E + 08	0.0037	0.83
UKD1	Transition	6.9E + 07	0.0026	2.04
UKD3	More Developed	9.0E + 07	0.0026	1.07
UKD4	Transition	1.0E + 08	0.0031	1.64
UKD6	More Developed	5.3E + 07	0.0010	1.38
UKD7	More Developed	1.8E + 08	0.0061	0.65
UKE1	Transition	8.6E + 07	0.0037	1.50
UKE2	More Developed	3.8E + 07	0.0011	1.06
UKE3	**Transition**	**1.2E + 08**	**0.0046**	**0.81**
UKE4	More Developed	8.9E + 07	0.0028	1.35

TABLE B6 (Continued)

NUTS-2 code	Class	SCFs 2014–2020	SCFs (% of GDP)	SCFs (2014–2020/ 2007–2013)
UKF1	More Developed	7.6E + 07	0.0026	0.82
UKF2	More Developed	7.8E + 07	0.0021	1.21
UKF3	**Transition**	**7.2E + 07**	**0.0031**	**1.42**
UKG1	More Developed	4.9E + 07	0.0014	0.95
UKG2	Transition	8.5E + 07	0.0031	1.55
UKG3	More Developed	1.0E + 08	0.0028	0.71
UKH1	More Developed	2.8E + 07	0.0008	0.74
UKH2	More Developed	4.3E + 07	0.0010	1.31
UKH3	More Developed	5.3E + 07	0.0017	1.52
UKJ1	More Developed	2.7E + 07	0.0005	0.69
UKJ2	More Developed	3.0E + 07	0.0008	0.77
UKJ3	More Developed	3.7E + 07	0.0010	1.25
UKJ4	More Developed	5.3E + 07	0.0016	1.43
UKK1	More Developed	4.5E + 07	0.0012	0.98
UKK2	More Developed	3.4E + 07	0.0011	1.51
UKK3	Less Developed	3.0E + 08	0.0114	0.95
UKK4	Transition	4.3E + 07	0.0016	1.27
UKL1	Less Developed	1.1E + 09	0.0462	1.31
UKL2	More Developed	1.2E + 08	0.0032	1.43
UKM5	More Developed	9.5E + 07	0.0024	0.92
UKN0	Transition	1.0E + 08	0.0032	0.62

Note: Bold values refer to NUTS-2 regions potentially penalized in the allocation of SCFs (either NTA or LT regions).
Abbreviations: GDP, gross domestic product; NUTS, Nomenclature of Territorial Units for Statistics; SCFs, Survey of Consumer Finances; SF, Structural Fund.

APPENDIX C: ROBUSTNESS CHECK: THE ECONOMIC GROWTH OF NTA AND LT NUTS-2

In this section we show a set of additional details related to the SDID and SCM estimated in Section 4.1. In particular, Table C1 displays the value of units weights $\hat{w}^{sdid}$ associated to each NUTS-2 in the control group based on the SDID introduced by Arkhangelsky et al. (2021) according to Equation (2). Table C2 highlights time weights $\hat{\lambda}^{sdid}$ during the pretreatment period for the set of analyzed countries based on Equation (4).

Tables C3 and C4 exhibit units weights assigned to NUTS-2 in the donor pool for all NTA and LT regions based on the SCM introduced by Cattaneo et al. (2021).

TABLE C1 The following table exhibits units weights $\hat{w}^{sdid}$ based on the SDID introduced by Arkhangelsky et al. (2021).

Belgium		Greece NTA		The UK		Germany		Greece LT		Spain	
BE21	0.274	EL52	0.523	UKE2	0.137	DED2	0.887	EL42	0.274	ES11	0.443
BE22	0.023	EL64	0.477	UKE4	0.046	DED4	0.113	EL51	0.318	ES42	0.463
BE23	0.102			UKF2	0.101			EL54	0.066	ES43	0.094
BE24	0.031			UKG1	0.187			EL61	0.091		
BE25	0.044			UKG3	0.045			EL63	0.251		
BE31	0.506			UKH2	0.148						
BE35	0.020			UKJ4	0.146						
				UKK2	0.036						
				UKK3	0.019						
				UKK4	0.028						
				UKL1	0.025						
				UKL2	0.054						
				UKM5	0.028						

Abbreviations: LT, Lost Treatment; NTA, Not Treated Again; SDID, Synthetic Difference-in-Differences.

TABLE C2 The following table exhibits year weights $\hat{\lambda}^{sdid}$ during the pretreatment period based on the SDID introduced by Arkhangelsky et al. (2021).

	Belgium	Greece NTA	The UK	Germany	Greece LT	Spain
2000	0.000	0.000	0.000	0.224	0.000	0.000
2001	0.000	0.100	0.000	0.000	0.000	0.000
2002	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.000	0.000	0.000	0.000	0.591	0.000
2004	0.000	0.000	0.000	0.776	0.000	0.000
2005	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.000	0.000	0.212	0.000
2007	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.241	0.000	0.000	0.000
2010	0.280	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.300	0.000	0.000	0.002	0.000
2013	0.720	0.600	0.759	0.000	0.195	1.000

Abbreviations: LT, Lost Treatment; NTA, Not Treated Again; SDID, Synthetic Difference-in-Differences.

TABLE C3 The following table exhibits units weights for the control units in the donor pool based on the SCM introduced by Cattaneo et al. (2021) for *NTA* regions.

BE32		BE34		EL53		UKC1		UKE3		UKF3	
BE21	0.781	BE21	0.678	EL52	0.065	UKE2	0.401	UKE2	0.162	UKE2	0.281
BE23	0.200	BE23	0.322	EL64	0.935	UKE4	0.015	UKE4	0.015	UKE4	0.206
BE31	0.019					UKF2	0.036	UKF2	0.019	UKG1	0.015
						UKG1	0.248	UKG1	0.034	UKH2	0.264
						UKG2	0.069	UKG3	0.506	UKJ4	0.201
						UKG3	0.224	UKH2	0.058	UKM5	0.033
						UKH2	0.007	UKI3	0.192		
								UKJ4	0.014		

Abbreviations: NTA, Not Treated Again; SCM, Synthetic Control Method.

TABLE C4 The following table exhibits units weights for the control units in the donor pool based on the SCM introduced by Cattaneo et al. (2021) for *LT* regions.

DE80		DEG0		EL41		EL65		ES61	
DED2	0.043	DED2	0.521	EL54	0.519	EL51	0.642	ES42	0.215
DED4	0.957	DED4	0.479	EL63	0.481	EL63	0.358	ES43	0.785

Abbreviations: LT, Lost Treatment; NTA, Not Treated Again.

APPENDIX D: ROBUSTNESS CHECK: IN-TIME PLACEBO

In this section we show the results for two in-time placebo tests to verify whether the different economic development pattern experienced by the NTA regions and the control group is actually induced by the absence of treatment in the programming period 2014–2020, or if instead a lower economic growth was experienced by these NUTS-2 even in the previous years.

The fake treatment years are, respectively, 2006 and 2009. Figures D1 and D2 show that the economic divergence in NTA regions with respect to the control group starts after 2013. They refer to the results shown in Tables 6 and 7.

Such results suggest that the economic penalization is not either due to the programming period 2007–2013 or to the financial crisis that started in 2008. They confirm that the development gap is experienced during the programming period 2014–2020, coherently with the lower amount of SFs allocated to NTA regions due to the EU enlargement.

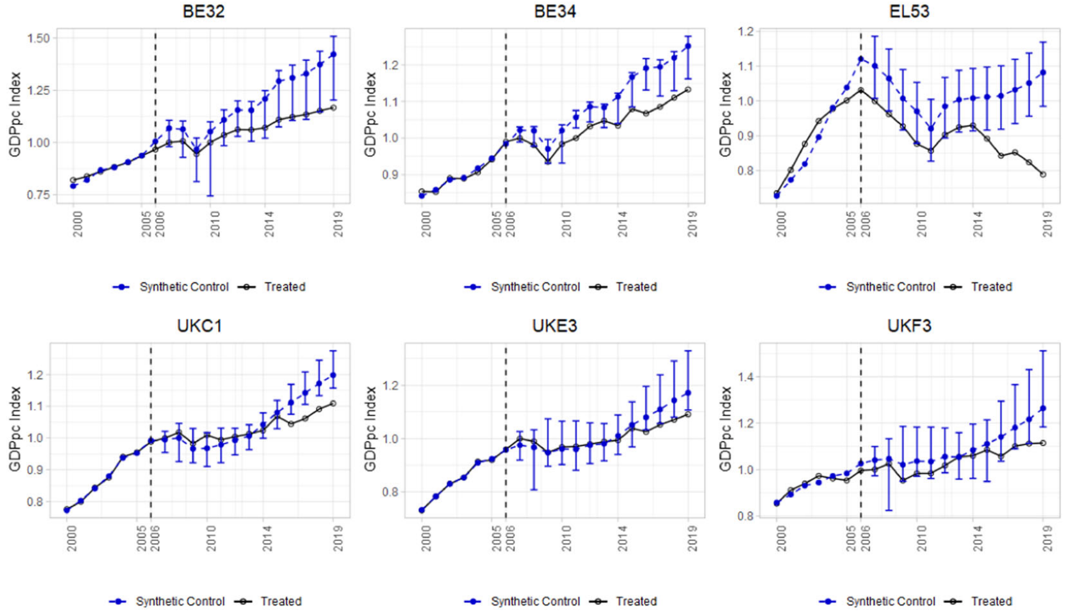

FIGURE D1 We show the SCM proposed by Chernozhukov et al. (2021) for NTA regions. Fake treatment year is 2006. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; SCM, Synthetic Control Method.

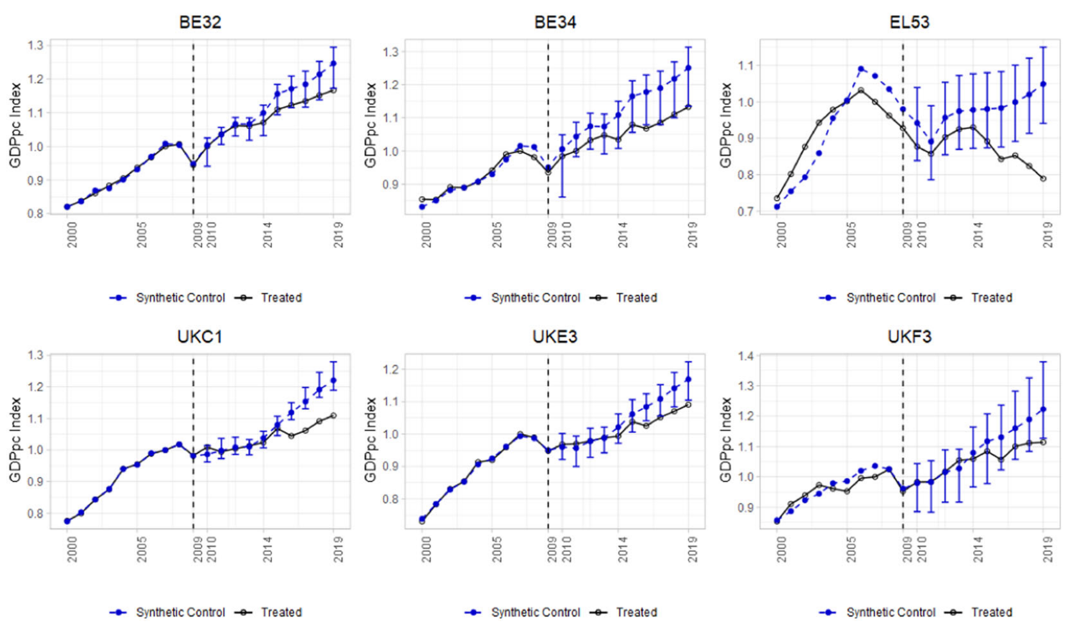

FIGURE D2 We show the SCM proposed by Chernozhukov et al. (2021) for NTA regions. Fake treatment year is 2009. Prediction intervals are estimated with a confidence level equal to 0.95 ($\alpha = 0.05$). GDP, gross domestic product; GDPpc, GDP per capita; NTA, Not Treated Again; SCM, Synthetic Control Method.

APPENDIX E: ROBUSTNESS CHECK: THE ECONOMIC GROWTH NTA AND LT NUTS-3

In this section we show additional details related to results presented in Section 4.4. More specifically, Table E1 exhibits the aggregate ATT for NTA and LT NUTS-3 based on the panel event study proposed by Callaway and Sant'Anna (2021). Results are computed based on Equation (7) and refer to models presented in Tables 8 and 9, where we show the ATT in each year since the start of the treatment (2014–2019).

Furthermore, Table E2 and Figure E1 provide information on balance in pretreatment covariates between the treatment and control groups before and after reweighting. In particular, we show the standardized difference of the mean covariates balance based on the generalized DiD method introduced by Hazlett and Xu (2018). Notice how after the reweighting the difference in the mean across covariates tends to decrease for all analyzed countries.

TABLE E1 We report the Aggregate ATT estimated based on the panel event study introduced by Callaway and Sant'Anna (2021) based on Equation (7).

	Belgium	Greece *NTA*	The UK	Germany	Greece *LT*	Spain
ATT aggregate	−0.040***	−0.046***	−0.052***	−0.006	−0.009	−0.009
Standard error	(0.013)	(0.014)	(0.015)	(0.016)	(0.016)	(0.010)
Number of observations	585	221	2106	533	312	247

Note: Standard errors are reported in parentheses.

Abbreviations: ATT, average treatment effect on treated; LT, Lost Treatment; NTA, Not Treated Again.

$^{*}p < 0.10$; $^{**}\ p < 0.05$; $^{***}\ p < 0.01$.

TABLE E2 We report the standardized difference of the mean covariate balance based on the generalized DiD method introduced by Hazlett and Xu (2018).

Variable	Group	Belgium	Greece *NTA*	The UK	Germany	Greece *LT*	Spain
Empl A	Unweighted	0.433	0.299	−0.543	0.527	−0.779	0.275
Empl B–E	Unweighted	−0.595	0.523	0.468	−0.621	−0.344	−0.571
Empl F	Unweighted	0.382	0.193	0.394	−0.577	0.581	−0.615
Empl G–J	Unweighted	−0.647	−0.332	−0.776	0.293	0.685	−0.583
Empl K–N	Unweighted	−0.601	−0.516	−0.636	−0.574	0.425	0.609
Population	Unweighted	−0.698	−0.664	0.388	−0.560	−0.657	0.675
GDPpc lagged	Unweighted	−0.587	−0.778	−0.651	−0.589	0.356	−0.635
Empl A	Weighted	0.293	0.091	−0.404	0.330	−0.594	0.042
Empl B–E	Weighted	−0.427	0.322	0.233	−0.494	−0.101	−0.440
Empl F	Weighted	0.201	0.017	0.217	−0.382	0.401	−0.392
Empl G–J	Weighted	−0.483	−0.071	−0.586	0.141	0.425	−0.452
Empl K–N	Weighted	−0.333	−0.343	−0.489	−0.320	0.240	0.392
Population	Weighted	−0.470	−0.494	0.256	−0.310	−0.538	0.462
GDPpc lagged	Weighted	−0.381	−0.595	−0.522	−0.437	0.154	−0.504

Abbreviations: DID, Difference-in-Differences; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NTA, Not Treated Again.

Similarly, Figure E2 displays the mean difference of covariates between treated units and matched observations in the donor pool for each pretreatment year based on Imai et al. (2021). The mean difference is further standardized by the standard deviation of each covariate across all treated observations in the data set.

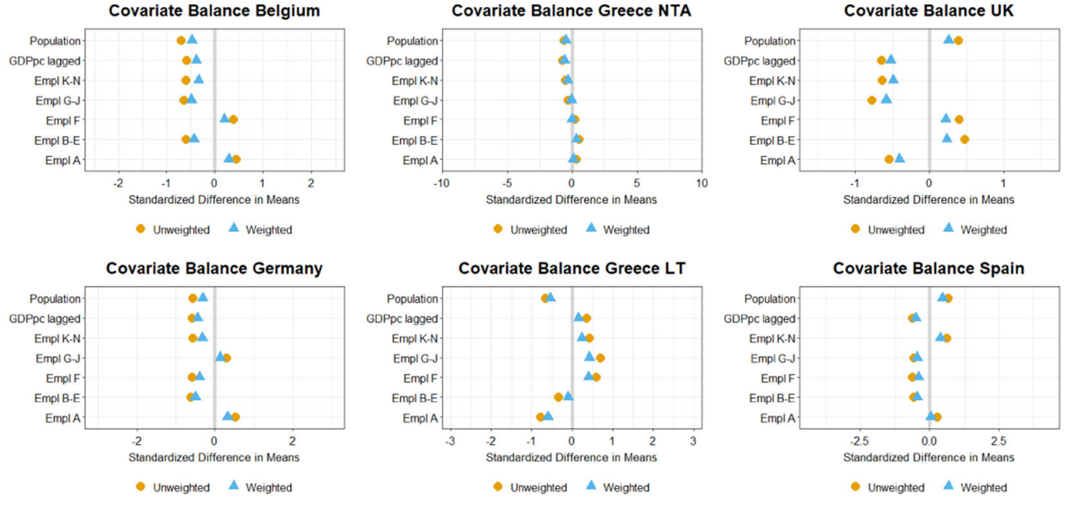

FIGURE E1 We show balance in pretreatment covariates between the treatment and control groups before and after reweighting. The standardized difference of the mean covariate balance is computed based on the generalized DiD method introduced by Hazlett and Xu (2018). DID, Difference-in-Differences; GDP, gross domestic product; GDPpc, GDP per capita; LT, Lost Treatment; NTA, Not Treated Again.

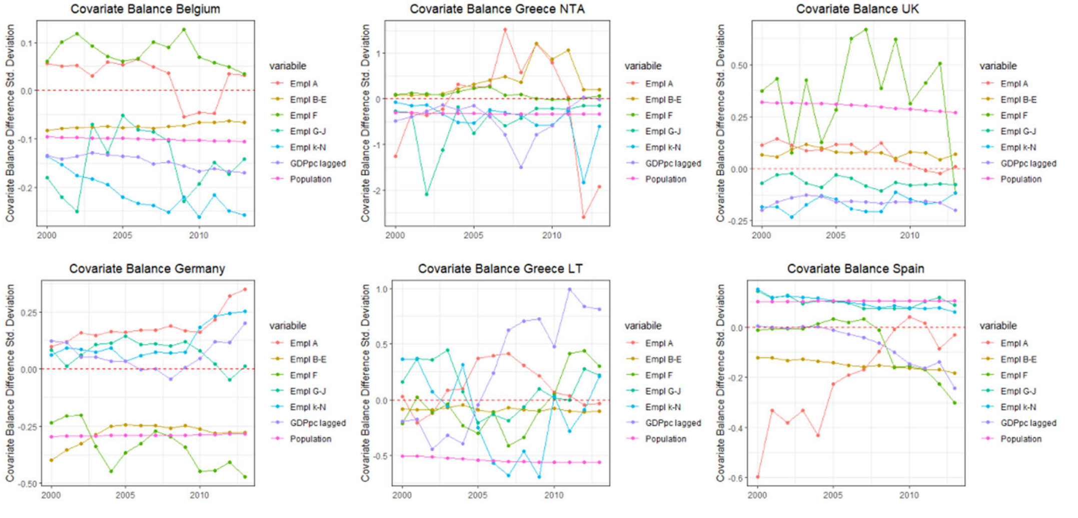

FIGURE E2 We show the mean difference of covariates between treated units and matched observations in the donor pool for each pretreatment year based on the method proposed by Imai et al. (2021). The mean difference is measured in terms of standard deviation units. LT, Lost Treatment; NTA, Not Treated Again.

APPENDIX F: ROBUSTNESS CHECK: THE MAGNITUDE OF THE ECONOMIC PENALIZATION

In this section we provide additional information related to the similarity of the size of ATT coefficients estimated, respectively, in Sections 4.4 and 4.6. To do this, we use a t test with $n - 2$ degrees of freedom (where n is the sample size) computed according to the following formula (Clogg et al., 1995):

$$t = \frac{\varphi_1 - \varphi_2}{\sqrt{Variance\,(\varphi_1)} + \sqrt{Variance\,(\varphi_2)}}, \tag{11}$$

where φ_1 and φ_2 are the estimated coefficients and $Variance(\varphi_1)$ and $Variance(\varphi_2)$ are the associated variances.

In particular, Table F1 reports the p value of t tests comparing ATT coefficients reported in Tables 8 and 12. Notice how t tests never reject the null hypothesis that the magnitudes of estimated ATT coefficients are equal. This result confirms the size of the estimated economic penalization for NTA regions obtained in Section 4.4, suggesting that the magnitude in the economic gap is not driven by pre-existing local socioeconomic differences.

TABLE F1 We show the p value of t tests comparing ATT coefficients reported in Tables 8 and 12.

	Belgium			Greece			The UK		
	CSA	HAZ	IMA	CSA	HAZ	IMA	CSA	HAZ	IMA
2014	0.814	0.666	0.890	0.603	NA	0.007	0.423	0.614	0.588
2015	0.735	0.564	0.978	0.306	NA	0.314	0.512	0.523	0.539
2016	0.403	0.089	0.350	0.999	NA	0.604	0.519	0.423	0.634
2017	0.294	0.161	0.466	0.062	NA	0.127	0.481	0.440	0.615
2018	0.363	0.155	0.391	0.262	NA	0.282	0.626	0.396	0.602
2019	0.426	0.249	0.482	0.419	NA	0.425	0.510	0.384	0.614

Abbreviations: ATT, average treatment effect on treated; CSA, Callaway and Sant'Anna (2021); HAZ, Hazlett and Xu (2018); IMA, Imai et al. (2021).