

Exploring the recent upsurge in productivity disparities between the European regions*

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Abstract:

This paper analyses the evolution of productivity disparities across 156 European regions in the period 2000-2015. Using regional data, a battery of inequality indexes enables us to assess the extent of regional disparities. After confirming that labour productivity is the main component of income disparities, a dynamic shift-share analysis is carried out at a 10-industry level of disaggregation. The study evaluates the relative role of the three components underlying the disparities in regional productivity: changes in the industry mix, and within- and between-industry productivity gaps. The main results can be summarized as follows. Firstly, regional disparities are on the rise again in the EU. Secondly, most regions are now closer to the average, while a small group of the richest regions are moving further away. Thirdly, the main drivers of productivity disparities are within-industry differences in labour productivity with regard to the richest regions and, less importantly, the specialization of the richest regions in more progressive industries. Finally, the net effect of structural change is still making a positive contribution to convergence with the leading regions.

Keywords: Productivity disparities, unbalanced economic growth, spatial imbalance.

JEL classification: R10; R11; R12.

1. Introduction

The convergence of per-capita income across regions is one of the most prominent issues on the European Union (EU) agenda. Recent studies based on historical regional data corroborate that over the course of almost half a century, from 1950 to 1990, per-capita income across Western European regions converged. However, over the last three decades this evolution has weakened and even reversed. In particular since the Great Recession, divergence has increased (Fratesi and Rodríguez-Pose, 2016). Thus the inverted-U pattern postulated by Williamson to describe the long-term relationship between per-capita income and regional disparities has turned into an N-curve in some European economies and the United States (Ganong and Shoag, 2017). Simultaneously, a widening gap is observed between a group of very dynamic regions and others that are stuck in a low-development trap (Iammarino et al., 2019).

The process of market integration in the EU has promoted convergence for some decades throughout the improvement of infrastructures and basic conditions in less developed regions and the configuration of EU value chains across European regions. But since mid 1990's, and particularly since the economic crisis in 2008, the new economic scenario has unleashed new diverging forces. The combination of accelerating globalization and the wave of technological change mainly led by new information and communication technologies (ICT) has had an uneven effect on European regions. While these forces have strengthened the competitive advantages of some large city-regions and reinforced the role of agglomeration in propelling economic growth, they have also eroded the comparative advantages of low- and middle-income regions and their potential to create employment and economic activity. In these unlucky regions automation and integration into global value chains involving the offshoring of some manufacturing tasks have reduced employment in many manufacturing sectors.

In this paper we intend to clarify the extent to which this recent upsurge in regional disparities in income per capita has arisen as a result of increasing disparities in labour productivity across European regions. As Esteban (1994) showed, regional labour productivity differences rather than variability in employment and participation rates across regions are the main drivers of per-capita income disparities. Insofar this situation still persists in Europe, such as the evidence gathered up in our research reveals, exploring the relative role of the factors underlying productivity disparities becomes a central

candidate to help us understand why income per capita is diverging again. Following Esteban (2000) we perform a shift-share analysis to break down regional productivity disparities into three components: industry mix, sector-by-sector productivity gaps between the regions and one reference region, and an allocative component. According to this decomposition, the increase in aggregate productivity disparities across regions could be attributable to relative changes in the industry composition of any region with regard to the reference region, to increasing differences in labour productivity in specific industries across regions, and to the degree of specialization of a region compared to the reference region.

Generally speaking, the debate about regional productivity convergence in EU regions in the post-1980s period found wide consensus in considering that the structural change process was exhausted (Cuadrado-Roura et al., 1999; Le Gallo and Dall’Erba, 2008). In this respect, changes in the composition of the industry mix were found to have a negligible impact on aggregate regional productivity and convergence between EU regions, while improvements in productivity within industries appeared to be the main drivers of regional productivity (Esteban, 2000; Ezcurra et al., 2005; Villaverde and Maza, 2008; Le Gallo and Kamarianakis, 2011). However, the nature of the recent upsurge in regional income disparities, and thus in labour productivity, has again called into question the potential role of structural change and within-industry productivity growth in explaining current regional disparities.

In this regard there are at least two interesting contributions to consider. One of these is the theoretical model devised by Barrios and Strobl (2009), which suggests that there is no reason to expect that changes in regional productivity differentials will stop when all countries (or regions) become industrialized. According to the authors, other types of technology shock similar to those that occurred at the start of the industrialization processes could lead not only to bigger within-industry differences between regions but also to the start of a new phase of structural change, and thus to a new wave of regional disparities. For instance, rich regions may grow faster and diverge from other regions through labour reallocation from low-productivity sectors, such as textiles, to high-productivity sectors, such as ICT industries or advanced services. The other contribution is the empirical study by O’Leary and Weber (2015), which measured the effects of structural change on the productivity growth and convergence/divergence performance of 181 EU regions between 1980 and 2007. Despite confirming the superiority of the

within-industry productivity effect, the authors' main contribution was finding that the small structural-change effect is especially important for those regions located at the two poles of the distribution. Bearing these results in mind, it is important to find out the extent to which today's regional divergence in Europe is related to the start of a new wave of structural change in the richest regions or to the increasing technology gap in specific industries. Exploring the structural change effect also makes it possible to evaluate whether the reallocation of resources from low- to high-productivity sectors is more intense in low-income regions, thus promoting European convergence, or in high-income regions, thus strengthening regional disparities. This analysis will shed new light on the tricky question of the validity of regional policies aimed at easing structural change in order to promote balanced development in the long term.

The present study describes the evolution of regional productivity disparities at NUTS-2 level in 13 European countries (Austria, Belgium, Germany, Denmark, Greece, Spain, Finland, France, Italy, the Netherlands, Portugal, Sweden and the United Kingdom) for 2000-2015. Our aim is to look at what lies beneath the disparities in labour productivity across European regions. In order to do this, we have broken down the increase in labour productivity into those forces attributable to industry-mix change and those attributable to technological change within specific industries. To this end we provide a shift-share exercise that differs in two aspects from the traditional shift-share studies based on the Esteban (2000) approach (Ezcurra et al., 2005; Villaverde and Maza, 2008; Le Gallo and Kamarianakis, 2011; O'Leary and Weber, 2015). One of these differences involves the selection of the benchmark region, and the other to the dynamic nature of the exercise.

To our knowledge, this is the first shift-share analysis carried out at EU level that takes the leading regions as a reference rather than an artificial EU average region, which is what previous shift-share studies have usually done.¹ Our choice is not arbitrary. It aims to be consistent with the pattern of regional disparities revealed by several inequality indicators. The other difference is to be implemented dynamically. Following Caselli and

¹ The first person to introduce the shift-share approach to the study of regional productivity growth was Esteban (2000), who modelled regional productivity growth as the sum of three components: structural change, differential industry productivity and the allocative effect. This form of shift-share has also been used by Le Gallo et al. (2003), Le Gallo and Dall'Erba et al. (2008), Batóg and Batóg (2007) and, with a slight variation, by Ezcurra et al. (2005) and Le Gallo and Kamarianakis (2011), who also introduced spatial econometrics.

Teneyro (2004), this approach consists of measuring the increase/decrease in the productivity gap between 155 EU regions and one leading region between two points in time rather than focusing exclusively on the absolute productivity gap in a particular year. Hence the dynamic shift-share approach enables us to identify the ways in which the top 5 richest regions in 2015 increased the gap between themselves and the others. The study is performed by using a 10-sector level of disaggregation in order to carry out a more thorough examination of the potential structural change arising from the development of new manufacturing industries and services.

Our results provide four main conclusions. First, they show that during the short period 2000-2015 regional income and productivity disparities are seen to be increasing again. This result is robust to the use of different inequality indicators and is especially noticeable in those indicators that particular reference the richest regions. Second, these disparities have been driven mainly by the rapid progress of some of the richest regions, while low- and middle-income regions are now bunched closer to the EU average and an increasing number of low-income regions are trapped at the bottom of the distribution. Third, the shift-share analysis shows that the increasing distance in within-industry productivity is the main driver of regional disparities and is mainly located in manufacturing and advanced services. In this regard, while Esteban (2000) and Ezcurra et al. (2005) show that the within-industry effect is the main determinant of static productivity differences between regions, our study confirms that this effect is also widening the gap between the leading regions and the others. And fourth, the structural change effect, despite being smaller, had a net positive effect by shortening distances from the leading regions. Arguably our findings point to some policy implications. On the one hand, they validate the appropriateness of EU cohesion policies aimed at helping lagging regions to catch up by using investment in human capital and social capabilities for innovation as tools, while on the other hand they seem to support the relevance of invigorating the structural change component in less developed regions by promoting mobility across industries to shape a more competitive industry mix.

The remainder of the paper is organized as follows. Section 2 briefly reviews the literature on the relationship between economic development, spatial disparities and the role of structural change in the process. Section 3 presents the data gathered to run the research and some descriptive statistics on the evolution of per-capita income and labour productivity disparities in 156 European regions from 2000 to 2015 (NUTS-2 regions of

the EU-13). In Section 4 we carry out a shift-share analysis to clarify the roles played by the technology gap within industries, structural change, and regional specialization in the increase of regional disparities. The concluding section remarks our main findings and launches some economic policy recommendations.

2. The link between spatial inequality and the industry mix

The literature on the evolution and determinants of regional disparities is based on the seminal work by Williamson (1965), which postulated an inverted U-shaped relationship between economic development and inequality in regional income per capita.² In the early stages of industrialization the distribution of economic activity across regions becomes more unequal. Manufacturing and high-value activities become concentrated in a handful of more advanced regions, while all the other regions continue to rely on agriculture or more traditional manufacturing. Productivity in the modern industries increases more rapidly, fuelled by technological change and economies of scale, and thus income per capita grows faster in the industrialized regions than in the traditional ones, bringing about regional divergence. Afterwards, in more advanced stages of development, the reallocation of factors (capital and labour) between industries and across regions in search of higher remunerations, along with the spread of technology across regions and the compensating effect of economic policy, will tend to mitigate regional disparities and encourage regional convergence.

The preliminary evidence presented by Williamson (1965) in support of this hypothesis lacked robustness due to the short time span considered. Later on, Kim's (1995, 1998) use of regional historical data for the United States proved the existence of the inverted U-curve over the long term. In Europe, especially since the publication by Geary and Stark (2002) of a new method to territorialize national GDP across regions, the number of countries with historical regional data has soared.³ The evidence provided for many countries reveals that, at least since the mid-nineteenth century, the Williamson curve is true in some countries such as Great Britain (Crafts, 2005; Geary and Stark,

² This idea is based on the famous *Kuznets curve* (Kuznets, 1955), which postulates the same relationship between a country per-capita income and personal inequality.

³ In Europe, the earliest historical studies were based on cross-sectional or panel data using official databases starting in 1975 or 1980. Their main drawback was to offer a time span that was too short to detect the potential "structural change effects" that could explain the inverted U-shaped pattern. Most of the European regions included in these samples underwent the "structural change process" in the Golden Age or even earlier.

2016), Spain (Martínez-Galarraga et al., 2010 and 2015) and Portugal (Badia-Miró et al., 2012), while other countries such as Belgium (Buyst, 2010 and 2011), Sweden (Enflo and Rosés, 2015) and France (Combes et al., 2011; Rosés and Sanchis, 2019) show a persistent decline in regional disparities from the final decades of the nineteenth century. The historical evidence is less conclusive for Italy because of the traditional north-south divide (Felice, 2011).

As far as an explanation of this long-term pattern of regional disparities is concerned, the structural change hypothesis prevails. The increase in regional disparities was initially driven by industrialization and market integration, which concentrated modern industries in a few regions. In this stage of development, the first industrialized regions benefit from market potential, external economies, political power, the attraction of labour and capital, and the preference of firms to locate there. For instance, the historical experience of US regions confirms that in the second half of the nineteenth century manufacturing industries concentrated in the north while the south remained agrarian (Kim and Margo, 2003). Later on, the nationwide convergence between agricultural and non-agricultural wages and the more rapid transition of the labour force from agricultural to non-agricultural jobs in poorer regions explains overall per-capita income convergence across states in the twentieth century, specially in the decades following World War II (Kim, 1998; Caselli and Coleman, 2001; Kim and Margo, 2003). Similar long-term perspectives in terms of labour reallocation are shown for Sweden (Enflo and Rosés, 2015), Spain (Martínez-Galarraga et al., 2015), France (Combes et al., 2011; Díez-Minguela et al., 2016) and Italy (Felice, 2019; Capelli et al., 2019).

However, for the period after 1980, the vast number of studies based on the use of official datasets of regional gross value added (GVA) lend little support to there being a reduction in regional disparities⁴. In general, these studies reveal that the convergence process became weaker or even ceased, but regional disparities persisted, and any period of convergence became transitory. This was quite an unexpected result and controversial for US regions where the absence of cultural and institutional barriers to factor mobility and technological spillovers was expected to pave the road to convergence. In Europe, on the contrary, it was understood to be an intrinsic European problem and was included as one of the main targets on the EU political agenda and formed part of the economic

⁴ For a wide-ranging survey of this literature, see Magrini (2004).

analysis. This strand of empirical literature yields some interesting conclusions. First, convergence across European countries is not necessarily accompanied by regional convergence. Second, regional income gaps persist over time and are mainly determined by productivity gaps (Esteban, 1994). Third, the sectoral specialization of the regions is considered one of the most likely reasons for the persistence of productivity gaps. In this regard, studies based on shift-share analysis show that the industry mix has only a weak impact on productivity differentials across European regions, whereas disparities are mainly explained by differences in labour productivity within the same sectors in different regions (Esteban, 2000; Ezcurra et al., 2005; Le Gallo et al., 2003; Le Gallo and Kamarianakis, 2011). In other words, the existence of region-specific factors that are closely related to regional endowments of capital, transport infrastructures and R&D expenditure are more significant than the industry mix when it comes to explaining regional differences in productivity (Ezcurra et al., 2005).⁵ This limited relevance of the industry mix component has been interpreted as a sign of the exhaustion of the structural change process as a driver of regional productivity convergence.

Moving on to the last two decades, it is difficult to draw a precise line to illustrate the evolution of regional disparities in Europe. It varies depending on the number of countries (and regions) considered, the methodology and even the concept of region used in the study. In general, however, the evidence points to the persistence and even worsening of income disparities and thus to the start of a potential new phase of divergence. Studies based on the econometric analysis of cross-country data confirm that the long-term inverted U-curve between per-capita income and regional inequality has been completed and that a new pattern of regional income inequality is emerging in most of the advanced countries (Barrios and Strobl, 2009; Henning et al., 2011; Lessman, 2014; Castells-Quintana et al., 2015; Lessman and Seidel, 2017). The widespread persistence of income gaps across European regions is also confirmed by studies based on the use of different concepts of regional units to reduce or eliminate nuisance spatial dependence (Magrini 1999 and 2004). However, the use of different concepts of region do not always yield the same conclusions. For instance, Maza and Villaverde (2011) find that regional disparities are larger when NUTS2 regions are used instead of Metro regions, although

⁵ In recent decades additional regional-specific factors have been associated with the concept of territorial capital. This includes the endowment of climate-related factors and natural resources, quality of life, and the agglomeration economies provided by the cities or industrial districts along with other factors such as social capital (informal rules, solidarity, etc.) (Camagni, 2017).

the process of European regional convergence has been stronger among Metro than NUTS2 regions. Nevertheless, other studies reject the hypothesis of absolute convergence and suggest that we are seeing the start of a polarization process in Europe, with a select group of the wealthiest regions moving away from the rest (Magrini, 2004).

The emergence of regional disparities has rekindled interest in the potential role of structural change as a driver of convergence/divergence between regions, especially in Europe, where it could have significant implications for the design of regional economic policies. Barrios and Strobl (2009) associate structural changes with advances in the EU integration process and the incorporation of new member states. According to these authors, such structural changes have triggered a mechanism similar to that described by Williamson (1965) with regard to the industrialization process, increasing regional disparities. Considering the implications of the theoretical model presented in Barrios and Strobl (2009), there are reasons to believe that regional disparities in Europe today might also be associated with other types of structural change more specifically related to the new wave of technological change. The latest computer revolution is biased towards more abstract skills, and thus the agglomeration of new skill-intensive activities in some cities is seen as the new driving force behind regional disparities (Glaeser and Resseger, 2010; Berger and Frey, 2014; Glaeser et al., 2014). These results point to the increasing concentration of the most advanced industries and services in the richest European regions, providing a rather pessimistic perspective for the less developed regions because of their lack of resources to attract new sectors and technologies. However, the empirical study by O’Leary and Weber (2015) reveals that the as yet incomplete structural change process involving Europe’s poorest regions still emerges as a potential force of convergence. Hence, while technological changes spread unevenly and favour the most advanced regions, the poorest regions continue to shift factors towards more productive activities. For this reason, the shift-share analysis presented in Section 4 is carried out with the aim of weighing the roles of the dual forces deriving from changes in the industry mix of different kinds of regions and those arising from the new technological gap within industries in an attempt to explain the recent upsurge in European regional disparities.

3. Data and measures of regional inequality

3.1. Data

The main data source used in our study is the BD.EURS (NACE Rev.2) regional dataset. This provides basic macroeconomic variables (GVA at current and constant prices, employment, gross fixed capital formation at constant level, and capital at constant prices) and the main data source used to build it is EUROSTAT (see Escribá-Pérez et al., 2019, for a more detailed description of the dataset).⁶

In order to better adapt the available information to the aim of the paper, the BD.EURS (NACE Rev.2) dataset has been modified. To be specific, we increase the number of regions and sectors, and this allows us to carry out a more exhaustive analysis of the role played by the industry mix in the evolution of regional disparities in Europe. Thus the dataset is broken down into 10 different sectors in accordance with NACE Rev. 2 (at one digit): (1) agriculture, forestry and fishing, (2) extractive industries, energy and water utilities, (3) manufacturing, (4) construction, (5) wholesale and retail trade, transport and storage, hotels and restaurants, (6) information and communication, (7) financial and insurance activities, (8) real estate activities, (9) professional, scientific and technical services, administration and support service activities, and (10) non-market services (public administration and defence, compulsory social security, education, human health, social work activities). We would, of course, have preferred to work with more finely disaggregated data, but this is the best we have been able to do with the official statistics available.⁷

Our dataset comprises 156 regions covering the EU-13 countries (Austria, Belgium, Germany, Denmark, Greece, Spain, Finland, France, Italy, the Netherlands, Portugal,

⁶ The BD.EURS (NACE Rev.2) dataset is available at :

<https://www.sepg.pap.hacienda.gob.es/sitios/sepg/es-ES/Presupuestos/DocumentacionEstadisticas/Documentacion/Paginas/BasededatosBDEURS.aspx>

⁷ EUROSTAT disaggregates the services sector into several activities, but does not do the same for manufacturing. We are aware that this narrows the scope of our research into finding changes in productivity derived from changes in the industry mix.

Sweden and the United Kingdom).⁸ Regions are defined as NUTS-2, except for Germany and the United Kingdom, where they are defined as NUTS-1.⁹

Following the BD.EURS (NACE Rev.2) methodology, we get the gross value added (measured in €2010) and employment variables, which enable us to compute GVA per worker (measured in €2010) at regional level for the 10 different sectors. In order to complete the dataset with the GVA per capita, we obtained information on regional population from EUROSTAT (2018). The dataset for this paper spans the period 2000–2015.

3.2. Descriptive analysis

3.2.1. Regional inequality in GVA per capita and labour productivity

In this section some basic statistics show the evolution of regional inequality in the 156 European regions included in the sample. First, inequality is measured using different indicators. Table 1 shows the coefficient of variation (CV) in column [1], the population-weighted coefficient of variation (WCV) in column [2], the interdecile ratio (P90/P10) in column [3], the interquartile index (P75/P25) in column [4], and the Gini and Theil GE(0) indexes in columns [5] and [6] respectively.

TABLE 1

In general, all the indexes in Table 1 (except the interquartile ratio) show an increase in the dispersion of the 156 European regions. According to the CV and the WCV, the regions became more scattered around the European average between 2000 and 2015. However, regions distributed between the first and third quartiles are closer together in 2015 than they were in 2000. It would seem, then, that the area in the central part of the

⁸ Luxembourg and Ireland are excluded from the sample because they are small countries (Luxembourg only has one region). Moreover, it is well-known that Ireland has by far the lowest standard rate of corporation tax on manufacturing of the advanced economies, resulting in multinational companies “locating a very high fraction of the enterprise global profits in Ireland”. This could therefore increase national macroeconomic indicators such as GDP (OECD, 2016). Crescenzi and Giua (2016) also excluded these two countries from their analysis.

⁹ NUTS-1 regions in Germany are referred to as "Länder" and in the UK until March 2011 as "Government Office Regions (GORs) in England" whereas from 1 April 2011 should be referred to as 'regions' for statistical purposes. According to the OECD classification, these regions are called TL2 (Territorial Level 2). Thus the combination of these two levels facilitates greater comparability of geographic units at the same territorial level (OECD, 2018). Crescenzi and Giua (2016) and de Dominicis (2011) also combine NUTS-1 and NUTS-2 regions in their respective empirical studies.

distribution has become condensed and the distance between the first and third quartiles shorter.

Since these results are not conclusive enough, we need to explore the pattern marked out by other inequality indexes. The Gini and the Theil provide more accurate measurements of inequality than the CV and WCV because they compute all the distances between any pair of regions in the distribution, not only the dispersion with regard to the average. Moreover, both have the ability to reflect any change in the relative position of pairs of regions even if they are both located either above or below the mean.

As Table 1 shows, the two indexes report an increase in inequality for the whole period, but especially since 2007. The Gini coefficient grew at an average annual rate of 0.368% over the period 2000-2015, while the Theil (0) grew at 0.679%. This is consistent with the P90/P10 range, which grew at 0.784% per year. It suggests that the distance between the two poles of the distribution has increased and that therefore the distances between any region inside the central part of the distribution and the two poles have increased too. The simple consideration of this fact could explain the more rapid increase of the Theil and Gini indexes compared to the CV and the WCV, which only record distances with regard to the mean.

3.2.2. Kernel density functions

To shed further light on the distributional changes that have taken place in the poles of the distribution, Figure 1a shows the kernel densities for per-capita GVA, while Figure 1b shows the kernel densities for labour productivity (in both cases normalized according to the EU-13 average) for 2000 and 2015. The variables of interest are plotted on the x-axis, while the associated density is presented on the y-axis.

In Figure 1a the distribution of per-capita GVA presents a positive skew with the tail on the right-hand side, but this tail inflated in 2015 with respect to 2000, indicating that a group of rich regions became consolidated at the very top end of the distribution. A similar result was found by Magrini (1999) and Enflo (2010), who detected a tendency towards a polarization of income distribution across European regions.

We have also carried out a Theil decomposition to explore whether the regional disparities in per-capita GVA are due to divergent trajectories in regional demographic

patterns or labour productivity.¹⁰ The Theil decomposition reveals that around 75% of regional disparities in per-capita GVA are explained by disparities in labour productivity, while the employment rate accounts for a modest 20-25%. These proportions have remained fairly stable over the fifteen years analysed and are consistent with Duro and Esteban (1998) conclusion that most regional disparities arise from regional differences in labour productivity. We will therefore now focus our analysis on the evolution of labour productivity.

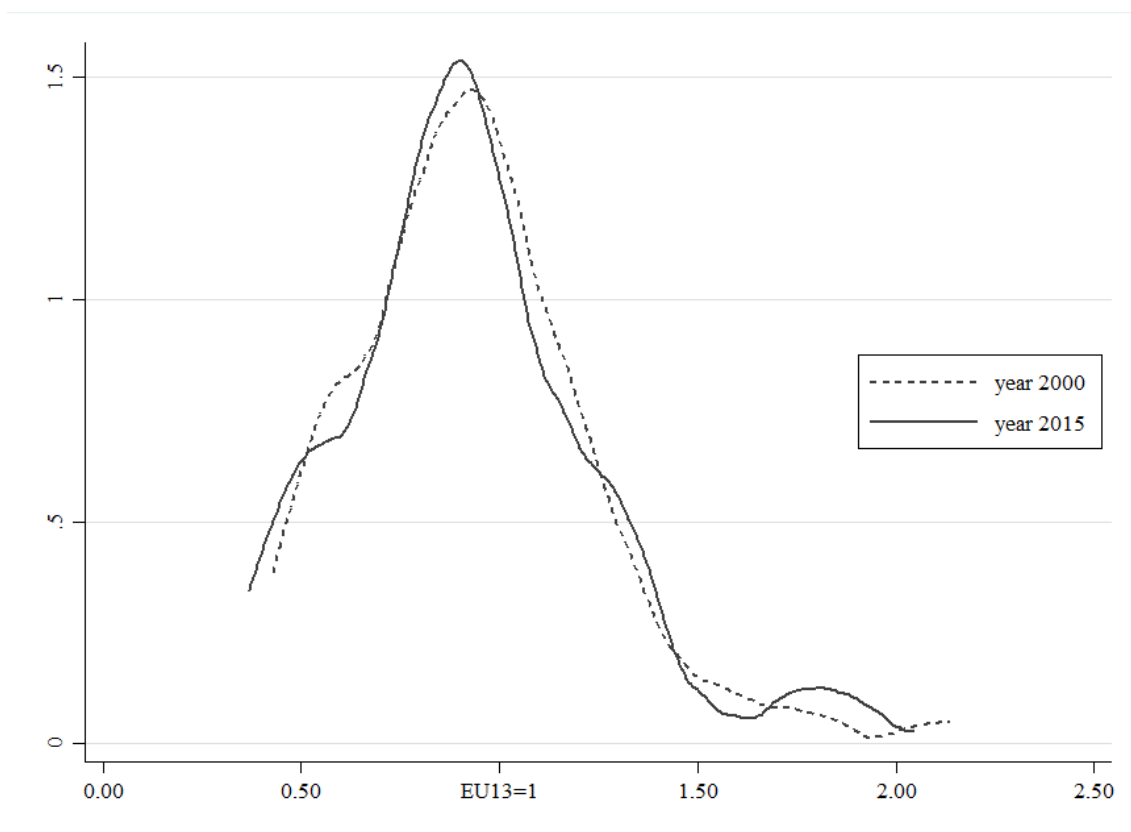
Figure 1b shows the labour-productivity kernel-density functions normalized according to the EU-13 average for 2000 and 2015. Now the positive skew of the distribution disappears, and the function behaves more normally than in the case of GVA per capita. From 2000 to 2015 regional labour productivity became compressed around the mean and the two poles of the distribution inflated. This shows that a group of rich and poor regions became consolidated at the top and bottom ends of the distribution respectively. From the mid-1990s a group of very rich European regions are moving further ahead. This result reaffirms the tendencies pointed out in other studies (Pittau and Zelli, 2006; Ezcurra and Pascual, 2007; Enflo, 2010; Magrini, 1999).

Figure 1a. Kernel distribution of GVA per capita

¹⁰ Duro and Esteban (1998) originally broke down the Theil index of regional per-capita income into four factors: (i) labour productivity, (ii) participation rate, (iii) active over working-age population rate, and (iv) working age over total population rate. We have broken it down into only two components: labour productivity and participation rate. Algebraically:

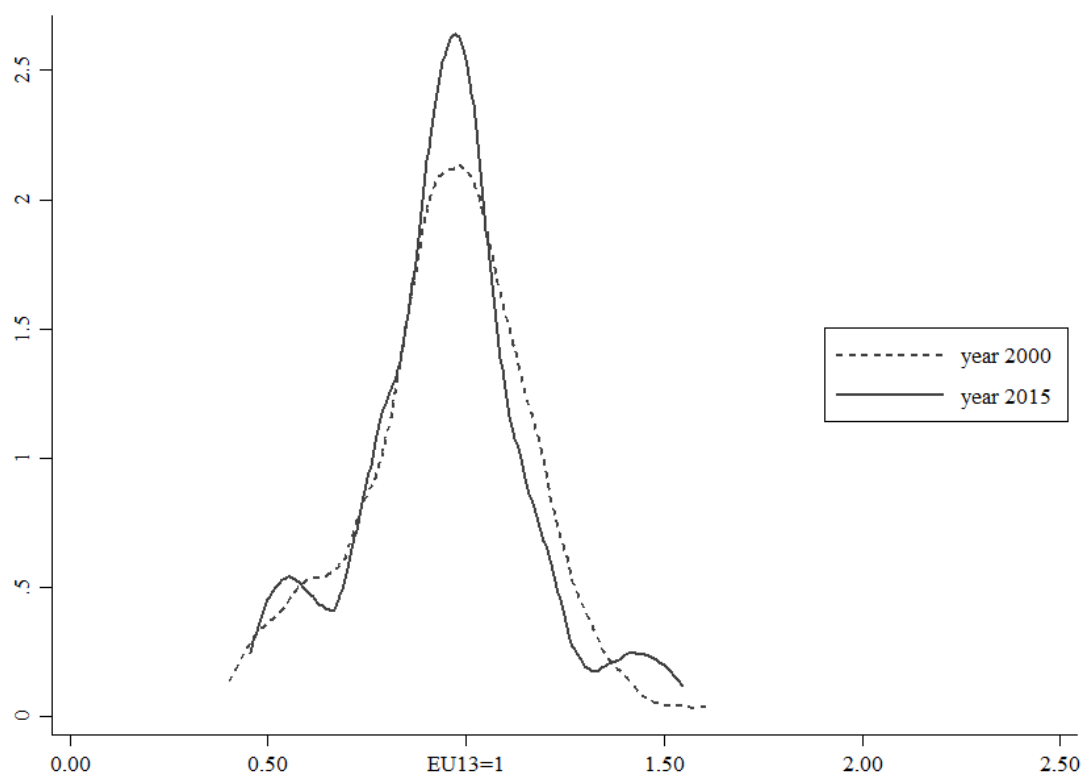
$$(x, s) = \sum_i s_i \log\left(\frac{\mu}{x_i}\right) = \sum_i s_i \left\{ \log \frac{GVA/EMP}{GVA_i/EMP_i} + \log \frac{EMP/POP}{EMP_i/POP_i} \right\}$$

where s_i denotes the share of region i in the total EU-13 population, μ is the EU-13 average per-capita income, and x_i is the regional average of per-capita income.



Notes: kernel = epanechnikov, bandwidth (2000) = 0.0897, bandwidth (2015) = 0.0824.
Source: BD.EURS (NACE Rev.2) and own elaboration.

Figure 1b. Kernel distribution of GVA per worker



Notes: kernel = epanechnikov, bandwidth (2000) = 0.0603, bandwidth (2015) = 0.0516.
Source: BD.EURS (NACE Rev.2) and own elaboration.

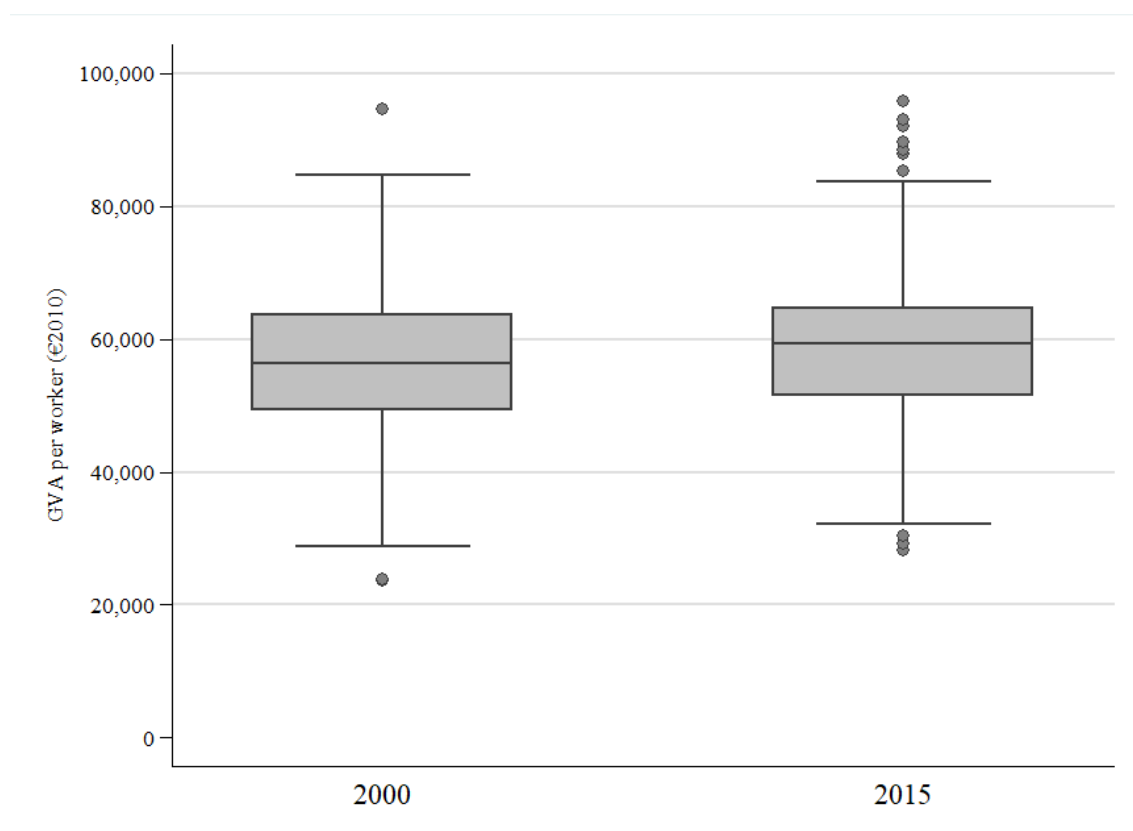
3.2.3. Regions clustered at the top and bottom of the distribution

The box-plot diagram in Figure 2 enables us to visualize the changes in the regional distribution of GVA per worker in greater detail and to identify movements in the poles of the distribution. The box contains 50% of the probability mass distribution, so the bigger the box, the bigger the dispersion of regional GVA per worker. The horizontal line inside the box represents the median value, while the extreme values of the vertical lines outside represent 1.5 times the interquartile distance. The small circles represent the outlier regions. The size of the box has barely shrunk between 2000 and 2015, although the median value has risen.¹¹ In 2000 the only outlier region at the top end of the distribution was London, but by 2015 another six regions had joined the ranks (Brussels, Brabant Wallon, Hovedstaden, Île-de-France, Groningen and Stockholm). This group of regions inflates the upper tail of the kernel function represented in Figure 1b. At the

¹¹ The information on the box plots in Figure 2 is complemented with a two-sample (paired) t-test in which we can reject the null hypothesis (at 1%) that labour productivity averages are the same for 2000 and 2015. Therefore there is an increase in average labour productivity from 2000 to 2015.

opposite pole, Norte and Centro, both in Portugal, were the outliers in 2000, and in 2015 a Greek region, Anatoliki-Makedonia-Thraki, joined this group of lower outliers. The evidence provided so far points to the ongoing relevance of a group of top regions that are pushing up regional disparities and another group of poor regions that are breaking away from the central part of the distribution.

Figure 2. Box-plot diagram: GVA per worker in European regions, 2000 and 2015



Source: BD.EURS (NACE Rev 2) and own elaboration.

Table 2 ranks the European regions according to their labour productivity in 2015 to enable us to observe what has happened at the poles. In that year the top ten regions are London, Île de France, Stockholm, Brussels, Hovedstaden, Groningen, Brabant Wallon, Antwerpen, Vlaams-Brabant, and Noord-Holland. With the exception of London, all these regions have increased their distance from the EU-13 compared to 2000, settling at around 33% to 63% above the EU-13 average in 2015. This distance has grown by an average of 10 percentage points since 2000. In addition, only two of these regions were at least 50% above the EU-13 average in 2000 (London and Brussels), but four more had joined this group in 2015 (Île de France, Stockholm, Hovedstaden and Groningen).

The top five in 2015 are regions that are home to the capital cities of their corresponding countries: London (UK), Île de France (France), Stockholm (Sweden), Brussels (Belgium), and Hovedstaden (Denmark).¹²

TABLE 2

In contrast, the bottom ten regions are below 59% of the EU-13 for 2000-2015 and they have narrowed the gap between them and the EU-13 by an average of 2 percentage points, from 53% of the EU-13 in 2000 to 55% in 2015. This group comprises a number of Greek regions (Kentriki Makedonia, Peloponnisos, Kriti, Dytiki Ellada, Thessalia, Ipeiros, Anatoliki Makedonia, and Thraki) and a few Portuguese regions (Algarve, Centro and Norte). Again, the increase in European regional inequality seems to be driven by a group of regions that grew by more than the average and that is mainly made up of the capital regions of the richest European countries, with the exception of Berlin.

Therefore, according to the descriptive analysis above, regional productivity disparities are seen to be increasing during the period 2000-2015. The kernel density functions show that, while most regions are grouped together around the mean, the group of regions located at each of the two poles of the distribution tends to inflate. Given how noteworthy this trend is, it is important to find out the extent to which it is the result of an increasing technology gap between industries in the rich regions with regard to other regions or whether instead it is due to new forces of structural change. In the next section, therefore, we focus especially on questioning the relative roles of structural change and within-industry and between-industry components in explaining recent regional disparities.

4. Shift-share analysis

Over the last two decades various studies have agreed that differences in labour productivity between European regions can be attributed to the intrinsic characteristics of the regions rather than to their industry mix (Esteban, 2000; Le Gallo et al., 2003; Ezcurra et al., 2005; Batóg and Batóg, 2007; Le Gallo and Kamarianakis, 2011). These region-

¹² Rosés and Wolf (2019) find that the capital regions of Europe seem to have increased in size in relation to other regions in terms of population, employment and GVA. When observed over the course of the twentieth century, the recent revival of capital cities in Europe comes after a period of decline between 1945 and the 1980s, in line with the long-term evolution of regional inequality in Europe.

specific productivity differentials, which are uniform across sectors, have been associated with intrinsic regional characteristics such as endowments of human and physical capital, investment in R&D and even institutions. Meanwhile the exhaustion of the structural change process during the Golden Age years would explain the weak role of the industry mix in regional disparities over the last three decades.

Now, however, the current wave of globalization and technology change could apparently be changing the economic structure of the regions and their ability to absorb new technologies (Iammarino et al., 2019). Cutting-edge technologies stimulate the development of the finance sector, knowledge-intensive industries, and advanced services, activities that offer new opportunities for investment and job creation. These new jobs are more intensive in the use of highly skilled workers than traditional routine-task activities were and will therefore tend to be concentrated in large metropolitan areas where companies can satisfy their own needs. The urban premium for firms derives from the interaction between different agglomeration economies, the sorting of the most talented people, and a tough selection between the most productive firms in large markets, jointly with the relationship between dynamic competitive advantages and their impact on innovation in spatially concentrated companies (Behrens et al., 2014).

In this section we propose to decompose the variation in labour productivity across European regions following the shift-share methodology developed by Caselli and Tenreyro (2004). This should enable us to discover how much of the recent upsurge in labour productivity inequality in Europe comes from a “within-industry” effect (technological divergence with the leading regions), how much from a “structural change” effect (divergence respect to the pattern of specialization in the leading regions) and how much from a “between-industry” effect (labour reallocation across sectors that are not the more productive in the leading regions). The method involves measuring the differences in labour productivity (y) of each region i with regard to the leading region, L , between t and $t-1$:

$$\Delta \frac{y_{i,t} - y_{L,t}}{y_{L,t}} = \frac{y_{i,t} - y_{L,t}}{y_{L,t}} - \frac{y_{i,t-1} - y_{L,t-1}}{y_{L,t-1}} \quad (1)$$

Caselli and Tenreyro (2004) take a hypothetical “average region” as a benchmark. Nevertheless, in order to take into account the rapid progress of a group of rich regions observed in Europe over the period analysed, we have followed Enflo and Rosés (2015),

who use a leading region as the benchmark. Indeed, we consider five different benchmark regions separately, these being the top five regions in the EU-13 according to labour productivity figures for 2015 (see Table 2). The idea is to capture the dispersion pattern of regional labour productivity that already applied in the analysis in the previous section. In 2015, the top five regions exhibit a labour productivity level at least 50% higher than the European average (EU-13=1): London (1.63), Île-de-France (1.59), Stockholm (1.57), Brussels (1.53) and Hovedstaden (1.51). For the purposes of comparing our results with others, we also present the results using a benchmark “average region.”

The shift-share analysis breaks down the differences in labour productivity across regions into three major components, as can be seen in following equation:

$$\Delta \frac{y_{i,t} - y_{L,t}}{y_{L,t}} = \sum_{j=1}^J \bar{s}_{ij,t} \Delta \left(\frac{y_{ij,t} - y_{Lj,t}}{y_{L,t}} \right) + \left[\sum_{j=1}^J \left(\frac{\bar{y}_{ij,t}}{y_{L,t}} \right) \Delta s_{ij,t} - \sum_{j=1}^J \left(\frac{\bar{y}_{Lj,t}}{y_{L,t}} \right) \Delta s_{Lj,t} \right] + \sum_{j=1}^J (\bar{s}_{ij,t} - \bar{s}_{Lj,t}) \Delta \frac{y_{Lj,t}}{y_{L,t}} \quad (2)$$

where j denotes the sector, i is the region, L is the leading region, $s_{ij,t}$ is the share of sector j in the total employment of region i , $\Delta x_{j,t}$ is the difference between t and $t-1$ ($\Delta x_{j,t} = x_{j,t} - x_{j,t-1}$), and $\bar{x}_{ij,t}$ is an average value ($\bar{x}_{ij,t} = \frac{x_{ij,t} + x_{ij,t-1}}{2}$).

The study is broken down into the maximum number of sectors available, i.e. 10 sectors from the NACE classification. The usefulness of the shift-share decomposition applied here is directly related to the number of production activities considered (O’Leary and Weber, 2015). A smaller number of sectors would tend to overestimate the similarity of the industry mix across regions, thereby underestimating the importance of the structural component in accounting for regional productivity dispersion. The larger the number of sectors considered, the larger the expected structural change effect.

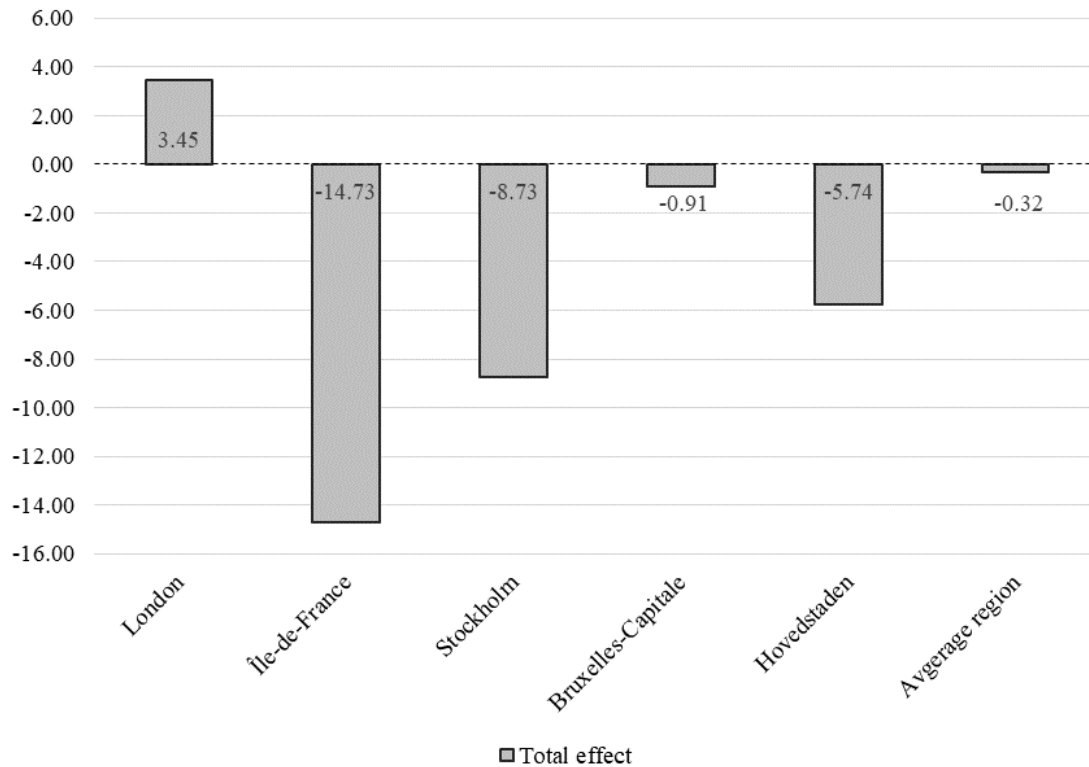
As stated above, the productivity gap between each of the regions and the leading region can be expressed as the sum of three factors: the within-industry component, the labour reallocation component and the between-industry component. First, the “within-industry” component represents the labour-productivity catch-up or divergence of each sector j along with its equivalent in the leading region, weighted by the average share of employment in sector j of each region i . Second, the “labour reallocation” term considers

the labour flows across sectors and convergence/divergence with respect to the productive structure of the leading region. And third, the “between-industry” component captures intersectoral productivity convergence/divergence. There is convergence when a region specializes in those sectors that become more productive in the leading region, whereas there is divergence when a region specializes in those sectors that become less productive in the leading region. The left-hand side of equation 2 denotes convergence with the leading region when it has a positive sign, otherwise it denotes divergence. The different terms on the right-hand side also represent convergence or divergence in terms of the “within-industry”, “labour reallocation” and “between industry” components, depending on whether their respective signs are positive or negative.

The study is based on a comparison of the 155 European NUTS-2 regions belonging to the EU-13 in relation to each benchmark taken separately. The results are summarized in Figures 3 and 4.

On average the 155 European regions have diverged by -14.73% from Île-de-France (FR10), by -8.73% from Stockholm (SE11), -0.91% from Région de Bruxelles-Capitale (BE10), -5.74% from Hovedstaden (DK01), and -0.32% from the “average region” (see Figure 3). As expected, the divergence found is small when the benchmark is the “average region” instead of one of the leading regions. Surprisingly, the shift-share analysis showed a rate of convergence with the richest region of Europe, London (UKI), of 3.45% between 2000 and 2015. This unexpected result is mainly attributable to the depreciation of the British currency against the euro since 2000. Labour productivity in the region of London was 1.70 times the European average in 2000, then fell to 1.35 in 2009 and afterwards rose progressively to 1.63 in 2015. The European regions therefore narrowed the gap with London between 2000 and 2015. This optimistic result is partly a monetary illusion, and convergence in real terms is still questionable. In order to avoid the plausible bias introduced by the monetary effect in the shift-share analysis, in the following calculations we do not use London as a benchmark region.

Figure 3. Convergence/divergence in labour productivity respect to the top five European regions and the “average region”, 2000-2015



Source: BD.EURS (NACE Rev.2) and own elaboration.

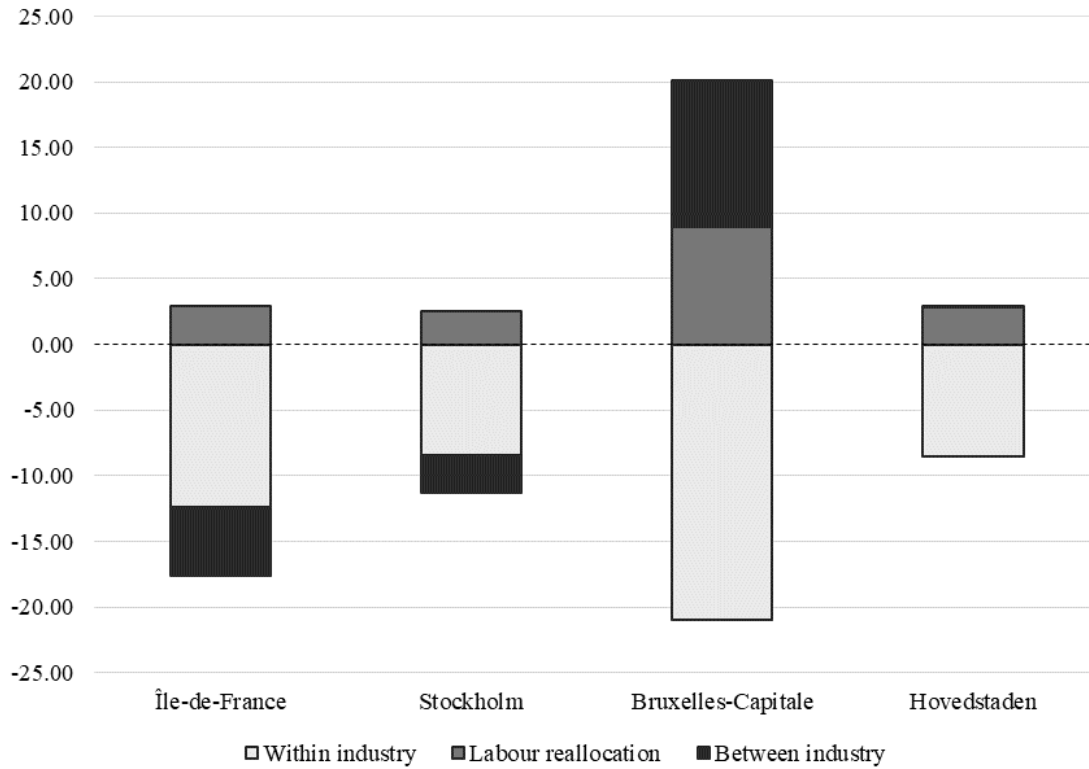
The decomposition assigns most of the divergence to the “within-industry” component (see Figure 4). In the literature this component represents the “productivity differential” associated with intrinsic regional attributes that make some regions more productive than others.¹³ In dynamic terms, the negative sign of this component denotes that the technology gap between the leading region and all the others increased between 2000 and 2015. Table 3 details the magnitude of the “within-industry” component by sector. Generally speaking, all the leading regions have increased their within-industry distances from the other regions in manufacturing, retail (WRTAF), ICT services, and finance.¹⁴ These activities are the most obviously related to the new wave of technology change. For the remaining activities we find mixed results, although the negative sign still prevails. The predominance of the within-industry effect is consistent with the results obtained by Esteban (2000), Ezcurra et al. (2005) and Le Gallo and Kamarianakis (2011), who found that interregional differences in labour productivity were mainly explained by within-industry productivity gaps. It is also consistent with the findings of O’Leary and

¹³ The differences observed across regions in the ratios of capital per worker, human capital stock, and technology level are the most reliable candidates for explaining differences in productivity between regions.

¹⁴ Although the reference regions do not specialize in manufacturing, the negative sign is explained by the fact that the labour productivity gap in manufacturing between the leading regions and the other regions was higher in 2015 than in 2000.

Weber (2015), who identified within-industry productivity growth as the main determinant of regional productivity growth, regardless of the region's level of development.

Figure 4. Shift-share analysis components, 2000-2015



Notes: The positive sign represents convergence with the leading region; the negative sign, divergence. The shift-share decomposition for the “average region” is not presented because, although the direction of the effects is the same than the one for the Île-de-France and Stockholm, the dimension of the effects is much smaller and turns out practically negligible using the scale of this figure. Source: BD.EURS (NACE Rev.2) and own elaboration.

TABLE 3

The second term of equation 2 represents the movement of the labour force from any one of the ten sectors to another in search of better job opportunities. As can be seen in Figure 4, the “labour reallocation” effect is positive but very small in the four cases analysed. We find two potential explanations for this inconsequential contribution of “structural change” to overall divergence. One of them concerns the counterbalancing forces that operate simultaneously in the leading, medium and less-developed regions as regards the changing composition of the production structure. While the low- and

medium-productivity regions tend to emulate the production structure of the leading regions through a process of tertiarization (convergence), the richest regions are reallocating workers to the emerging knowledge-intensive industries and services (divergence). In the four cases represented in Figure 4, the final result is a weak but positive convergence with the leading region.

The final balance of the structural change effect contradicts the general consensus on the exhaustion of the structural change process in Europe (Esteban, 2000; Ezcurra et al., 2005; Villaverde and Maza, 2008; Le Gallo and Kamarianakis, 2011) and reveals a labour reallocation effect which, despite being smaller than the within-industry effect, makes a positive contribution to shortening distances from the richest regions. This is consistent with O’Leary and Webber (2015), who found a positive and significant impact of labour reallocation on labour productivity growth, although again smaller than the within-industry effect. These authors estimated the elasticity of labour productivity with regard to labour reallocation for regions with different levels of income per capita and found that those located in the first and last quantiles of the income distribution exhibit higher elasticities than those in the central part of the distribution. This means that labour reallocation is increasing productivity in the poorest and richest regions at a higher rate than in the middle-income regions. O’Leary and Webber’s (2015) results are in line with Abromovitz’s (1986) suggestion of a convergent effect derived from structural change for the less developed regions, but they also reveal structural change as a new and significant source of growth, and thus divergence, for the richest regions. However, the net effect of structural change on the evolution of regional disparities remains undetermined in the O’Leary and Webber (2015) study. While labour reallocation pushes the poorest regions to converge with middle-income regions by emulating their industry mix, it also moves the richest regions further away by strengthening factors associated with the most technologically advanced industries and services.

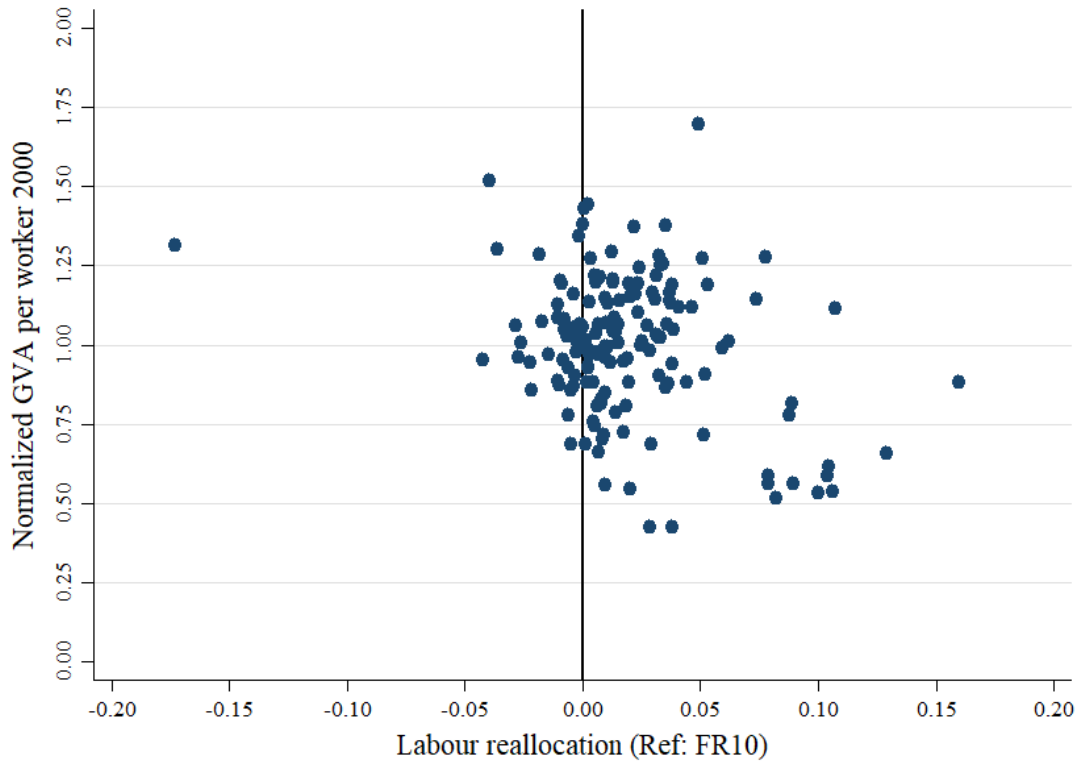
Our dynamic shift-share study goes one step further. It enables us to calculate not only the net labour reallocation effect in terms of convergence/divergence between each region and the leading region, but also the net aggregate effect. Figure 5 shows the net structural change effect by region, taking the Ile-de-France (FR10) as benchmark, with regard to GVA per worker normalized by the mean. In general, regions with a positive structural change effect (convergence) predominate in the plot. In all the poorest regions

this effect is positive, and in the regions in the central part of the distribution the positive sign predominates although some regions are diverging, but the regions at the top of the distribution show more variability. The final balance is positive and denotes convergence with the leading regions. The results are robust regardless of the benchmark region considered, as can be observed in Table 3, and represent new evidence in favour of the view that structural change should be considered in economic policy paying special attention to the relevant sign associated with regions with dissimilar income levels.

In the aggregate “labour-reallocation” component, the increasing share of services in the non-leading regions trumps the emerging presence of modern activities in the leading regions. Modern sectors are still not big enough to have a determining impact on total “labour reallocation” that provokes divergence with the leading regions. It is also probable that the new sectors are not yet being properly measured in the statistics. The high level of aggregation in the manufacturing industry, for instance, could be masking part of the “structural change” that is occurring in the most advanced regions and that lastly will lead to divergence with the rest. Therefore, despite the fact that we have broken down the economic structure of the regions into ten activities so as to capture any potential new “labour reallocation” effect, the current level of disaggregation still fails to provide a grained description of how resources are more attracted by the most progressive activities in the leading regions, at least as far as manufacturing is concerned. Thus, part of “reallocation effect” remains still hidden inside the positive sign of the “within-industry” effect.¹⁵

Figure 5. Relationship between GVA per worker in 2000 and "labour-reallocation" effect.

¹⁵ O’Leary and Webber (2015) arrived at similar conclusions in their analysis based on 181 European regions for the period 1980-2007. They found that the role of structural change in European regional productivity growth was far from negligible, and substantially stronger for those regions at the top of the distribution.



Notes: The GVA per worker in 2000 has been normalized by the EU-13 average (y-axis).
 Île-de-France (FR10) as the benchmark region (x-axis).
 Source: BD.EURS (NACE Rev.2) and own elaboration.

The final term, the “between-industry” component, can be interpreted as that part of regional divergence that derives from the specialization of the leading region in more productive industries compared to the other regions. We find a negative “between-industry” effect in Île-de-France and Stockholm. The negative sign denotes that these leading regions tend to specialize more intensely than the others in those industries in which productivity is increasing at above the average rate. We find that most of the negative effect originates in three activities that are very closely associated with the new wave of technology change: utilities, ICT services and finance (see Table 3). In general, all the leading regions considered in our study exhibit a negative sign (divergence) in these sectors in relation to the non-leading regions, denoting a higher specialization in these industries. This important result supports the hypothesis that the current increase in regional disparities in Europe is driven mainly by those regions in which big metropolitan capital cities are located and where local conditions are more suited to attracting new industries. Taking advantage of certain urban agglomeration economies could act as a focus of attraction for knowledge-intensive industries and services.

For the sake of comparability, the results of the shift-share analysis for the “average region” are also included in Table 3. The signs found are similar to those for the Île-de-France and Stockholm: positive for the “labour reallocation” component (indicating convergence) and negative for the within-industry and between-industry components (indicating divergence). Unlike in the leading regions, the sign for the “within-industry” effect for manufacturing and finance remains positive (indicating convergence), while the “between-industry” effect emerges with a negative sign for manufacturing (indicating divergence). This supports the idea that the leading regions are the main drivers of regional inequality in Europe through increased productivity in those industries most specifically associated with the spread and embodiment of new technologies, while technological catch-up with the “average region” could still represent a source of convergence for most European regions.

Figures 6 to 9 show the spatial distribution of the total “shift-share” effect and its three components (within-industry, labour reallocation and between-industry), the main aim of this being to identify specific patterns in connection with the regions’ spatial locations and levels of development by considering the sign of each component. Due to lack of space we have represented only the results with regard to Île-de-France. This benchmark region is marked in black, while divergent regions are coloured light grey and convergent regions dark grey. The negative sign (divergence) predominates on Figure 6, where the “total shift-share” is plotted, i.e. Île-de-France is moving further away from most other European regions in terms of labour productivity. The exceptions are some of the poorest regions in Spain (Castilla-La Mancha), Portugal (Centro) and eastern Germany (Brandenburg, Sachsen and Thüringen), which are overcoming their low levels of development and have narrowed the gap between them and the leading region.

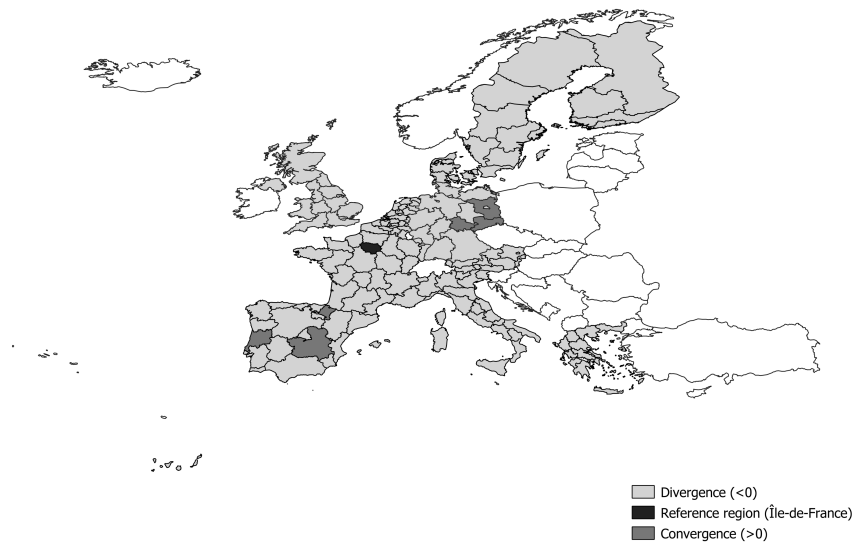
Figure 7 confirms that the total “shift-share” effect is dominated by divergence resulting from the “within-industry” component. Again, most of the regions in Europe are diverging from Île-de-France due to a higher technological advance in this leading region. At the same time, only a few of the least developed regions in Europe—in Portugal, Spain, and eastern Germany—have progressed enough to narrow the gap with the leader, possibly by taking advantage of their lagging behind or by benefitting from

European policies of redistribution,¹⁶ or even from their proximity to state capital regions such as Lisbon, Madrid or Berlin. Figure 8 which shows the “between-industry” effect, reinforces the spatial distribution of the “within-industry” effect. Divergence with regard to Île-de-France dominates the figure, confirming that this leading region is becoming more specialized in high-productivity industries compared to the middle- and low-income regions. However, when the benchmark region is compared with the richest regions in Europe, dark grey (positive sign) dominates the figure, which means that London, Stockholm, Helsinki, Bremen, Hamburg, Baden-Würthemberg, Bayern, Hessen, Piemonte, Lombardia, Veneto, Emilia-Romagna, and Marche have increased their specialization in the most productive sectors more than Île-de-France across the period analyzed.

Finally, in Figure 9 “labour-reallocation” convergence with Île-de-France is predominant across European regions. Although positive, this effect is not high enough to counterbalance the divergent forces stemming from advances in technology and the subsequent pattern of specialization. Thus Figure 6, in which the three effects are summarized, reveals that most of the European regions have diverged from Île-de-France and that only a few lagging regions in Portugal, Spain and eastern Germany have achieved some level of convergence with this leading region. The results obtained for Île-de-France could be extended to the other leading regions.

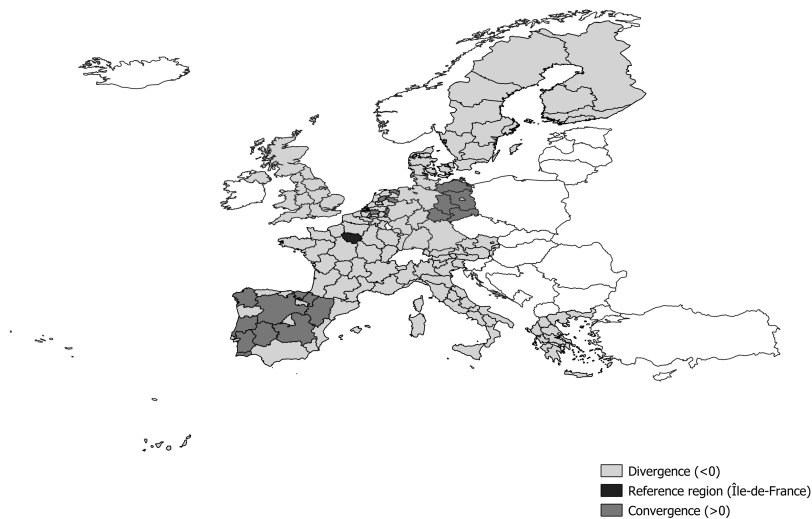
Figure 6. Total shift-share convergence/divergence.

¹⁶ Although the question of whether or not EU cohesion policies have been successful remains open (see Mohl, 2016), some ex-post (Gagliardi and Percoco, 2017) and ex-ante evaluation papers (European Commission, 2014; Bosca et al., 2018 for Spanish regions) find evidence that the EU cohesion policy benefits those regions lagging furthest behind.



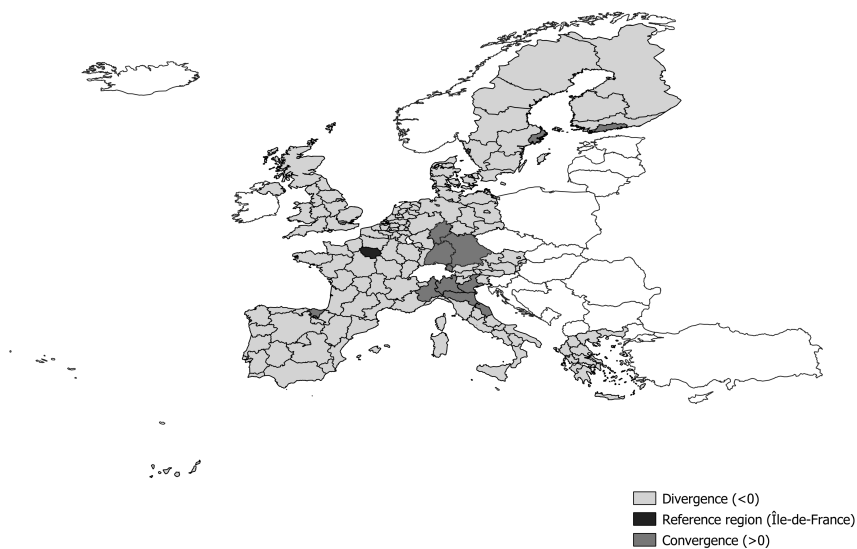
Source: BD.EURS (NACE Rev.2) and own elaboration

Figure 7. Shift-share: “Within-industry” component.



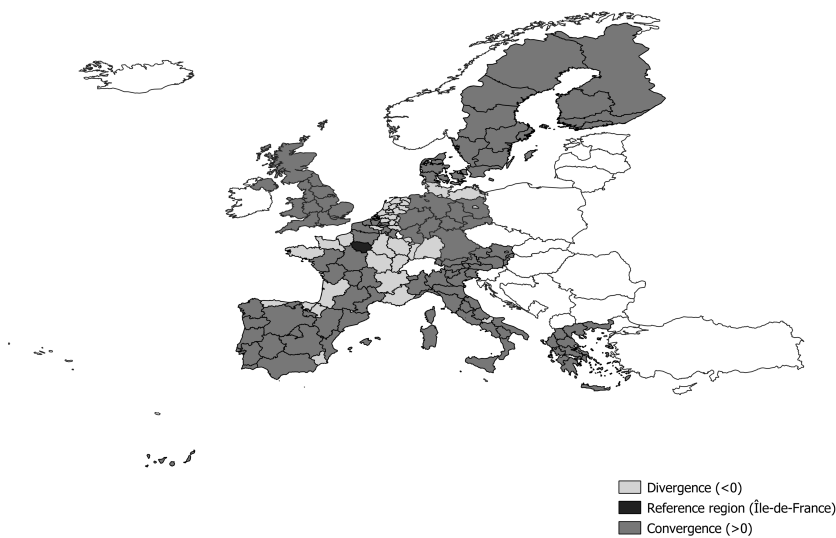
Source: BD.EURS (NACE Rev.2) and own elaboration

Figure 8. Shift-share: “Between-industry” component.



Source: BD.EURS (NACE Rev.2) and own elaboration

Figure 9. Shift-share: “Labour reallocation” component.



Source: BD.EURS (NACE Rev.2) and own elaboration

5. Conclusions

In this paper we have analysed the evolution of regional productivity disparities at NUTS-2 level in 13 European countries over the period 2000-2015. The results confirm the upsurge in regional productivity disparities in Europe. We have also seen that this has mainly been driven by the rapid progress made by some of the richest regions in Europe, while low- and middle-income regions were closer to the European average in 2015 than they were in 2000. At the same time, an increasing number of low-income regions are becoming trapped at the bottom pole of the distribution. These results are in line with the idea of an N-shaped relationship between per-capita income and regional inequality observed for the United States (Ganong and Shoag, 2017). This increase in regional disparities comes hand by hand with the emergence of an increasing group of richest regions moving away from the European average (Magrini, 1999; Enflo, 2010).

The dynamic shift-share study using as reference the regions that are leaders in productivity let us to conclude that these regions, most of them home to capital cities, had higher than average labour productivity growth rates over the period 2000-2015, and that their success was mainly the result of a bigger increase in productivity within most industries (within-industry effect) and a higher specialization in the most dynamic ones (between-industry effect). The divergence in terms of the within-industry effect extends to most industries, but especially to those associated with the new wave of technology change (manufacturing, ICT services, finance, professional services, and retail services). Meanwhile the between-industry effect reveals that prosperity in the richest regions is also linked to specialization in these industries.

According to our results, the main source of labour productivity divergence across the EU-13 regions in 2000-2015 has been the “within-industry” effect. The dynamic competitive advantages derived from agglomeration have propelled innovation, the development of knowledge intensive activities and productivity growth in the richest regions. Meanwhile in low- and medium-income regions, where this kind of “intangible capital” linked to agglomeration is more scarce, labour productivity remains static.

If knowledge creation gives rise to regional disparities, knowledge diffusion across regions should be the way to compensate by improving the opportunities of less dynamic areas. Hence regional and national authorities should focus their attention on easing

technology flows across regional borders. Cohesion policies should continue to encourage worker training and skills in the less developed regions alongside connectivity between regions, especially with the biggest cities as hubs of innovation and productivity growth. For several decades the European Union has fostered territorial cohesion by improving the stock of infrastructures and human capital in the less developed regions. Now, after decades of convergence, the gap between European regions is increasing again and it seems to be led by the centripetal forces of agglomeration. Therefore the European Union should allocate more resources to encouraging technology spillovers from the richest regions to the less developed and to promoting integration and complementarity between regions with different development levels.

Notwithstanding the ideas thrown up by these results, the sign for the “labour reallocation” effect does not allow us to confirm, at least for now, that “structural change” is becoming a central force in explaining the upsurge in European inequality, as it was in past waves of technological change (Williamson, 1965). On the contrary, in the period analysed the “labour reallocation” effect still emerges as the only active point of convergence. As far as the level of disaggregation allows, there is no evidence that structural change in the leading regions tips the scales in favour of divergence, as one of Barrios and Strobl’s (2009) main conclusions postulated. Our results make it possible to balance the empirical results found by O’Leary and Weber (2015) regarding the different sensitivities of low- and top-income regions to changes in the industry mix. So far we find that the divergent “structural change” effect in the richest regions is more than counterbalanced by convergence in the remaining regions. From a policy point of view, the still positive active role of the industry mix suggests that policies focusing on uniformly improving productivity in the less developed regions should be complemented with more specific regional policies designed to ease factor mobility across sectors within the same region. Such policies would help to shape a more competitive industry mix that would match well with the forces of agglomeration, new technology change and globalization.

Finally, we are aware of the weaknesses deriving from the use of a degree of sector disaggregation that does not enable us to capture relevant changes in the production structure, especially in the manufacturing sector. The compilers of official statistics also acknowledge that there are problems in correctly identifying, measuring and defining new sectors, jobs and capital. Lastly, and just as importantly, it may be that the concept of

“structural change” based on the idea of labour reallocation is becoming obsolete in an era of technology change that is less intensive in job creation. Whether the underrepresentation of “structural change” in the explanation of overall changes in regional inequality is a question of time or data is a matter that should be addressed in future research. For the moment, the predominance of the positive effect in structural change is a sign that those policies aimed at improving labour mobility between sectors are still helping to avoid greater disparities between European regions. They should continue to do so, especially as regards compensating for the emerging forces derived from the combination of agglomeration economies, new technology change and globalization.

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Table 1. Inequality indexes for GVA per capita. NUTS-2 regions, EU-13

	[1]	[2]	[3]	[4]	[5]	[6]
Year	CV	WCV ¹	P90/P10	P75/P25	Gini	Theil GE(0)
2000	0.314	0.315	2.246	1.511	0.177	0.048
2001	0.309	0.307	2.212	1.497	0.174	0.046
2002	0.305	0.304	2.214	1.497	0.172	0.045
2003	0.295	0.291	2.132	1.471	0.166	0.041
2004	0.295	0.292	2.126	1.481	0.166	0.041
2005	0.298	0.297	2.078	1.474	0.167	0.042
2006	0.298	0.296	2.159	1.513	0.167	0.042
2007	0.298	0.300	2.179	1.507	0.167	0.043
2008	0.301	0.295	2.184	1.467	0.168	0.041
2009	0.297	0.289	2.170	1.405	0.164	0.039
2010	0.310	0.301	2.278	1.450	0.173	0.043
2011	0.320	0.308	2.389	1.492	0.181	0.046
2012	0.329	0.319	2.497	1.474	0.188	0.049
2013	0.336	0.324	2.624	1.450	0.192	0.051
2014	0.329	0.325	2.553	1.458	0.188	0.051
2015	0.326	0.330	2.525	1.462	0.187	0.053
2000-2015 ²	0.255	0.310	0.784	-0.220	0.368	0.679

Notes: ¹The Williamson Index when the coefficient of variation is weighted by the population. ²Annual average growth rates for 2000-2015. Source: BD.EURS (NACE Rev.2) and own elaboration.

Table 2. Ranking of GVA per worker at NUTS-2 level, 2000-2015 (EU-13=1)

ISO	Region ¹	2000		2015	
		GVA/EMP ²	Ranking	GVA/EMP ²	Ranking
TOP 10					
UKI	London	1.70	1	1.63	1
FR10	Île-de-France	1.38	5	1.59	2
SE11	Stockholm	1.44	3	1.57	3
	Bruxelles-Capitale / Brussels				
BE10	Hoofdstedelijk Gewest	1.52	2	1.53	4
DK01	Hovedstaden	1.43	4	1.51	5
NL11	Groningen	1.32	9	1.50	6
BE31	Prov. Brabant Wallon	1.37	7	1.45	7
BE21	Prov. Antwerpen	1.30	10	1.43	8
BE24	Prov. Vlaams-Brabant	1.29	11	1.40	9
NL32	Noord-Holland	1.20	24	1.33	10
BOTTOM 10					
EL52	Kentriki Makedonia	0.59	147	0.59	147
PT15	Algarve	0.55	151	0.59	148
EL65	Peloponnisos	0.59	146	0.58	149
EL43	Kriti	0.53	153	0.58	150
EL63	Dytiki Ellada	0.54	152	0.58	151
EL61	Thessalia	0.56	149	0.56	152
EL54	Ipeiros	0.56	148	0.55	153
EL51	Anatoliki Makedonia, Thraki	0.52	154	0.52	154
PT16	Centro (PT)	0.43	155	0.50	155
PT11	Norte	0.42	156	0.48	156

Notes: ¹Regions in this column are ordered according to the 2015 ranking in the last column. ² These two columns represent the region GVA per worker with regard to EU-13=1 in 2000 and 2015 respectively. Source: BD.EURS (NACE Rev.2) and own elaboration.

Table 3. Shift-share components by sector and benchmark regions, 2000-2015

	Within industry											Labour reallocation
	Agricult	Utilities	Manuf	Constr	WRTAF	ICT services	Finance	Real estate	Prof services	Non-market services	TOTAL	TOTAL
Île-de-France (FR10)	2.31	-0.38	-3.04	2.30	-4.67	-1.83	-0.41	-3.62	-1.69	-1.37	-12.41	2.90
Stockholm (SE11)	-0.65	2.53	-7.34	2.91	-3.94	-1.54	-1.22	-2.49	-1.55	4.89	-8.39	2.56
Bruxelles-Capitale (BE10)	-6.64	3.90	-10.23	-1.79	-2.75	-0.34	-1.21	-1.79	0.02	-0.18	-21.01	8.96
Hovedstaden (DK01)	-2.47	11.82	-13.48	-0.78	-0.55	-2.45	-1.58	-0.67	1.63	-0.01	-8.53	2.78
Average region	0.07	0.37	0.27	-0.15	-0.68	-0.25	0.36	-1.26	0.07	0.39	-0.80	0.86

	Between industry											
	Agricult	Utilities	Manuf	Constr	WRTAF	ICT services	Finance	Real estate	Prof services	Non-market services	TOTAL	
Île-de-France (FR10)	-2.04	-0.22	2.42	-1.27	0.06	-4.64	-0.38	-0.22	1.02	0.04	-5.22	
Stockholm (SE11)	0.91	-1.23	4.38	-1.00	0.08	-5.55	-1.39	0.18	0.43	0.28	-2.90	
Bruxelles-Capitale (BE10)	7.12	-0.88	9.40	0.58	0.39	-1.67	-5.33	0.00	1.06	0.47	11.14	
Hovedstaden (DK01)	2.67	-6.33	8.34	-0.11	0.05	-5.53	-1.74	1.48	0.51	0.67	0.02	
Average region	0.28	-0.13	-0.34	-0.04	0.00	-0.53	-0.11	0.24	0.32	-0.07	-0.38	

Source: BD.EURS (NACE Rev.2) and own elaboration

