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Working Paper

Regional heterogeneity in occupational change: Using Census data to investigate employment polarisation and upgrading at NUTS-3 level

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Regional heterogeneity in occupational change: Using Census data to investigate employment polarisation and upgrading at NUTS-3 level

JRC Working Papers Series on
Labour, education and Technology
2022/03

Esperanza Vera-Toscano, Marta Fana, Enrique Fernández-Macías

LABOUR EDUCATION TECHNOLOGY

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Regional heterogeneity in occupational change: Using Census data to investigate employment polarisation and upgrading at NUTS-3 level

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Abstract

Using Census data, this paper proposes an empirical approach to look at differences and changes in the composition of employment across NUTS-3 level regions of six European Union countries over the period 1981 – 2011. We focus on jobs (defined as specific occupations within specific sectors) as our unit of analysis. We rank all jobs based on their average educational level and divide these distributions into terciles. We accommodate the approach to compare regions to their national average and see how they evolve compared to the national trend. Our aim is to determine if regional employment structures converge over time and whether they are polarising, upgrading or downgrading. Several hypotheses regarding possible underlying factors of structural changes are further discussed. Results show a high degree of heterogeneity in the different regions. This presents considerable challenges for policymakers, as they need to gear their efforts at regional, more localised level.

Keywords: Job polarisation; economic restructuring; technological change; Census data; regional heterogeneity.

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- Hurley, J., Grubanov-Boskovic, S., Bisello, M., Vacas-Soriano, C., Fana, M., & Fernández-Macías, E. (2021). European Jobs Monitor 2021: Gender gaps and the employment structure, Eurofound and European Commission Joint Research Centre, Dublin.

Executive summary

Using Census data, this paper proposes an empirical approach to look at differences and changes in the composition of employment across NUTS-3 level regions of six European Union countries over the period 1981 – 2011. We focus on jobs (defined as specific occupations within specific sectors) as our unit of analysis. We rank all jobs based on their average educational level and divide these distributions into terciles. We accommodate the approach to compare regions to their national average and see how they evolve compared to the national trend.

Our aim is to determine if regional employment structures converge over time and whether they are polarising, upgrading or down-grading. Several hypotheses regarding possible underlying factors of structural changes are further discussed. Results show a high degree of heterogeneity in the different regions. This presents considerable challenges for policymakers, as they need to gear their efforts at regional, more localised level.

Results show that we can differentiate between general trends and peculiarities. In terms of general trends, we have found evidence of some degree of convergence in the regional occupational structures of the countries analysed over the last four decades. This convergence is driven by sectorial trends which are to some extent shared: the continuing decline of agricultural employment, which resulted in a decline of low-quality jobs in some of the less developed regions; a less advanced but equally significant process of deindustrialisation, which generated net declines in mid-quality jobs in many rich non-capital regions; and the continuing expansion of public sector jobs, which, especially in less developed regions, drove the expansion of high-quality employment. However, this mild but significant convergence has to be qualified in at least two ways. First, this convergence has been stronger in the middle layers of employment than at the extremes: in other words, there are fewer regions characterised by middling or polarised occupational structures (to a large extent, because of the previously mentioned process of deindustrialisation), while most of the observed differences in the regional occupational structures tend to be related to the concentration of good and bad job. This relates to the second qualification to the mild convergence observed: it should be noted that even if the degree of regional occupational differentiation is slightly smaller than four decades ago, it remains very significant. The capital regions are still in all cases concentrating a disproportionate share of all the good quality jobs, with less developed regions concentrating most of the bad quality jobs. In fact, this axis of regional concentration of good vs. bad quality jobs has been slightly reinforced by the increasing disappearance of the category of industrialised regions concentrating large shares of mid-quality jobs.

And of course, these general trends should not obscure some important peculiarities across the six countries analysed. Perhaps contrary to expectations, our analysis has shown that capital regions did not always grow in terms of employment (Austrian, Irish and Portuguese capital regions declined in relative terms over the last few decades), nor did they always upgrade in occupational terms (in fact, over the last few decades all the capital regions with declining employment also downgraded in occupational terms, as well as the Greek capital region despite its increasing employment). Each of the countries analysed had some interesting peculiarities to note: the virtuous occupational impact of economic modernisation in Spain and Portugal, the striking association between employment growth and occupational downgrading in Greece, the notable stability in the regional occupational structures in Austria and Ireland despite rapid economic growth, and the strong and highly idiosyncratic process of regional occupational divergence observed in Romania (a case where the previously mentioned general trends hardly apply).

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1 Introduction

There is abundant literature in social sciences about the patterns of occupational change in advanced economies (Autor et al., 2006; Goos & Manning, 2007; Goos et al., 2009; Oesch & Rodríguez-Menés, 2011; Oesch, 2015; Fernández-Macías & Hurley, 2017). Most of these works focus on developments at the country level, typically finding either job polarisation (i.e., an expansion of low and high-paid jobs at the expense of those in the middle) or occupational upgrading (i.e., a relative expansion of high-paid jobs vs the rest). Some exceptions exist for specific periods or countries, such as occupational downgrading or a relative expansion of mid-paid jobs (Fernández-Macías & Hurley, 2017). The factors studied as possible drivers of these national patterns of occupational change include routine-biased technical change (RBTC) and international trade, labour market deregulation and institutional transformation, and secular shifts in labour supply (i.e., educational upgrading, increasing female participation and migration).

Storper's (2013) evidence shows that interregional economic divergence within countries grows in many developed economies. These heterogeneities are likely to affect the occupational structure of the different regions, with significant socio-economic implications. The employment structure across occupations and sectors and its change over time are crucial determinants of the employment opportunities and life chances available to the working-age population in a given region or country. Therefore, regional heterogeneity in occupational structure change is likely to impact the development of future social and productive forces, affecting productivity, social mobility and inclusive growth, and providing income redistribution challenges for governments. Efforts to understand and project changes in occupational distribution need a localised, regional lens.

Few studies look at recent patterns of occupational change at the regional level, and in nearly all cases, they focus on regional differences within a specific country. The two countries where this has been more researched are Germany (Dauth, 2014; Senftleben-Konig & Wielandt, 2014; Blien & Dauth, 2016) and the United Kingdom (Kaplanis, 2007; Jones & Green, 2009; Lee et al., 2015). Less evidence is available for other countries such as Spain (Consoli & Sánchez-Barrioluengo, 2016), the Netherlands (Terzidis et al., 2017) and Italy (Aimone et al., 2021). These studies find equal or larger differences in the trends of occupational change by region than between countries. Yet, the same dominant patterns of job polarisation and upgrading tend to be observed. A cross-national perspective on the regional patterns of occupational change, which, to our knowledge, has only been attempted by Hurley et al. (2019), may uncover different regularities and allow for further generalisations in this respect.

This paper proposes an empirical approach to look at differences and changes in the composition of employment across NUTS-3 level regions of six European Union (EU) countries over the period 1981 – 2011. We borrow and complement the approach followed in Hurley et al., (2019), which examines nine EU Member States and compares their regions to an EU-average (for those nine countries). Our purpose is to compare regions to their national average (in these six countries) and see how their occupational structure evolves relative to the national trend. One of the main interests of this research lies in its approach to analysing regional heterogeneity in changes in the employment structure, which can be applied to any geographical area.

Our aims are: (1) To see which regions within the six EU countries studied are most (least) like each other and to determine if regional structures are becoming more alike or less alike over time; (2) To analyse regional differentials in occupational change over the period 1981-2011 identifying patterns of job polarisation and occupational upgrading; and (3) To discuss several hypotheses regarding possible underlying factors behind these changes and the way particular sociodemographic groups are affected by it.

Our paper contributes to the debate on regional heterogeneity in occupational change in at least two unique ways. First, to the best of our knowledge, this is the first study to systematically analyse short- but also long-term- patterns of employment structural change in a number of EU countries by region. The availability of Census data since 1981 allows us to do so. This is relevant because one might want to use the observed changes in occupations over time to shed some light on the evolution

of the demand for labour in the near future. Second, this study takes advantage of NUTS-3 level regional information instead of the NUTS-2 level employed in Hurley, et al., (2019). Given the geographical dimension of the demand and supply for/of labour (often defined by commuting patterns and distances), NUTS-3 probably reflects the natural boundaries of local/regional labour markets better than NUTS-2. Identifying these shifts in occupational and sectoral employment and how these vary across regions can help policymakers understand how structural change contributes to unbalanced regional growth patterns.

2 Literature Review

This section discusses empirical evidence of structural change and the theoretical arguments pleading for either occupational upgrading or polarisation.

On the one hand, there is a group of scholars who argue that change in the employment structure behind the increase in wage inequality strongly depends on the deployment of ICT and automation technologies. According to this argument, known in the literature as Routine Bias Technical Change, employment expanded in occupations which are complementary to technology, while it contracted in those occupations whose main activities (tasks) can be substituted by machines (Acemoglu and Autor (2010); Goos, Manning and Salomons (2009); Autor and Dorn (2013); Autor, Katz, and Karney (2006)). Another argument in favour of polarisation focuses on labour supply. More specifically, recent migration flows boosted the polarisation phenomena (OECD, 2008, p. 83). Thus, the United Kingdom and the United States attracted high-skilled and many low-educated migrants from Eastern Europe (Oesch, 2013, p. 96) and Central America (Wright & Dwyer, 2003, p. 309), respectively.

However, empirical evidence on the shape of structural change is mixed. According to Fernández-Macías, 2012; Oesch and Piccitto 2019; Fernández-Macías, et al., (2016) and Hurley et al. (2019), European countries have been characterised by high heterogeneous patterns as well as a major upgrading trends instead of polarisation. According to Oesch and Piccitto (2019) upgrading characterises the European experience of the past 40 years where technology constantly increased the demand for high-skilled staff at the expense of low-skilled personnel, where the onset of globalisation shifted labour-intensive mass production from the North to the South, and where educational expansion massively augmented the supply of mid- and highly qualified workers (Crouch, 1999; Tåhlin, 2007). Overall, educational expansion and migration surges could have been pull factors facilitating the relative increase of qualified occupations in most cases and the relative increase of low-paying jobs in a few cases, thus providing a supply-side explanation of the difference between cases of pure occupational upgrading and cases of job polarisation observed across some European countries. In line with this argument, Oesch (2013) shows that occupational upgrading closely tracked educational expansion in most countries, with few exceptions (in particular, Spain and the United Kingdom), yet the surges of migration in some developed economies over the last few decades facilitated an expansion of low-paying jobs (Oesch, 2013; Krings, 2020) and greater polarisation.

The RBTC hypothesis as main driver of structural change (and increasing wage inequality) has been questioned by other strand of studies (see for instance Di Nardo and Card, 2002). Three main sets of counter-arguments are nowadays well established in the literature. Employment shifts could be seen as a result of changes in aggregate demand (Madariaga, 2018; Gregory et al.,2001). Moreover, according to Gregory et al. (2001), the contribution of trade, measured by exports and domestic shares in final consumption, has a positive impact on high skill jobs in the manufacture sector while the opposite occurs for low tech manufactures. Similar results are provided by Bogliacino et al. (2013) where the intermediate demand strongly affects job creation while trade does not show any significant role. Still, final demand and its composition are shaped by societal class structure and the way socio-economic institutions shape them. This second line of explanation puts institutions (i.e., minimum wage legislation, union density, contractual flexibility, etc.) as main driver of structural employment change (Esping-Andersen (1990); Oesch (2015), Wright and Dwyer (2003); Oesch- Rodríguez-Menés (2011); Cirillo (2016).

Interestingly, this well-established literature on shifts in the employment structures of advanced economies tends to focus on developments at country level, and, in many cases, is predicated more or less explicitly on the prevalence of patterns of employment polarisation or (less often) employment upgrading at national level.

Relatively few studies look at recent shifts in employment at regional level in detail (Dauth, 2014; Senftleben-Konig and Wielandt, 2014; Blien and Dauth, 2016 for Germany; Kaplanis, 2007; Jones and Green, 2009; Lee et al., 2015 for the UK; Consoli and Sanchez-Barrioluengo, 2016 for Spain; Terzidis et al., 2017 for the Netherlands; and Aimone et al., 2021 for Italy). Overall, they highlight noticeable differences in the quality of employment at the local level, with heterogeneous patterns of different intensity that warrant further investigation and comparison from a cross-country perspective. More specifically, the degree of urbanisation can play an important role, with regions that are initially more urbanised more likely to have a polarised employment structure as shown by Dauth (2014) for the West German case. In particular, changes in employment patterns in capital cities appear to stand out vis-a-vis the rest of the country (notably in the United Kingdom) more than the rural vs urban dichotnomy (Kaplains, 2007). The results also highlight the role of the public sector in providing good-quality employment, reducing inequalities and mitigating regional differences (Jones and Green, 2009). In terms of the forces behind these changes at local level, several studies conclude that there is an association between job polarisation at local level and the concentration of routine jobs, emphasising the role of technological change in polarising the employment structure by displacing routine, mid-paid jobs. At the same time, local demand is also a very important factor contributing to increased employment in low-skilled services, notably generated by the presence of highly skilled workers, which leads to consumption spillovers.

Among empirical works on regional employment trends in Europe, the European Jobs Monitor 2019 (Hurley et al., 2019) is the only one which analyses regional employment shifts across several European countries, highlighting regional heterogeneities both within countries and across them. Regional changes do not necessarily mirror country average confirming the relevance of intra-country investigations. In particular, two patterns emerge for most of the regions: polarisation and downgrading. Both trends characterise some French, UK, German regions, while both Spanish and Italian regions experience a relative expansion of low-paid jobs (downgrading) between 2002 and 2015.

Furthermore, findings suggest that capital regions are those experiencing polarising trends, while employment in largely rural regions (for the six countries covered, 2002-17) continued to be skewed towards low-paid jobs but this skew was much milder in 2017 than in 2002, suggesting some relative improvement of aggregate job quality. Although no analysis on the determinants of such trends have been performed, the authors show in detail the contribution of sectoral specialisation across regions and patterns.

3 Empirical approach

3.1 Using the job-based approach to monitor the evolution of employment structures over time.

In order to study the evolution of the employment structures over time across different regions of the EU, we adopt the jobs-based approach extensively followed in the literature (U.S. Council of Economic Advisors, 1996; Wright and Dwyer, 2003; Goos et al., 2009; Autor 2010; Oesch, 2015; Fernández-Macías and Hurley 2017). First, this methodology uses jobs as the unit of analysis, defined as specific occupations within specific sectors.[1] The two concepts of occupation (hierarchy of roles) and sector (horizontal distribution of economic activities) correspond to two fundamental dimensions of

[1] Established international classifications of occupation (the International Standard Classification of Occupations, ISCO) and sector (NACE) allow operationalising this jobs-based approach using various national data sources available such as the Labour Force Surveys (LFS) or the Census data used in this paper and widely documented later in this section. The extensive harmonisation of ISCO and NACE measures across countries ensure international comparability.

the division of labour within and across organisations, making the approach intuitive and conceptually coherent. Next, a measure of job quality (based on their average educational level in this case, as we will explain later) is assigned to each of those jobs to construct job-quality rankings, which are then grouped into a number of job quality tiers. The approach consists of ranking and grouping the jobs according to their quality and then studying the change across time in the number of workers across the different tiers of job quality. Thus, for example, the polarisation argument is based on the observation of faster growth of the top and bottom tiers with respect to the middle tiers (that is, a relative expansion of the extremes vs. the middle of the structure of the jobs). Given this focus, we now present some details on the data used and the methodology followed for accommodating the estimation approach to a regional analysis using Census data.

3.2 Data and main variables.

Our analysis uses Census data extracted from the Integrated Public Use Microdata Series (IPUMS) (Minnesota Population Center, 2019). Table 1 provides detailed information on the years used and the population of each country studied. Samples were restricted to workers aged 22 to 64 reporting to be employed with valid data on the occupation and industrial sector.

Table 1. Sample composition

Countries	Years	Sample design	Sample fraction	Sample size 2011
Ireland (IE)	1981-1991-2002-2011	A 10% random sample of the recoded household records from each county was selected.	0.1	474,535
Greece (IE)	1981-1991-2001-2011	A systematic sample of one in 10 households drawn by the Hellenic Statistical Authority/IPUMS	0.1	1,470,071
Spain (ES)	1981-1991-2001-2011	A systematic sample of every 10th dwelling, drawn by the country	0.1	4,107,465
Austria (AT)	1981-1991-2001	A systematic sample of every 10th private household after a random start; 100% data of institutional households; drawn by Statistics Austria	0.1	839,501
Portugal (PT)	1981-1991-2001-2011	A systematic sample of every 20th household with a random start, drawn by the country	0.05	528,870
Romania (RO)	1992-2002-2011	A systematic sample of one in 10 households given a random start, drawn by the National Institute of Statistics.	0.1	1,991,024

To the best of our knowledge, few studies have used Census data to study patterns of occupational change (see Murphy & Oesch, 2018 using national data for Switzerland and Ireland; and Consoli & Sánchez-Barrioluengo, 2016 using NUTS-3 level data for Spain). Census data is a very appropriate source to study shifts in the employment structure at the regional level for at least three reasons. First, it provides extensive samples that allow for very granular analysis of the labour market structure, including combining the variables of region, sector, and occupation. Second, it is one of the few data sources which provides relevant information at NUTS-3 level for a number of countries. The nomenclature of territorial units for statistics (NUTS) is a geographical classification system, according to which the territory of the European Union is divided into hierarchical levels. The four hierarchical levels are NUTS-0, NUTS-1, NUTS-2 and NUTS-3. This classification enables cross-border statistical comparisons at various regional levels within the EU. NUTS-3 represents the smallest territorial unit within this classification, corresponding to provinces in Spain, districts in Austria, prefectures

in Greece, regional authorities in Ireland, a group of municipalities in Portugal, and counties in Romania.[2] Beyond the critical role that regions play in EU policymaking, notably in cohesion policy, much differentiation in economies, labour markets and employment structures are visible only with a detailed region-based analysis as the one presented here. Third, the Census data allows extending the regional analysis of these six European countries over three decades (the 1980s, 1990s, 2000s). Fernández-Macías & Hurley, (2015) already considered four decades of analysis but only at the national level. Census data offers a unique opportunity to identify short - and long-term - patterns of employment structural change at regional and national levels.

Using the Census data contained in the IPUMS database, we adopt the fundamental elements of the jobs approach, as follows:

- *Jobs as our unit of analysis*. The variable OCCISCO of the IPUMS database[3] records the person's primary occupation. For someone with more than one job, the primary occupation is typically the one in which the person has spent the most time or earned main labour income. These schemas are translated into ISCO-88 at the one-digit level in IPUMS, providing nine occupational groups[4] . In addition to occupations, we use the available information on 15 economic sectors. The industry codes (variable INDGEN) are relatively comparable across samples. The groupings roughly conform to the International Standard Industrial Classification (ISIC).[5] Thus, we define a job as each cell in a matrix defined by crossing nine 'occupational groups' and 15 'economic sectors'. Jobs (combinations of OCCISCO and INDGEN) with fewer than 30 observations were collapsed into neighbouring jobs.[6] More specifically, we combine neighbouring jobs across neighbouring 'economic sectors' given their greater similarities. In other words, we give preference to occupation in the definition of jobs, because the same occupation across different sectors tends to be more similar than the same sector across different occupations (see Fernández-Macías et al. 2017 for a discussion of the relative importance of occupation and sector in determining labour market positions). In the European Jobs Monitor reports up to 2017 and other relevant literature (Wright and Dwyer 2003; Goos et al. 2009), the level of detail has generally been defined by the combination of two-digits for both occupation and sector, although there have also been many different approaches (for instance, ISCO at the three digit level without any differentiation by sector, as in Oesch and Piccitto 2019; or one digit in both occupation and sector as in this paper, for instance in Oesch and Murphy 2016). While the two-by-two-digit classification may be preferable because it provides a good compromise between granularity in the definition of jobs and comparability (see Elias, 1997)[7], the unavailability of this information together with the fact that we are studying jobs at a regional level (which in practice implies adding a third

[2] Local Administrative Units (LAU) are even smaller geographical areas. However, this level of disaggregation is not available from Census data.

[3] It is worth noting that as indicated in IPUMS website '*The classification of occupations differs across countries and within countries over time. The OCCISCO coding scheme provides a common standard to ease comparison across time and space. It is unavoidably imprecise because some samples fit the ISCO classification better than others, or provide more detailed categories. Sometimes the logic of the original classification suggested a particular interpretation of a given occupational title, but it was no more than inferential. In general, OCCISCO tends to be more comparable within countries than across countries.*' Since our analysis does not compare occupations across countries but across regions within countries (which are consistent by definition), as discussed later on in the text, we do not think this is a limitation.

[4] Excluding armed forces, other occupations, unspecified or n.e.c. and unknown.

[5] Yet, there were numerous judgments calls in making the differing industry classifications conform to INDGEN. Not all categories are available in all samples because of the nature of the underlying classifications. More information available at: https://international.ipums.org/international-action/variables/INDGEN#comparability_section

[6] Murphy and Oesch (2017) who use Census data to study occupational change at national level in Ireland and Switzerland also followed this approach for the definition of jobs.

[7] "*There is a sharp improvement in agreement rates between coding frames which are compared at the 2-digit level as opposed to the 3-digit level. The further improvement at the 1-digit level is not so marked*" (Elias 1997: 11).

variable to define the jobs, increasing the granularity of the analysis considerably) justifies the use of this more aggregated data.

- *Ranking jobs by their quality*. It should be emphasised that this approach does not generally aim at studying the evolution of job quality as such, but to evaluate structural change in employment from the perspective of job quality. Thus, job quality is a tool for evaluating structural change, not the object of analysis on its own. In this paper, we use the average educational level[8] of workers in each country and job as a proxy for job quality. While in the majority of studies using this approach, jobs are ranked and classified by their wages (the higher an occupation's median wage, the better the occupation) this information is not available in IPUMS data. Thus, we opted for using the average educational level of workers in each job as a proxy, a decision that can be justified in three ways: (a) from a standard economic perspective, the educational level is associated with productivity, which is a direct determinant of pay and working conditions (Muñoz de Bustillo et al., 2011, pp. 29-45); (b) from a credentialist perspective, educational titles provide advantages for workers in their competition for the best jobs (Blaug, 1985); and (c) the educational level of workers is obviously associated with the skill requirement of jobs, which, in many perspectives, are a direct component of job quality (Green, 2007). In more practical terms, it has been shown that the correlation between the ranking of jobs (occupation-sector combinations) by education and wages tends to be very high (around or above 0.8, corresponding to a joint variance of the two rankings close to two thirds of the total; see Hurley et al. 2013 and Fernández-Macías 2010). As reported by Fernández-Macías, et al. (2017), the one persistent and probably structural trend has been for good-quality jobs to grow faster than poorer-quality jobs – regardless of the measure used to assess the quality of the jobs, although using an educational ranking tends to produce slightly less polarisation because some of the jobs typically declining in the middle (semi-skilled industrial occupations) tend to occupy middling positions in terms of wages but lower in terms of (formal) educational credentials (see Hurley et al. 2013 and Fernández-Macías 2010 for more details; see also Oesch and Piccito 2019).
- *Terciles as job-quality tiers*. Given our interest in identifying polarisation and upgrading within the employment structure of NUTS-3 regions in six European countries, we classify occupations into three groups of approximately equal size (terciles), ranked from lower to higher educational attainment. Jobs with the highest average educational attainment are assigned to the third tercile (good jobs), those with lower education to the first tercile (bad jobs).

Although in this paper we adopt these fundamental elements of the jobs approach, it was necessary to make some important adaptations to make this approach fit for the kind of regional analysis with Census data which we do here.[9] These adaptations are necessary for several reasons. First, the level of heterogeneity of the initial employment structures of regions tends to be much higher than that of countries. The typical (country-level) analysis of occupational change focuses on what types of jobs grow or decline over a specific period, abstracting from initial structural differences: this is much more problematic when analysing regions because the initial structures are so different that abstracting from them can lead to wrong conclusions. Second, whereas countries can be considered as relevant units of analysis of structural employment change (because they correspond to some extent to independent labour markets), regions have to be considered instead as sub-units of a bigger entity (the national labour market). The natural point of reference of occupational change at the regional level is the overall trend at the national level, much more than the initial occupational structure (which is the usual reference point of national analysis). Finally, the fact that we cover such a long period

[8] Up to four different levels of education were defined: less than primary completed, primary completed, secondary completed, university completed. Occupation-sector combinations are rank-ordered by the mean educational attainment of the workers in the first year of study. See Table A1 in the Annex for correlation between educational rankings across periods.

[9] These adaptations are broadly in line with the ones previously used by Hurley et al (2019) for regional analysis at the EU level, with some exceptions that we will explain.

of analysis (four decades, spanning across different occupation and sector classifications) creates comparability problems for the underlying classifications that have also to be considered.

We used a modified version of the jobs approach previously explained for all these reasons. Essentially, this adaptation involves differentiating two levels of analysis:

1. At the **national level**, we use a completely standard jobs approach to provide context for the subsequent regional analysis. In a nutshell: using census data, we calculated employment levels by occupation and sector pairs in each of the countries analysed, in the beginning and end of the period; then, we ranked occupation-by-sector combinations (jobs) according to their average educational level at the beginning of the period; then, we grouped those jobs in three groups, initially holding the same quantity of employment (one-third each), and corresponding to low-, medium- and highly-education jobs; and finally, we calculated how much did each of those three job quality tiers change over time. Relative growth at the top tercile with respect to the other two corresponds to upgrading, relative decline of the middle tercile with respect to the other two corresponds to polarisation, and so on. This is very much in line with the approach used in most of the literature, and as we will see in the next section, our headline results are also very much in line with previous research.
2. For the **regional level**, the approach is rather different but consistent and complementary. Of course, the underlying data, periods and countries are the same. For the first year of analysis, employment is distributed across occupation-by-sector combinations (jobs), which are then ranked by their average educational level in each country and assigned to three equal-sized groups (low-, medium- and high-education jobs). Then, those three groups are used to characterise the initial employment structure in each region of that country: if a given region has a more polarised employment structure than the overall country where it belongs, it will have larger relative shares of employment in the lower and upper terciles. The same exercise is repeated for the final year of analysis: all national employment is distributed across occupation-by-sector combinations (jobs), ranked by their average education, and assigned to three equal-sized groups (terciles). The relative shares of employment in each of those terciles in each region can be then used to characterise the occupational structure in a given region compared to the national average at the end of the period. As a result of this exercise, we end up with two 'tercile distributions' for each region of a given country, one for the first year and one for the final year of analysis: the first one reflects how such a region differed in terms of its jobs structure to the overall country in the first year; the second one reflects how the same region differed from the country in the final year. Comparing the two relative pictures (the initial and the final), we can assess how a given region changed its occupational structure, always relative to the national average trends. If in the first year the region was polarised relative to the national average, whereas in the final year it was upgraded, we can say that such a region experienced a process of upgrading and negative polarisation (expansion of middle and upper terciles, decline of lower), relative to the national trends.

The focus of this paper is of course the regional level of analysis, but it is important to note that the national analysis should also be taken into account in order to get a full picture of the regional trends of occupational change. This is because the regional results do not on their own reflect the patterns of occupational change in a given region, but the degree of convergence or divergence in the occupational structure of a given region with respect to the national average over a given period of time. Findings at the regional level will tell us how a region has converged or diverged to the national patterns; then, the national patterns themselves will show us towards what trends did the regions converge or diverge. This is especially important if we want to compare regions across countries. Two regions experiencing a similar process of upgrading relative to their country averages, but where the country averages are downgrading in one case and upgrading in the other, will in fact have experienced very different occupational trends.

This approach is, in our view, a very efficient way to solve the previously mentioned challenges of analysing occupational change at the regional level. First, under the revised approach, we achieve a radical simplification of the analysis of the regional trends, focusing on the most relevant dimension for regional analysis, namely the degree of convergence or divergence of a given region with respect to the national average. Second, with this approach, we explicitly embed the analysis of each region within the analysis of the overall national patterns of occupational change, allowing to compare regions within the same country and even regions across countries. Finally, this approach also solves (at least partly) the comparability problems posed by the changes in the underlying classifications of occupation and sector throughout the period analysed. Since the regional analysis is done by comparing each region with the national average at a given point in time (therefore, with strictly consistent classifications), and then conducting a kind of second-order comparison between the degree of convergence/divergence in the first and final year, the potential problem of inconsistent classifications is minimised.

This paper borrows the methodology from Hurley et al. (2019) and complements it to some extent. Hurley et al. (2019) focuses on nine Member States: Belgium, Czechia, France, Germany, Italy, Poland, Spain, Sweden and the UK, for the period 2002 to 2017; it uses EU-LFS data, which allows to analyse regions at the NUTS-2 level of detail and jobs defined as occupations at the 3-digit ISCO level which are later on ranked (for job-quality purposes) based on wages. In this paper, we analyse six-member states (only one of which -Spain- was covered by Hurley et al. 2019), for a much longer period (1980 to 2010), and with the regional analysis conducted at the NUTS-3 level of detail, and jobs defined as combinations of occupations and sectors at the one-digit level and job-quality ranked based on education

4 Results

4.1 The context: changes in the employment structure at country level

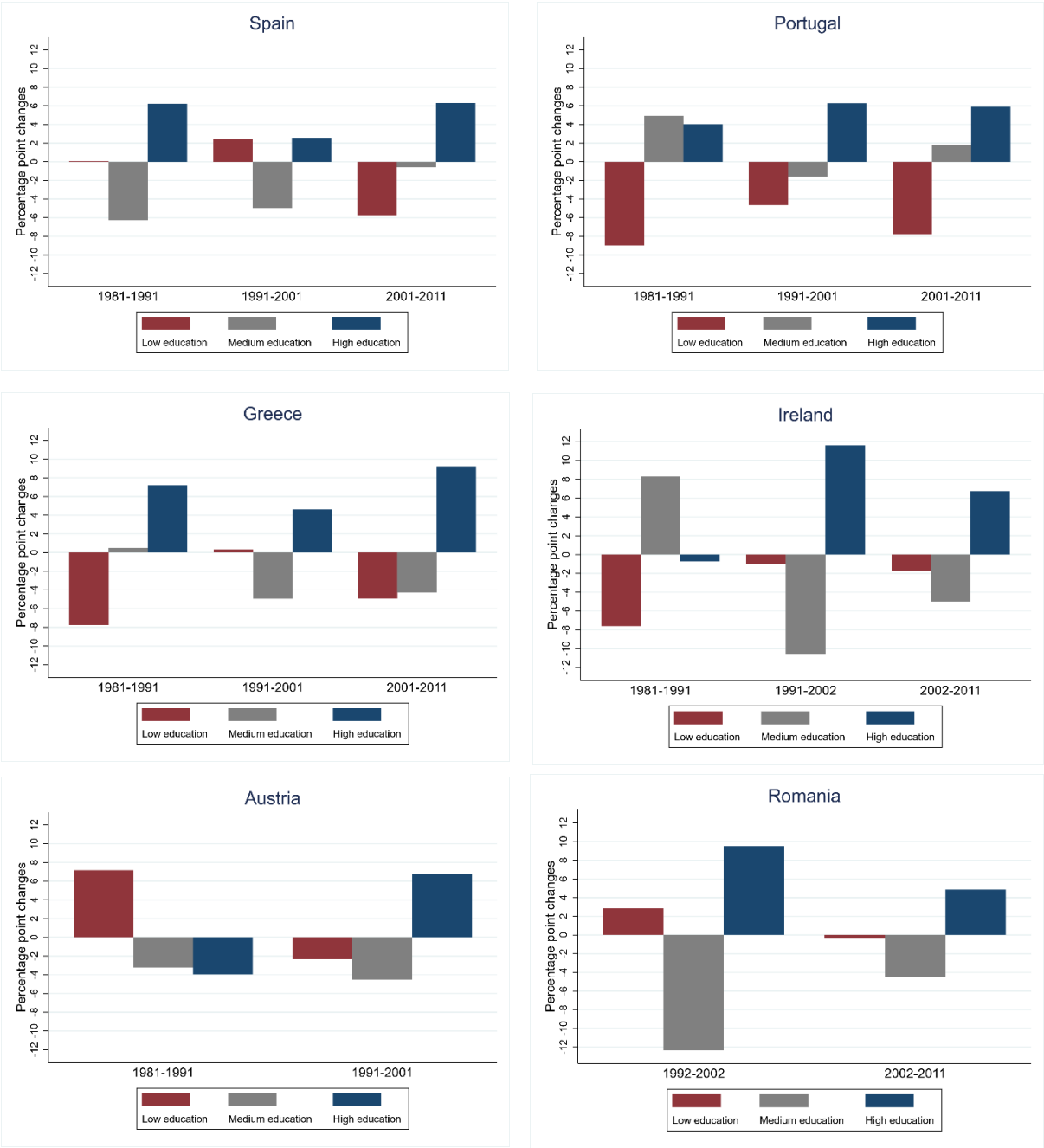
We start the analysis by looking at the national patterns of occupational change in the six countries studied. This will provide important contextual information, and the national level patterns should also be understood as representing the common (or average) trends of occupational change in all regions of each country, and should serve as reference for the rest of the analysis.

Figure 1 displays the patterns of occupational change across the three terciles (bad, medium and good quality jobs) for the six countries over the past three (two) decades. These results suggest considerable differences in patterns of polarisation and upgrading in different decades for the studied countries. As shown by the cumulative proportional changes relative to the base year (1981 for Spain, Portugal, Austria, Ireland and Greece and 1992 for Romania), the proportion of employment in the top tercile of jobs has significantly increased in all countries. However, the middle and low terciles changes present a more heterogeneous behaviour across countries and decades. These results justify the need for both country-level analysis (to investigate country heterogeneity in the changes in the employment structure) and decade-specific analysis. As already mentioned, the availability of three decades of information will allow exploring further the differences in the overall national patterns of structural change, both the short and longer-term.

For the case of Spain, our analysis shows an overall pattern of 'polarisation with strong upgrading'. The fraction of low-education jobs remained roughly stable between 1981 and 1991 to moderately increase between 1991 and 2001 and steeply fell in the last decade (2001-2011). Simultaneously, there was a pronounced fall in the fraction of employment in the mid-education occupations in the first two decades, which became muted in the final period. The proportion of employment in high education jobs increased across all periods, particularly in the first and last decade.

The patterns of occupational change in Greece between 1981 and 2011 imply a solid and consistent process of 'upgrading', with a uniform expansion of the top tier of jobs and either stability or decline for the bottom and middle tiers. Only in the 1991-2001 period can Greece be characterised as a mild form of 'job polarisation'.

Figure 1. Occupational change across terciles by decade and country.



Note: For Spain, Portugal, Ireland, Greece and Austria, 1981 terciles of occupations ranked by level of education were used as the reference to measure change. For Romania, the reference year was 1992.

Portugal experienced a steady decrease in the fraction of low education jobs and a significant increase in the share of high education jobs, which would qualify the country for 'strong upgrading'. The middle layer of jobs experienced less consistent trends, with significant growth in the first decade, a slight decline in the second, and a small increase in the third. Therefore, although Portugal is a case of overall occupational upgrading, there was some expansion in the middle, especially in the first period. Similar to Portugal is Ireland, whose changes in the occupational structure also reflect a long-running trend towards 'upgrading'. Also similar to Portugal, the first decade in Ireland showed a middle-bias in occupational change (with middle-education jobs strongly growing in relative terms).

For Austria, an 'upgrading' trend is very clear for the 1991 to 2001 decade. Still, it should be noted that the previous decade of 1981-1991 was characterised by an almost perfectly reversed pattern of 'downgrading'. If we aggregate the patterns over the entire period, Austria would be described as a case of 'job polarisation' because the net result of contrasting developments at the top and bottom of the occupational structure is positive. In contrast, the consistent trend of decline in middle employment implies a growing gap in mid-education jobs.

Last, Romania experienced some 'polarised upgrading' in the first decade examined. It mildly increased the share of low education jobs while more markedly increasing the share of high education jobs (consequently decreasing the percentage of middle education jobs). The second decade (2002-2011) shows a milder (less polarised) version of the same pattern.

The summary provided in Table 2 shows important contextual information for the rest of the analysis of this paper because it represents the change in the employment structure of the six studied Member States that will be the reference for the regional analysis.

Table 2. Summary of employment structure change 1981-2011 at country level

	Upgrading/Polarisation trend		
Country	**1981-1991**	**1991-2001**	**2001-2011**
Spain	Polarised upgrading	Polarised	Upgrading
Portugal	Mid-biased upgrading	Upgrading	Upgrading
Greece	Upgrading	Polarised upgrading	Upgrading
	1981-1991	**1991-2002**	**2002-2011**
Ireland	Middle-biased	Polarised upgrading	Polarised upgrading
	1981-1991	**1991-2001**	**2002-2011**
Austria	Downgrading	Upgrading	N/A
	1981-1991	**1992-2002**	**2002-2011**
Romania	N/A	Polarised upgrading	Polarised upgrading

How consistent are these broad patterns with those published in the specialised literature for similar countries and periods? As in previous research (Fernández-Macías & Hurley, 2017; Oesch & Rodríguez-Menés, 2011), we find a diversity of patterns of occupational change across countries and periods, with the dominant ones being polarisation and (in particular) upgrading. Also, in line with those previous studies, our evidence shows that the top tiers of the occupational structure (the most education tercile in our analysis) have tended to grow most consistently across countries and periods, whereas the low and middle tiers display more variation. It is more difficult to compare our results for specific countries with previous literature because the periodisation, data and measure of job quality are not the same. In Fernández-Macías & Hurley, (2015), a long-term analysis of the patterns of occupational change was carried out for Spain, using data from Labour Force Surveys rather than Census. Although the periods are rather different, the broad picture given by our analysis and that of Fernández-Macías & Hurley, (2015) for the last three decades in Spain is quite consistent. Both analyses show alternating periods of polarisation (especially in the early 90s) and upgrading (especially in the late nineties and early 2000s). We can also try to compare our findings with those of Oesch & Murphy (2017) for Ireland, in this case using the same type of Census data but unfortunately with very different periodisation and a different variable to proxy job quality and rank occupations (Oesch & Murphy use wages, while we use education). While we find mid-biased growth in the 1980s, they find polarisation; and while we find polarised upgrading in the 1990s and 2000s, they find unambiguous upgrading. This partial inconsistency in the case of Ireland serves as a reminder of the

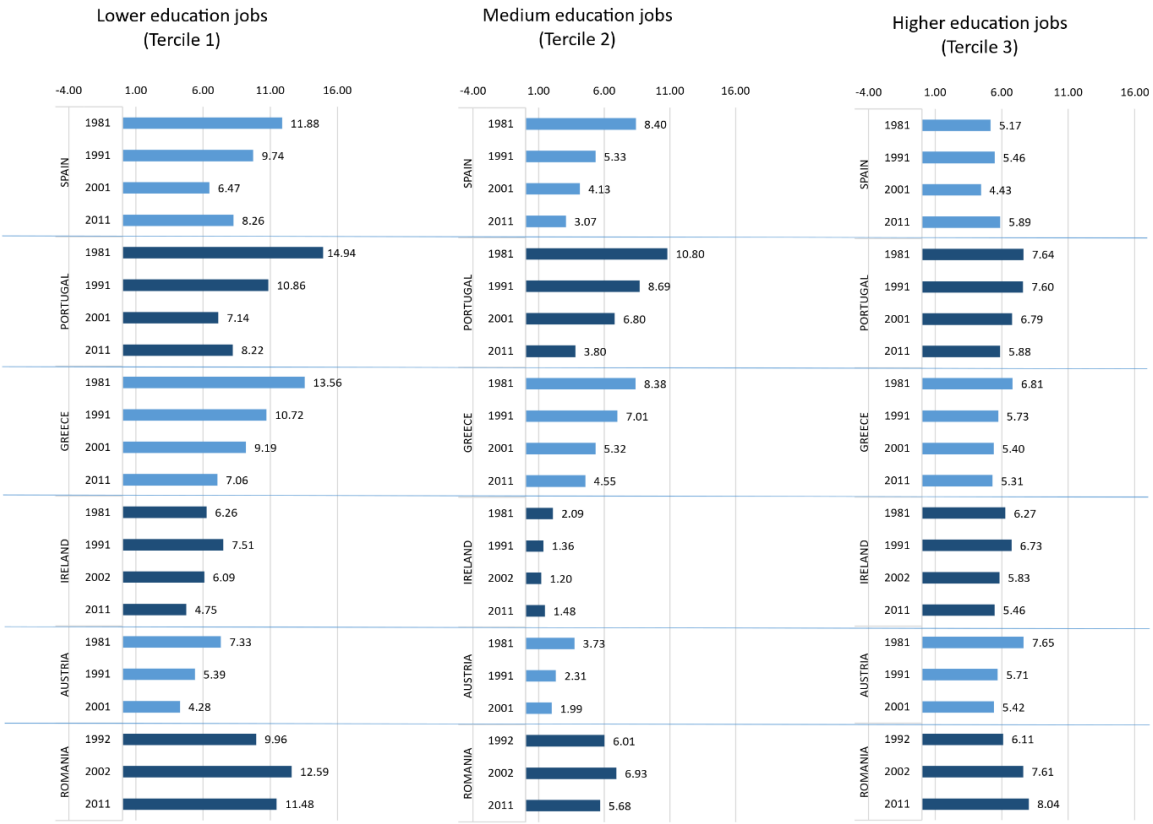
sensitivity of this kind of analysis to periodisation and job quality measures, which suggests caution in the interpretation of findings. Rather than focusing on small differences in details, this kind of analysis is most robust when focusing on broad patterns and trends. Having that in mind, it is remarkable that despite using a different data source to most previous studies, a different periodisation, and a different variable for proxying job quality and ranking jobs, the broad picture presented in Table 2 is indeed very consistent with previous similar studies.

4.2 A first look at changes in the employment structure at the regional level: convergence and divergence over time

To start exploring the difference between the national patterns of occupational change and the regional trends, we inspect the variability in the shares of employment by terciles across all regions within each country, as captured by the simple standard deviations of the regional percentages of employment in each tercile per country and period. Across the four decades, we can observe whether there has been a convergence or divergence in the regional occupational structures (relative to the national average) over time.

Figure 2 reveals some interesting facts that should help us link the national patterns discussed in the previous section with the regional deviations from those patterns we will discuss in the next section. First, there is generally more regional variability in the shares of employment in the lower and middle educational terciles than in the top. Thus, regions differ more in their shares of employment in low education jobs than in high education jobs. In other words: whereas some regions have high employment in low-education jobs and others very little, most regions have a similar share of high-education jobs. Second, in most cases, there was an important decline in the level of dispersion of the regional shares of employment in each educational tercile over time. In other words, the occupational structures of the regions (as represented by the shares of employment by job quality terciles) became more like the national average over time. This suggests a general trend towards convergence in regional occupational structures.

Figure 2. Regional convergence across terciles by decade and country as reported by the standard deviations.



Note: Standard deviations are calculated using the regional values of the share of people employed in each tercile for each year.

Third, we can see that the biggest convergence (as measured by the decline in dispersion) took place in the lowest tercile, and to a lesser extent in the middle tercile of employment. In fact, the dispersion in the regional shares of the top educational tercile did not move much over the 40-year period shown. Therefore, most of the convergence in regional occupational structures occurred because regions became less diverse in the share of employment in low and middle-education jobs. Fourth, three of the countries shown experienced much larger declines in their regional occupational dispersions: Spain, Portugal and Greece. Interestingly, these three countries are Southern European economies that joined the EU relatively late. They still had very sizeable agricultural sectors in the 1980s and experienced a late modernisation and economic restructuring in the 1980s to the early 2000s, with significant declines in agricultural and manufacturing employment and increases in public and private service sector jobs. Fifth, Ireland and Austria experienced comparatively mild changes in the dispersion of their regional occupational shares. However, those changes are similar to those observed in Spain, Portugal and Greece. To some extent, the milder trends in these two countries may be an artefact because of the relatively small size of these countries and the small number of regions used for the analysis (which may limit the amount of dispersion to be observed). Last, Romania stands out in this initial analysis as a clear outlier: it experienced a growing regional dispersion in the 1990s (in other words, a divergence in regional occupational trends) followed by a

mild decline in the 2000s (although not in high-education jobs). Throughout the entire period, Romania remains consistently the country with a higher level of regional differences in occupational structures, differences which do not change much over the period analysed.

4.3 Polarisation and upgrading across regions: a detailed look

Next, we move into a more detailed regional analysis and focus on the changes in the occupational structure of the different regions for the decades studied, relative to the national occupational structure in each country. To do so, first, we calculate for each year the difference between the share of bad jobs (lowest tercile of employment) in the region and in the country as a whole (which, by construction, is approximately 33.3%).

$$\Delta E(bad\ jobs)_{rt} = E(bad\ jobs)_{rt} - E(bad\ jobs)_{nt} \quad (1)$$

where $r = region; n = country; t = year; E(bad\ jobs) = share\ of\ employment\ in\ the\ lowest\ tercile$

Similarly, we calculate the difference between the share of good jobs (highest tercile) in the region and the country as a whole (again, approximately 33.3% by construction):

$$\Delta E(good\ jobs)_{rt} = E(good\ jobs)_{rt} - E(good\ jobs)_{nt} \quad (2)$$

A region with the same percentage of good and bad jobs as the country will have a value of zero in these differences (and for middle jobs, since the three must add up to 100). Thus, the values of these static indices of good and bad jobs in each region relative to the country average tell us how a given region differs from the average country occupational structure. If a region simultaneously has positive indicators for good and bad jobs, it has a more polarised occupational structure than the country; if it has a positive indicator for good jobs but a negative one for bad jobs, it has an upgraded structure; and so on.

These indicators have been calculated for the beginning and end points of the period studied for each county: comparing them, we can see whether a given region converged or diverged from the national average, and in what ways.

Next, we can also use more explicitly the difference between the initial and final values for the terciles for a given region to calculate indices of relative change in the occupational structure of regions, relative to the national average (which, again, is by construction fixed at 33.3% at all times).

$$Change\ in\ \%\ of\ bad\ jobs_r = \Delta E(bad\ jobs)_{rt} - \Delta E(bad\ jobs)_{rt-1} \quad (3)$$

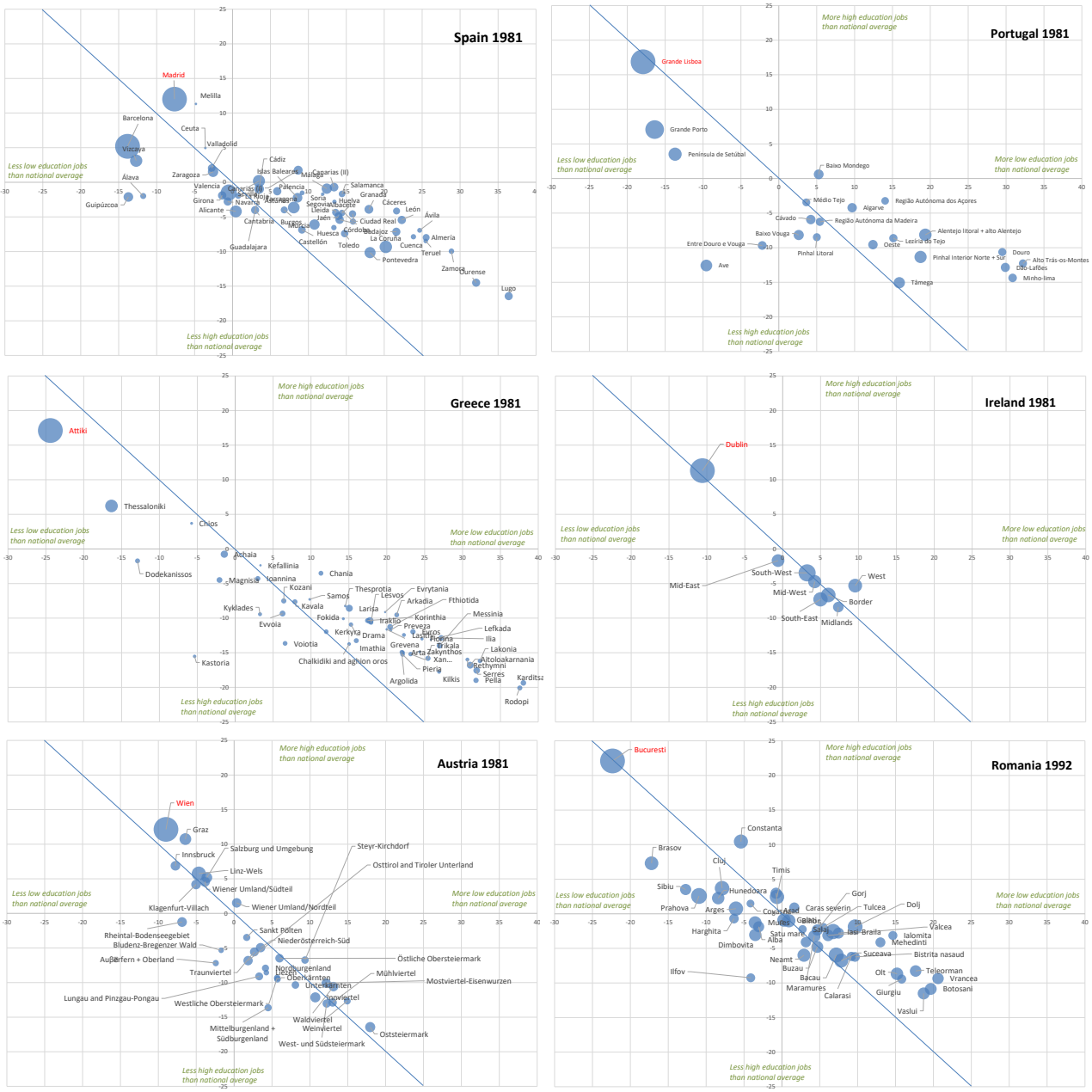
$$Change\ in\ \%\ of\ good\ jobs_r = \Delta E(good\ jobs)_{rt} - \Delta E(good\ jobs)_{rt-1} \quad (4)$$

These indices give us information on how a region changes its occupational structure relative to the country average and can be interpreted similarly in terms of job polarisation or upgrading patterns. When a region experienced a relative expansion (positive change in the respective indices) in the share of good and bad jobs simultaneously, we can say that it experienced a process of relative job polarisation compared to the national average. The magnitude of the values for the indices of change in good and bad jobs (comparable across regions and even across countries) can be used to assess and compare the extent of the observed structural changes. Declining values imply convergence to the national average and vice versa.

As we have repeatedly argued, it is important to remember that all the regional analysis is relative to the national average, and thus we are not describing patterns of job polarisation or upgrading per se, but with respect to the national average. To speak about job polarisation or upgrading in strict terms, we need to combine the analysis of this section with the analysis presented in an earlier section focusing on national patterns.

First, Figure 3 provides the relative difference between the employment structure of each region and its national average at the beginning of the period studied (1981 for Spain, Portugal, Greece, Ireland and Austria; 1992 for Romania).

Figure 3: Static relative polarisation and upgrading in regions compared to their national average in the initial year: 1981 for Spain, Portugal, Greece, Ireland and Austria; 1992 for Romania.



Note: The size of the bubbles reflect the relative importance in terms of employment of each region in the indicated year. Notice that bubble sizes are not comparable between countries.

This is the starting point of the changes that will be discussed in this section. These charts look remarkably similar in the six countries covered. The capital regions in the six countries are, often on their own, far away in the upper left quadrant (upgraded occupational structures), concentrating many of the good jobs of the respective countries. Then, going down in the diagonal we can find some of the rich non-capital regions of each country; in the case of industrialised ones (such as Barcelona and the Basque regions in Spain, or Porto-Setúbal-Aveiro in Portugal), they tend to be to the left of the

diagonal (mid-biased, concentrating mid-education jobs). Finally, the bulk of other regions tend to be lower in the diagonal but above it (downgraded and slightly polarised compared to the national average). The polarised and downgraded structure of these third group of regions in 1981 (1992 for Romania) is typical of still underdeveloped agricultural regions (concentrating many low-quality agricultural jobs, few mid-quality industrial and service sector jobs, and some high-quality jobs in public administration and services).

In short, the initial patterns of Figure 3 show that four decades ago, there was an important concentration of the good jobs in the capital regions, a downgraded and polarised occupational structure in the less developed regions, and an intermediate position concentrating mid quality jobs in some of the most industrialised (non-capital) regions.

Figure 4 represents the indices of relative change in the occupational structure for each studied country and its regions in the past four (three) decades. For each country, the horizontal axis represents the change in the percentage of bad jobs (equation 3), for each region between the first and last year observed. The vertical axis represents the change in the percentage of good jobs (equation 4). Each circle in these figures corresponds to a specific region. The size and colour of these circles reflect the change in employment share that each region represents over the total in each country (see the figure legend for details).

Moreover, whereas vertical and horizontal shifts imply changes in the share of good and bad jobs, shifts in the diagonals of each quadrant represent the four main patterns of structural change in the analysis, namely: (1) Upgrading, as regions move towards the top left quadrant; (2) Polarisation, moving on the top right quadrant; (3) Downgrading, moving on the bottom right quadrant; and (4) Middle-biased pattern, moving towards the bottom left quadrant.

Figure 4 shows significant differences in the patterns of change of the regional occupational structures of the 6 countries analysed.

Spain and Portugal experienced similar trends, with most regions spreading across the horizontal axis which represents middling (left of the diagonal) or polarizing (right of the diagonal) change. Some regions (such as the Galician regions of La Coruña, Lugo, Orense and Pontevedra) underwent a process of occupational upgrading simultaneous with a significant decline in employment (as indicated by the big empty bubbles), implying that most of the net decline in employment concentrated on low quality jobs, probably in agriculture. Some other regions underwent a process of job polarisation which is typically associated with deindustrialisation, although it is interesting to note that whereas in Spain this tended to be associated with net employment declines (Barcelona and Basque regions, historically industrial strongholds in Spain), in Portugal it was often associated with net employment growth in the polarising regions (as in Aveiro or Setúbal, also traditional industrial regions). Finally, it is interesting to note in both cases some important cases of middling (growth of mid-quality jobs) with significant employment expansions, suggesting a process of modernisation and employment concentration in some previously polarised agrarian regions (Málaga or Algarve).

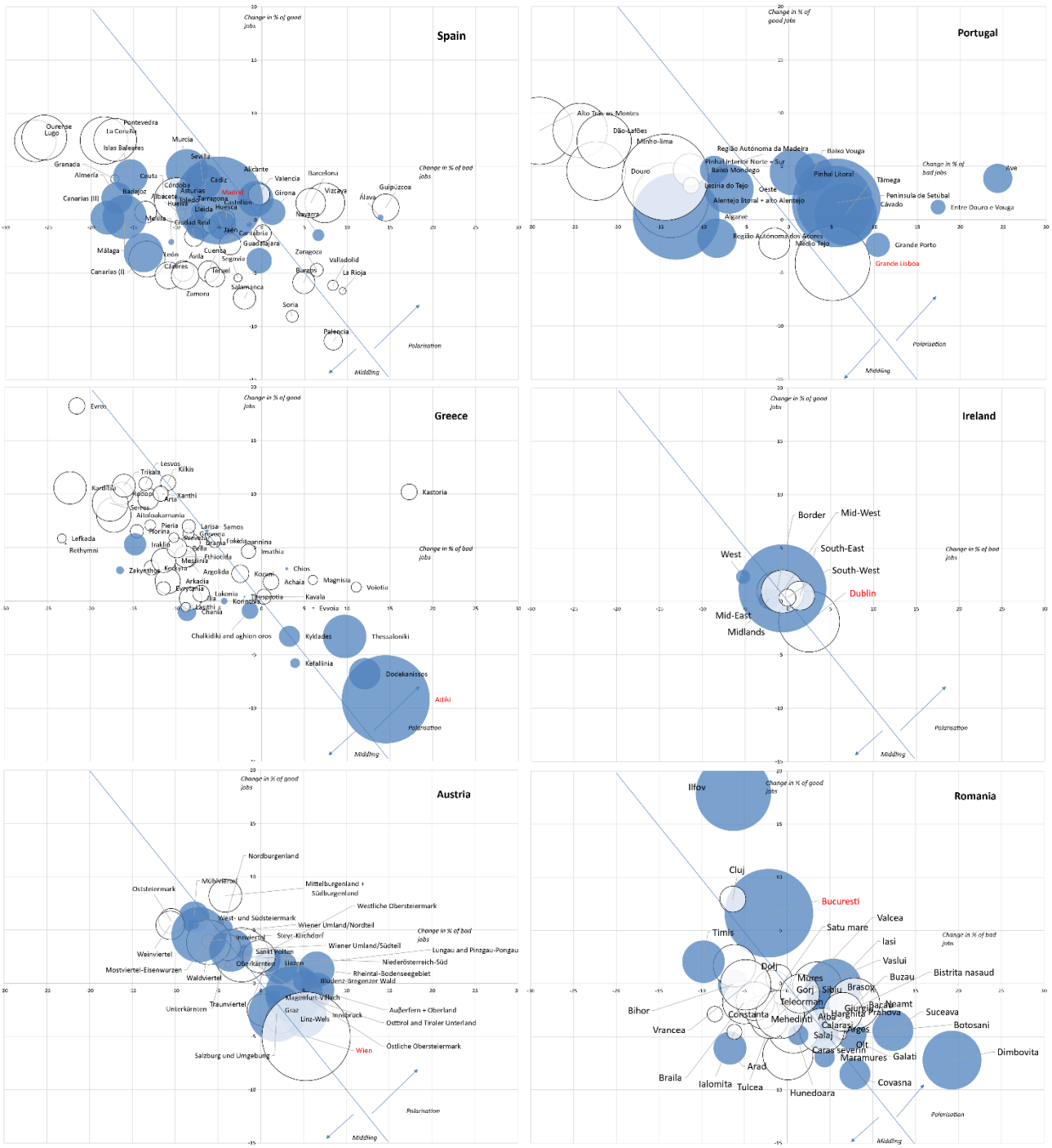
The patterns of Greece are very peculiar. Most of the regions expanding in employment experienced a significant occupational downgrading (the expanding employment was in low-quality jobs), whereas most declining regions experienced upgrading (the employment decline focused on low-quality jobs). This suggests a strong process of economic concentration in a few regions and a reallocation of low-quality jobs to the expanding regions. It is important to note that the disappearing low-quality jobs in the declining regions were probably agrarian, whereas the expanding low-quality jobs in the expanding regions are probably in private services.

Ireland and Austria show less change in the regional occupational structures in the last few decades (compared to the other countries analysed). It is important to remember that this does not mean that there was no occupational change in these countries overall: indeed, as discussed in the previous section, both Austria and Ireland experienced a strong process of upgrading from the 1990s, which as we can see now was more or less similarly distributed across regions. That said, there are still some interesting observations from Figure 4 to be made. In both Austria and Ireland, the capital

region declined in employment and downgraded in occupational terms (a pattern which is also observed in Portugal). And also in both countries, there are other (non-capital) expanding regions that are strongly upgrading in occupational terms. This implies a slightly more balanced pattern of regional growth than in other countries such as Spain or Romania. It is worth noting that, for the case of Ireland, this is in part an artefact on two counts: 1) the greater Dublin region in practice now encompasses Mid-East as an extended commuter belt (it was the Mid East region which recorded by far the greatest growth in employment). 2) the census data is household based, i.e., identifies the region of residence of the worker rather than the region of the workplace. Much of the Mid-East growth can be assumed to be related to employment in Dublin region.

Finally, Romania also shows peculiar patterns of occupational change. Although Figure 4 covers a shorter period for Romania than for other countries, the intensity of occupational change across regions was stronger (as indicated by the wider spread of the regional bubbles). The regions with more occupational change tended to be those expanding in employment. They concentrated on the diagonal extremes, implying a polarisation of employment by regions.

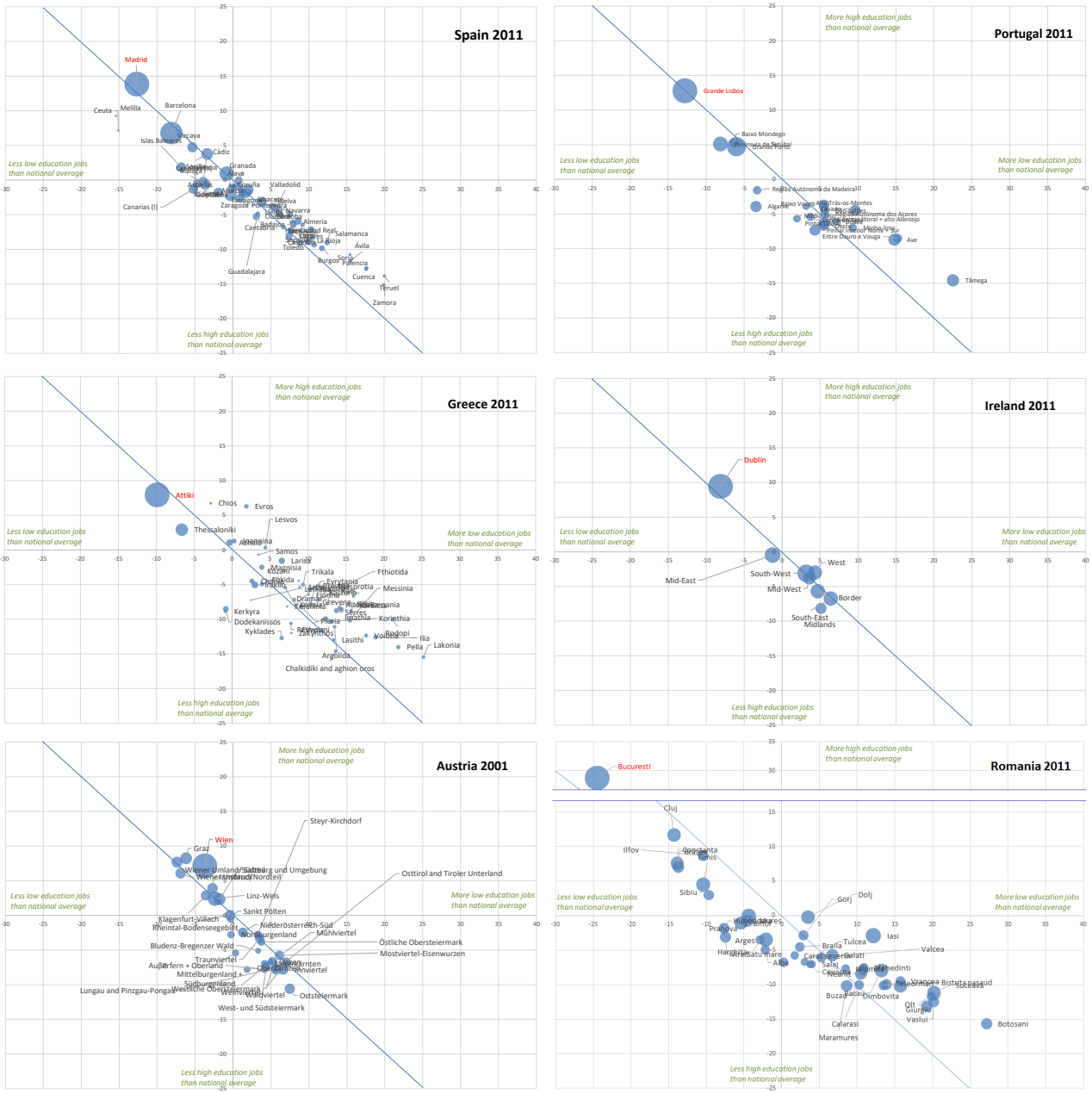
Figure 4. Changes in the regional employment structure compared to the national average in six EU countries, 1981-2011 (Spain, Portugal, Greece and Ireland), 1981-2001 (Austria), and 1992-2011 (Romania)



Note: Blue bubbles mean that the importance of the region employment compared to the national employment has increased between 1981 and 2001 (increase in the absolute number of jobs) while empty bubbles indicate that the importance of the region employment compared to the national employment has decreased during the same period (decrease in the absolute number of jobs). The larger the bubble the greater the increase/decrease in the number of jobs. Capital city regions are labelled in red. Notice that bubble sizes are not comparable between countries.

So what is the final result of these changes? Figure 5 helps getting an overall picture of the final impact of these occupational change across regions, by showing a final static picture of job polarisation and upgrading across regions in 2011 (2001 in Austria). Let's compare Figures 3 (initial regional occupational structures) and 5 (final).

Figure 5: Static relative polarisation and upgrading in regions compared to their national average in the final year: 2011 for Spain, Portugal, Greece, Ireland and Romania; 2001 for Austria



Note: The size of the bubbles reflects the relative importance in terms of employment of each region in the indicated year. Notice that bubble sizes are not comparable between countries.

We can see that in the last three or four decades there was some degree of convergence in occupational structures (indicated by the smaller spread of the regional bubbles in the final picture) simultaneous with a certain degree of regional polarisation (indicated by the increased concentration of regional bubbles along the diagonal which represents the level of concentration of employment in high-quality vs. low-quality jobs). This is because the regional distribution of economic development

in the last few decades has been affected by concentration, deindustrialisation and de-agrarization. The spatial concentration of employment has been in some cases in the capital regions (as in Spain, Romania or Greece), although in some cases it has instead concentrated in other rich regions while the capitals actually declined to some extent (as in Portugal, Austria and Ireland). The process of deindustrialisation has tended to reduce the importance of mid-quality jobs in some traditionally industrial rich regions, while the process of de-agrarization has tended to reduce overall employment but also reduce the importance of low-quality jobs in many less developed regions. In other words, the interaction between sectorial and regional patterns of economic development over the last few decades has on the one hand generated some convergence (removing some factors of regional differentiation), but it has also tended to concentrate the occupational differences across regions along the diagonal of high vs. low quality. In the next section, we will discuss some of these sectorial patterns in more detail.

4.4 Are the shifts in employment share by sector changing the employment structure of the regions?

Finally, to assess which economic sectors are contributing to changes in the occupational structure by region, we calculate the bivariate correlations between changes in the employment share of regional terciles and regional employment share by sector. In particular, we will provide evidence to support some hypotheses about the underlying sectoral drivers of occupational change that we advanced in the previous pages.

Findings in Table 3 can be summarised in four main insights. First, changes in the agriculture sector clearly dominate the evolution of the bottom tercile. This is especially true for Greece (corr=0.9), Spain and Portugal (correlation above 0.7) where the de-agrarization was strongly associated with the decline of employment in the bottom tercile in many regions. Second, changes in the manufacturing sector are often associated with the evolution of the middle tercile. Where there has been more deindustrialisation (fall of employment in manufacturing), there has been more polarisation (more relative fall in the intermediate tercile). In Spain, the strongest drops in manufacturing have been in the Basque provinces and Barcelona. All of them were very industrial in the 1980s and more services focused now, all of which were very 'polarising'. This 'polarising deindustrialisation' has been strongest in Romania and Spain, followed by Greece, Portugal and Ireland. In Austria, this effect seems quite weak (partly because Austria had already experienced some deindustrialisation before the 1980s, but also because its manufacturing sector was more resilient in the period analysed). Third, the public service sector contributes to explaining the top tercile's evolution in many regions, with the strongest effects observed in Greece and Ireland, followed by Spain and Austria, and then, Portugal and Romania. Last, perhaps surprisingly employment in services is not positively related to low-quality employment, in fact the relationship is often negative (particularly in Austria). On the contrary, it shows a positive relationship (although not very strong nor in all countries) with high-quality employment: in Romania and Austria, to a certain extent in Portugal and Ireland (but not in Spain or Greece). This probably reflects that the service sector aggregated at one-digit is quite heterogeneous, covering both low and high value-added services.

Table 3. Bivariate correlation between changes in the employment share of regional terciles and regional employment share by sector (percentage points changes between first and last year observed)

		Economic Sector			
		Agriculture	**Manufacturing**	**Private sector services[1]**	**Public sector[2]**
	Spain (1981-2011)				
Type of job (terciles)	Low-education (terc 1)	0.744	-	0.028	-
	Medium-education (terc 2)	-	0.858	-	-
	High-Education (terc 3)	-	-	0.292	0.633
	Portugal (1981-2011)				
Type of job (terciles)	Low-education	0.724	-	-0.407	-
	Medium-education	-	0.548	-	-
	High-Education	-	-	0.559	0.432
	Greece (1981-2011)				
Type of job (terciles)	Low-education	0.956	-	-0.372	-
	Medium-education	-	0.711	-	-
	High-Education	-	-	0.013	0.764
	Ireland (1981-2011)				
Type of job (terciles)	Low-education	0.855	-	-0.461	-
	Medium-education	-	0.530	-	-
	High-Education	-	-	0.539	0.736
	Austria (1981-2001)				
Type of job (terciles)	Low-education	0.827	-	-0.611	-
	Medium-education	-	0.154	-	-
	High-Education	-	-	0.609	0.633
	Romania (1992-2011)				
Type of job (terciles)	Low-education	0.849	-	-0.219	-
	Medium-education	-	0.880	-	-
	High-Education	-	-	0.794	0.465

Note: Changes in the employment share of regional terciles are calculated as the percentage point difference between 1981 and 2011
Changes in the regional employment by sector are calculated as the percentage point difference between 1981 and 2011

[1]Private sector services include wholesale and retail trade, hotels and restaurants, transportation, storage, and communication, financial services and insurance, business services and real estate, other services, and private household services.

[2] Public sector includes Public administration and defence, education and health and social work.

5 Conclusions

In the last few decades, there has been a vibrant debate in the social sciences about the nature of occupational change at the country level. Different countries and periods have been identified as job polarisation and occupational upgrading cases, providing a very useful comparative perspective of labour market trends at the national level. Until recently, this approach has rarely been applied to the comparative analysis of regional labour market trends, despite the fact that regional specialisation and integration patterns are likely to produce different paths in occupational terms, with obviously relevant policy implications. In this paper, we have adopted this methodology for the comparative analysis of regional occupational trends in six European countries, using census data. This data has important benefits for our purposes: most importantly, it provides samples which are consistent over long periods (four decades or more) and which are big enough to allow the analytical depth necessary for this analysis (which requires combining the variables sector, occupation and region). We had to make some compromises in order to use this data, reducing the detail of the classifications of occupation and sector and using education rather than wages to rank jobs. We also had to adapt the methodology, using the national occupational structure as a moving reference for the analysis rather than the initial occupational structure as a fixed reference. But these compromises and adaptations have allowed us to produce useful comparative evidence of occupational change at the regional level in these six European countries, which perhaps in the future may be adapted to other countries and periods.

To summarise the main findings of this paper, we can differentiate between general trends and peculiarities. In terms of general trends, we have found evidence of some degree of convergence in the regional occupational structures of the countries analysed over the last four decades. This convergence is driven by sectorial trends which are to some extent shared: the continuing decline of agricultural employment, which resulted in a decline of low-quality jobs in some of the less developed regions; a less advanced but equally significant process of deindustrialisation, which generated net declines in mid-quality jobs in many rich non-capital regions; and the continuing expansion of public sector jobs, which especially in less developed regions drove the expansion of high-quality employment. However, this mild but significant convergence has to be qualified in at least two ways. First, this convergence has been stronger in the middle layers of employment than at the extremes: in other words, there are fewer regions characterised by middling or polarised occupational structures (to a large extent, because of the previously mentioned process of deindustrialisation), while most of the observed differences in the regional occupational structures tend to be related to the concentration of good and bad job. This relates to the second qualification to the mild convergence observed: it should be noted that even if the degree of regional occupational differentiation is slightly smaller than four decades ago, it remains very significant. The capital regions are still in all cases concentrating a disproportionate share of all the good quality jobs, with less developed regions concentrating most of the bad quality jobs. In fact, this axis of regional concentration of good vs. bad quality jobs has been slightly reinforced by the increasing disappearance of the category of industrialised regions concentrating large shares of mid-quality jobs.

And of course, these general trends should not obscure some important peculiarities across the six countries analysed. Perhaps contrary to expectations, our analysis has shown that capital regions did not always grow in terms of employment (Austrian, Irish and Portuguese capital regions declined in relative terms over the last few decades), nor did they always upgrade in occupational terms (in fact,

over the last few decades all the capital regions with declining employment also downgraded in occupational terms, as well as the Greek capital region despite its increasing employment). Each of the countries analysed had some interesting peculiarities to note: the virtuous occupational impact of economic modernisation in Spain and Portugal, the striking association between employment growth and occupational downgrading in Greece, the notable stability in the regional occupational structures in Austria and Ireland despite rapid economic growth, and the strong and highly idiosyncratic process of regional occupational divergence observed in Romania (a case where the previously mentioned general trends hardly apply).

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Annex

Table A1. Correlation of ranking positions of different jobs by Census year

SPAIN	rank81	rank91	rank01	rank11
rank81	1			
rank91	0.8552	1		
rank01	0.8404	0.852	1	
rank11	0.8107	0.8809	0.9128	1

GREECE	rank81	rank91	rank01	rank11
rank81	1			
rank91	0.8947	1		
rank01	0.8248	0.892	1	
rank11	0.8096	0.8402	0.9241	1

PORTUGAL	rank81	rank91	rank01	rank11
rank81	1			
rank91	0.8501	1		
rank01	0.8306	0.8948	1	
rank11	0.8288	0.8846	0.9176	1

IRELAND	rank81	rank91	rank02	rank11
rank81	1			
rank91	0.8294	1		
rank02	0.8385	0.8982	1	
rank11	0.8412	0.8832	0.9422	1

AUSTRIA	rank81	rank91	rank01
rank81	1		
rank91	0.8084	1	
rank01	0.7558	0.8565	1

ROMANIA		rank92	rank02	rank11
rank92		1		
rank02		0.8964	1	
rank11		0.8808	0.9352	1

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