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Abstract

This paper analyses the long-term transformations of local labor markets in fifty Spanish provinces to identify the extent and the drivers of employment polarization. We find that the decline of 'routine' mid-skill jobs is strongly driven by technology adoption and, also, that it is a strong predictor of the expansion of low-skill service employment. These results are not specific to large metropolitan areas, and are robust to various controls and instrumental variables that account for long-term industry specialisation. We also find a positive, albeit small, local multiplier effect of high-skilled workers on the demand for non-tradable service jobs.

Keywords: Local labor market, Polarization, Multiplier

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1. Introduction

The goal of this paper is to analyze the evolution of the Spanish local labor markets over the period 1981-2011, an era characterized by profound social, political and economic changes. Give or take boom and bust cycles, the country's enduring struggle with high unemployment is often debated in terms of aggregate statistics with little, if any, appreciation for the transformations of the occupational structure. The present study fills this gap by identifying the technological, economic and demographic forces beneath the growth and decline of certain job categories.[1] Gaining a thorough comprehension of how occupational structures are organized, and of how they evolve, is essential to elucidate the pathways through which knowledge drives economic growth. To do this, the paper draws on two strands of research.

The first builds upon the tenet that industry classifications are ill-suited to capture the diversity of activities that are carried out within regions (Markusen, 2004). This resonates with empirical evidence showing that clusters exhibit significant heterogeneity in the attendant occupational mixes, and even if standardization reduces variety in later stages of the life-cycle, worker profiles still vary for the same industry (viz. industry code) in different regions (Christopherson and Storper, 1986; Saxenian, 1994; Gereffi and Korzeniewicz, 1994; Gray, 1998). Accordingly, scholars propose the alternative route of analyzing regional specialization by looking at what workers 'do' (e.g. occupations and skills) rather than what they 'make' (e.g. industry output) (Thompson and Thompson, 1985; 1993; Markusen and Schrock, 2006; Barbour and Markusen, 2007). Building on this, Feser (2003) shows that cluster constructs based on industry grouping (i.e. on the basis of input-output relationships) overlook important nuances of the local endowment of know-how that occupation-based analysis can fully account for. More recently, Renski et al (2007) also uncover significant differences when industries are grouped by labor content rather than by stage of the value chain. In the same vein, Markusen (2004) and Markusen and Schrock (2006) observe that industry is a poor predictor of occupational structure across US metropolitan regions.

[1] Throughout the paper we employ the term 'regional' in a generic way to denote various types of local economy including cities, metropolitan areas, provinces, commuting zones or regions. While acknowledging the important differences between these forms of spatial agglomerations we argue that they share sufficient similarities for the purpose of organizing a comprehensive literature review. Provinces are the unit of analysis for the second part of the empirical analysis but we prefer to couch the discussion in general terms to stress its relevance and usefulness in economic geography.

The idea that the local occupational mix is a reliable indicator of regional specialization connects with another relevant stream of literature, specifically empirical research on the polarization of labor demand. Using detailed information on the task content of occupations, Autor et al (2003) and Goos and Manning (2007) show that since the 1990s in, respectively, the US and Britain employment opportunities have increased for high- (e.g. managers, scientists, professionals) and low-skill (e.g. janitors, security guards, waiters and cleaners) occupations while demand for mid-skill jobs (e.g. clerks, production workers) has decreased. One of the main drivers of this process of structural change is the ubiquitous adoption of Information and Communication Technologies (ICTs) in production processes which, on the one hand, accelerated the replacement of jobs intensive in routine physical and cognitive tasks while, on the other hand, increasing the productivity of occupations for which problem-solving and interaction skills are important (Levy and Murnarne, 2004). In this process, low-skill occupations made it relatively unscathed through the computer revolution because their core work tasks entail physical dexterity and adaptability that are hard to automate (Autor and Dorn, 2013; Autor, 2015). More recently, Autor et al (2013) added to this body or work by showing that international trade, specifically trade with China, has been another crucial factor for recent structural changes in US local labor markets. Different from technology, however, the impact of trade competition on local labor markets is not limited to routine manufacturing jobs but affects also manual and high-skill jobs.

The task-based approach outlined above has gained traction among both scholars and policy-makers. To begin with, compared to other frameworks (i.e. skill-biased technical change) it offers a coherent account of the empirical patterns observed in the labor markets of US and Europe – especially the steady growth of demand for low-skilled workers (Acemoglu and Autor, 2011). Second, it provides a nuanced view of how disruptive forces like technology or trade affect selectively some work tasks (and the attendant skills) rather than causing job loss or worker displacement. Put otherwise, this approach accommodates the dual role of technology, both complementing and substituting human work – the computer being a good case in point. Third, it complements traditional labor economics by emphasizing qualitative changes in the content of occupations due to the emergence, decline or transformation of skills (Eurofound, 2015; Vona and Consoli, 2015). As regards its generality, plenty of studies confirm the pervasiveness of job polarization in Europe (Goos et al, 2014; Michaels et al, 2013) and in the context of other major technological transitions like electrification in the XIX century (Gray, 2013). Empirical work on polarization now covers the US (Autor and Dorn, 2013), Europe (Gregory et al, 2016) as well as individual countries (i.e. Adermon and Gustavson, 2011; Asplund and Barth, 2011; Dauth, 2014; Salvatori, 2015; Fonseca et al, 2015; Harrigan et al, 2016). The task-based approach has become popular also among economic geographers who study the impact of local occupational structures on competitive performance in metropolitan areas and regions (Bacolod et al, 2009; Feser, 2003; Scott and Mantegna, 2009; Scott, 2010).[2]

The convergence of these strands of research provides the backdrop to the present paper. Our goal is to analyze long-term changes in the employment structure of fifty Spanish provinces over three decades (1981-2011). In particular, we set out to address the following questions:

1. Have Spanish local labor markets experienced employment polarization?
2. If so, is there geographical correspondence between the decline of routine-intensive employment and the growth of low-skill service jobs?
3. Does high-skill employment have a positive effect on the demand for low-skill service jobs in local economies?

Our analysis yields five main findings. First, the structure of employment in Spain has polarized just like other advanced economies. With regards to this, the present study is an addition to a large catalogue of empirical studies, with the important caveat that labor market institutions in Spain are more rigid than the US or Britain. Second, there is a positive and robust correlation between the contraction of routine jobs and the diffusion of computing capital throughout the period. This is consistent with prior studies and it is a contribution to existing literature on polarization in Spain that has not assessed directly the impact of technology (Anghel et al, 2015; Donoso et al, 2015). Third, the expansion of low-skill service occupations (about +41%) and of high-skill workers (+57.3%) stand out together with a non-comparable increment of just 5.1% of employment in other medium to low-skill occupations (e.g. clerks, production workers,

[2] These two strands are also a challenge to established indicators of regional human capital such as total number of graduate residents or average educational attainment in the population. These are at best crude measures because they are disconnected from the dynamics of the attendant labor markets (see i.e. Florida et al, 2008; Boschma and Fritsch, 2009; Maleki, 2012; Gabe et al, 2013). This is even more so considering that the cognitive abilities acquired through education evolve along the career path and, thus, that human capital is not a stock but a flow of competences that are honed at the workplace.

construction) between 1981 and 2011. Fourth, tertiarization associated with low-skill service employment is stronger in regions with initial high level of routine occupations. This carries a number of implications considering that the bulk of service jobs are part-time and pay low wages compared to similarly medium/low-education occupations. Moreover, the demographics of low-skill workers has shifted from young to prime age which suggests that service jobs absorb part of the displaced routine workforce but, also, that younger cohorts may be crowded out from entry-level positions. Last but not least, the increase of the average educational attainment of low-skilled service jobs is strikingly similar to that of mid-skill routine occupations, which signals the possibility of skill mismatches. The fifth key finding of the paper is that high-skilled employment, especially among college workers, has a positive albeit modest effect on local job creation in non-tradable services. These results are robust to the inclusion of controls at province level as well as regional and year fixed effects.

The remainder of the paper is organized as follows. Section 2 describes the historical background of Spanish economy and provides information on the occupational structure at national and regional level. Section 3 provides empirical evidence of long-term changes in the structure of employment in fifty Spanish provinces and contains the empirical analysis of the drivers of these patterns. Section 4 summarizes and concludes.

2. Background and descriptive evidence

This section is organized in two parts. The first provides a synthetic overview of the empirical context under analysis, and pinpoints in broad strokes key phases of the recent economic development of Spain, while the second presents descriptive evidence on the evolution of labor markets, both at country- and province-level.

2.1. Key developments in the Spanish economy

Industrialization in Spain started in the second half of the 1950s, somewhat later than other Western European countries (Tortella, 1994). The process took off after the end of two decades of autarky propelled by strategic plans that mandated the creation of state-owned enterprises in the capital city Madrid aimed at maintaining control of strategic sectors (i.e. electricity, telecommunication). At the same time significant investments in infrastructure aided the consolidation of industrial clusters in Catalunya and in the País Vasco, of agriculture in rural regions (i.e. Castilla-La Mancha, Castilla y Leon, Aragon) and of the nascent tourism industry in coastal areas (i.e. Comunidad Valenciana and the islands). Against this backdrop Andalucía stands as an exception due to a diversified economy that blends tourism, agriculture and low-tech manufacturing. The 1970s challenged the status quo. Early in the decade growing international competition led to the relocation of manufacturing towards areas that enjoyed proximity to the traditional clusters while at the same time offering lower labor costs. This aided the emergence of newcomers such as Aragon, the northern province of Comunidad Valenciana, La Rioja and Navarra (Betran, 2011). The oil shocks of the mid-1970s however suffocated this development and worsened the conditions of peripheral agricultural areas that suffered significant outflows of population. The juxtaposition of the slump and of the so-called transition to democracy (1975-1978) shaped critical consensus around the need to change the model of economic development.

Our analysis focuses on the period 1981-2011, an era of profound institutional, economic and social transformations that stemmed from the context outlined above. The 1980s were characterized by structural reforms – including the devolution of competences to regions, a labor market reform, and the accession to the European Community – as well as policies that sought to rejuvenate the industry mix by, first, dismantling unprofitable state-owned enterprises and, second, by promoting the reconversion of manufacturing (Vasquez-Barquero, 1987). Aided by external circumstances such as the fall of oil prices and favorable exchange rates the Spanish economy entered an era of rapid expansion. As regards the geographical distribution of these processes, during the 1980s manufacturing consolidated around traditional poles like Barcelona, Bilbao, Valencia, Burgos and La Rioja, and expanded in formerly agriculture-intensive provinces such as Castellon, Guadalajara, Toledo and Asturias where new industries emerged as a response to increased foreign investments and booming domestic demand. At the other end of the spectrum industrial reconversion led to the closure of plants in northern provinces (i.e. Guipuzcoa and Valladolid) that had specialized in now obsolescent sectors or that lacked the capacity of scaling up activities to meet growing demand. All the while, peripheral provinces like Zamora, Ciudad Real, Badajoz, and Caceres saw the expansion of the construction industry (Tortella, 1994).

The 1993-1996 recession brought to a halt the prosperity of the previous decade due to a combination of falling domestic demand and growing foreign competition. This was the beginning of de-industrialization which, in spite of being rather generalized, had uneven consequences. The provinces that are home to the largest cities successfully reoriented their productive bases. Thus, Madrid continued to enjoy its status of capital city to attract high-end business services for telecommunications, transport, energy and banking; Catalonia's industrial capacity embarked on a slow reconversion from manufacturing of textiles to production of automobiles and chemicals; the region of Valencia became a seedbed of a rather diversified portfolio of medium-tech manufacturing activities such as toys, ceramics, furniture, shoes. In other regions this period entailed industrial restructuring and increasing specialization, for example in Aragon, La Rioja and Navarra. In stark opposition to these cases, the northern regions that hosted traditional industries like ship building, metal production and mining entered in decline – i.e. Castilla y Leon, Cantabria and the País Vasco.

Likewise, the impressive acceleration of the Spanish economy between the late 1990s and the mid-2000s did not entail shared prosperity. Some areas exploited new transportation infrastructures to attract foreign investments as well as skilled immigrants – i.e. Andalucía, Murcia and Valencia – while the decline in the north continued unabated, with the only exception of the País Vasco which recovered from the slowdown of the 1990s after successfully reconverting industry capacity towards advanced manufacturing, especially renewable technologies, pharmaceuticals and electrical equipment (Prados de la Escosura, 2003).

Summing up, the Spanish economy has gone through three main phases over the last thirty years: early industrialization, de-industrialization and the recent re-industrialization. Through these commotions the regions home to large cities - Madrid, Catalonia, País Vasco - proved resilient and adaptable through cycles of boom and bust, each in a distinctive way, while other regions took the risk of redirecting their established industrial base, whether it be manufacturing clusters in the north or service-intensive activities in the Mediterranean shore.

2.2. Descriptive evidence

The present study analyzes the evolution of labor markets in fifty Spanish provinces (NUTS 3) through the period 1981-2011.[3] The main data source is the decennial Population and Housing Census Survey (Census)[4] from which we extract and aggregate

[3] Ceuta y Melilla are excluded from the analysis due to their peculiarities: these are two provinces home to autonomous cities in the North of Africa with low administrative competences compared to other Spanish provinces. See map in Figure 6 Panel B for a guide.

[4] More information available at: http://www.ine.es/en/censos2011_datos/cen11_datos_inicio_en.htm

information on individuals' residence, sector of employment and main occupation at province-level.[5]

2.2.1. The evolution of occupational structure at national level

To create occupational categories we select full- and part-time private sector employees and assign each observation to a province on the basis of residence.[6] Following Acemoglu and Autor (2011), and using the 1991 CNO as a guide, occupations are assigned to one of three groups: low-skill non-routine manual (NRM) (i.e. service jobs such as cleaners, janitors); mid-skill routine (ROU) (i.e. clerks or machine operators); and high-skill non-routine cognitive (NRC) (i.e. managers, professionals).[7]

Using these categories as a reference, Figure 1 illustrates the long-term changes in the structure of the overall workforce. The first indication is that that, akin to what has been observed in several other countries, the Spanish labor market exhibits the trademark characteristics of employment polarization: between 1981 and 2011 the demand for routine jobs has increased by just 5.1%, well below the growth of low-skill NRM occupations (+40.9%) and of high-skill workers in NRC occupations (+57.3%). Interestingly, the decline in demand for ROU occupations was more pronounced during the 2000s while acceleration was faster for of high-skilled NRC jobs in the 1980s and during the 1990s for NRM jobs.

FIGURE 1 ABOUT HERE

Figure 2 shows the breakdown of changes in employment for finer job categories. Among routine occupations, employment of production/craft workers decreased in the 1980s and in the 2000s after remarkable growth in the intervening period. Such a pattern sets production jobs apart from other routine occupations that grew mostly during the first decade. Also construction jobs plunged in recent decades after an initial boom in the 1980s, while demand for high-skill occupations like sales and professionals grew mostly in the 1980s. Finally, executive-level positions expanded rapidly in the 1990s. These patterns resonate with a recent analysis of the changes in the occupational structure in Spain in the aftermath of the great recession (Anghel et al, 2014), and add to

[5] Although the original source of information for this survey is the Spanish Statistical Office, the 1981 database has been provided by iPUMS. More information at: https://www.ipums.org/

[6] We use the weighting factor provided by the national office of statistics. Since data for Census 1991 do not include a weighting factor, we applied a value of 20 for each individual following the iPUMS version of the same database for this year.

[7] See Annex A.

it by offering a longer term perspective. [8] The decline of mid-skill occupations also resonates with the findings of a study on the impact of international trade on the province-level employment in Spain (Donoso et al, 2015).

FIGURE 2 ABOUT HERE

In this picture the expansion of low-skill service jobs stands out, especially when compared to the sluggish growth of other similarly low-skill occupations (i.e. in construction, transportation, mechanics, farm, mining, production and craft). This trend is of interest for a number of reasons.

First, low-skill service employment accounts for the highest share of part-time jobs. Figure 3 illustrates the evolution of employment structure at the beginning of each decade in the three groups of occupations broken down by full-time workers, i.e. those who have a contract for the maximum number of hours allowed by law (40 hours per week) and part-time workers. At the beginning and at the end of the period, part-time jobs represent less than one fourth of employment in all types of occupations while this percentage increases in between. In 2011 part-time employment falls across all occupations, probably as a result of the economic crisis. These figures resonate with a broader international trend (see OECD, 2015) and highlight that NRM occupations account for the highest percentage of part-time workers through the entire period, reaching more than 40% of the workforce in 1991.

FIGURE 3 ABOUT HERE

Second, service jobs are at the bottom of the hourly salary scale and entail a non-negligible wage gap compared to similarly low-educated occupations. Since the Census does not include information on wages, we retrieve the Spanish Structural Salary Survey (SSS) for years 1995, 2002, 2006 and 2010. [9] These data are matched with the Census by means of the Spanish national occupation classification (CNO) code.[10] The SSS draws on a questionnaire that includes information on annual wages and number of hours worked by individuals. Using this we calculate the average hourly wage for the CNO principal group (adapted from ISCO-88). Because this is a unique code, we re-

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[8] Anghel et al (2014) focus on a shorter timespan: 1997-2012.

[9] Further details on the Structural Salary Survey at the website of the Spanish national statistical office: http://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736061721&menu=ultiDatos&idp=1254735976596 (Last Access: September 2016).

[10] We unified information from CNO-94 and CNO-11. Conversion Tables are available upon request.

assign the classification of SSS codes to CNO- three categories as proxy for the occupations.[11] Table 1 shows that in spite of the increase between 1995 and 2010 (5.85 to 9.97 euros/hour) low-skill service jobs clearly suffer a substantial wage gap of about 53% compared to other low-skill occupations.

TABLE 1 ABOUT HERE

Third, the mean age of NRM workers has increased. To illustrate this, we split workers in three groups: young (less than 29 years old); prime age (between 30 and 54) and older (over 54 and less than 65). We then calculate the percentage of each age category over the total of service workers as well as increments in each decade and in the full period.[12] Table 2 shows a clear aging of workers in service jobs, with a decline of more than half of young individuals accompanied by a 64% increment of prime age workers. This is suggestive of the extent to which displaced routine workers with work experience have been reabsorbed in jobs with a lower skill profile.

TABLE 2 ABOUT HERE

Yet another interesting feature is that the average level of education of service workers in Spain is relatively high. Figure 4 plots the usual occupational groups broken down by education levels: while around 25% of NRM workers were non-educated in 1981, this share decreases considerably in the 1990s and afterwards. In fact, over the period under analysis the level of education of workers in NRM and ROU occupations becomes strikingly similar. This resonates with previous work showing that the share of overqualified workers in Spain is twice that of other OECD countries (Dolado et al, 2013; Montalvo, 2013; OECD, 2010).

FIGURE 4 ABOUT HERE

2.2.2. The evolution of the occupational structure at province level

Recall from Section 2.1 that the regions home to Madrid, Barcelona and Bilbao maintained prominence through periods of growth and of recession, while de-industrialization pushed other manufacturing-intensive regions towards decline. Breaking down employment figures by province and by occupational group we observe in Table 3 that in 1981 routine occupations had the highest shares in two areas: (i) in industrial provinces of the north-east such as Alava, Guipuzcoa and Navarra specialized

[11] Matching table is available by request.

[12] Percentages do not sum 100% because there are some workers outside these intervals.

in the production of machinery, transport material and plastics, as well as metal extraction; and (ii) in eastern and south-eastern provinces home to manufacturing of shoes and leather products – i.e. Castellon, Alicante, Valencia (Comunidad Valenciana) – and to agro-food industries, like in Murcia and Jaen. Also the distribution of non-routine manual jobs is polarized between touristic destinations – i.e. Las Palmas, Tenerife (Canarias), the Islas Baleares, and Malaga (Andalucía) – and rural north-west provinces – i.e. Zamora, Avila Salamanca, Segovia (Castilla y Leon).

TABLE 3 ABOUT HERE

The table also shows significant decline in the demand for routine jobs in 2011 in all the manufacturing-intensive provinces mentioned above, as well as Barcelona and Madrid. It is important to reiterate however that these two mega cities exhibit largely diversified local economies, which is a prerequisite to adjust to de-industrialization. Indeed, Madrid has specialized in high-value intangible activities like finance and business services, while Barcelona reoriented its manufacturing capacity towards production and design of high-technology (Pérez and Sánchez, 2002). It is not surprising then that these two cities account for the highest shares of employment of non-routine cognitive occupations such as managers, executives and professionals. Conversely, while the demand for low-skill service occupations has increased everywhere, growth was especially high in manufacturing-intensive provinces such as Alava, Guipuzcoa, Vizcaya, Alicante, Valencia and Castellon.

To investigate the geographical distribution of these changes in employment across provinces we resort to the graphical inspection of Figure 5. In panel A, each province is shaded depending on the fraction of workers that were employed in routine jobs in 1981. Higher quintiles are colored with darker tones while the lowest quintiles in lighter colors. Using the same color coding we denote in panel B the changes in the employment of non-routine manual workers between 1981 and 2011. A comparison of the two panels confirms significant overlap between provinces with highest exposure to the contraction of manufacturing and those that have experienced the strongest tertiarization. As expected, in 1981 routine employment was most concentrated in the manufacturing poles in northern (i.e. País Vasco and Navarra) and eastern (i.e. Comunidad Valenciana) provinces. Three decades later, the same provinces have experienced the fastest growth of service employment. A similar pattern, if less intense, can be observed in Catalonia and Cantabria.

FIGURE 5 ABOUT HERE

Lastly, the scatter plot in Figure 6 offers yet more evidence with an OLS regression of initial share of routine employment and of changes in shares of NRM employment between 1981 and 2011 per province. The explanatory power of this bivariate relationship is substantial and confirms the positive correlation between initial routine employment in 1981 and subsequent growth of low-skill service employment.

FIGURE 6 ABOUT HERE

Building on these insights, the next section explores the main drivers of employment polarization in Spanish provinces.

3. Empirical analysis

This section is organized in three parts. After focusing on the relation between technological change and routine occupations, we elaborate an econometric analysis of the determinants of the growth of low-skill service employment, and an assessment of the role of high-skill occupations in the demand for non-tradable service jobs.

3.1. Is technology adoption stronger in routine-intensive provinces?

Previous literature suggests that the diffusion of automated processing is a prime cause of employment polarization (Autor et al, 2003). To test this conjecture, we assess whether local technology adoption was higher in routine-intensive Spanish provinces. The proxy for technology adoption is total investment (in 2011 thousands of euros) in office and industrial machinery per employee in each province (Source: Fundación BBVA).[13] Accordingly, we estimate the capital-labor substitution by means of first-stage-estimates regressions as follows:

$$\Delta Machinery_{jrt} = \alpha + \beta_1 ROU_{jt_0} + \gamma_r + e_{jrt} \qquad (1)$$

where the dependent variable is the change in investments on machinery per full time employee between t_0 and t_1 in area j. ROU_{jt_0} is the share of routine employment at the start of each decade in province j, γ_r is a vector of regional dummies and β_1 the coefficient of interest capturing within-province variation. Standard errors are clustered at region level (see Table 3 for the correspondence between provinces and regions).

[13] Stock and capital services in Spain: territorial and sectorial distribution. More information available at: http://www.fbbva.es/TLFU/microsites/stock08/fbbva_stock08_i31.html

The estimates of Table 4 indicate that a one percent increase of employment in routine occupations at the beginning of each decade is associated with an average 120.000 Euros increase of investments in industrial machinery (column 2) and 100.000 Euros in total machinery (i.e. office plus industrial) (column 3). Looking at the distributional characteristics, these estimates imply that a province at the 75th percentile of Routine Intensity (e.g. Alicante) experiences an average growth of total machinery investment that is 7% higher (8% in the case of industrial machinery) than that of a province at the 25th percentile (e.g. Cadiz).[14] This confirms the expectation that capital for labor substitution is stronger in areas with initially higher intensity of industrial activity and, thus, of routine task specialization.

TABLE 4 ABOUT HERE

3.2. Is routine employment a driver of the growth of service occupations?

As shown above, employment polarization is substantially driven by the growth of low-skill service occupations. Following previous literature we expect a rise in NRM jobs to be most pronounced in initially routine task-intensive labor markets where the potential for displacement of non-college labor from routine activities is greater. Table 5 offers a long-term view by regressing routine employment share on the change in service occupation at the beginning of each decade. The relationship is weak prior to the 1990s but becomes highly significant in the 2000s. Tellingly, the implied difference in NRM growth between the 75th and 25th percentile provinces from one decade to the next jumps from 4 to 9 percentage points.

TABLE 5 ABOUT HERE

Next, we consider a broad spectrum of factors that may influence the employment structure across provinces. In particular, we control for the human capital stock, local labor demand conditions, specific demographic characteristics that may influence local demand as well as local human capital creation capacity. Accordingly, we estimate the following model:

$$\Delta NRM_{jr,(t_1-t_0)} = \alpha + \beta_1 ROU_{j,t_0} + \beta_2 X'_{j,t_0} + \gamma_r + \varepsilon_{jrt} \qquad (2)$$

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[14] The population-weighted interquartile range of routine employment share averaged between 1981 and 2011 is 0.067.

This equation stacks the three decades between 1981 and 2011, so ΔNRM_{jrt} is the change in the employment share of service employment in province *j*, region *r*, over each decade, ROU_{jt_0} is the province share of routine employment at the beginning of each decade and $X^{'}_{jt_0}$ is a vector of controls at the start the of period. Table 6 shows the results of OLS first stage estimates that include also time period effects and province effects. The main specification of Panel A is repeated for college (Panel B) and non-college (Panel C) workers separately.

TABLE 6 ABOUT HERE

Looking at Panel A, model 1 presents a pooled specification with the ROU share measure, time dummies and regional dummies. The main coefficient of interest shows that a one percent increase of routine employment share at the beginning of the decade yields a 1.08% increase of service jobs' share. This is robust to the addition of various controls. Model 2 accounts for shifts in the human capital endowment by adding the ratio of college or more to non-college (i.e. no schooling, basic schooling, professional training) in the population (source: Census) as a measure of the capital stock. In Model 3 we control for a structural characteristic of local labor markets, namely the unemployment rate at province level (Source: Eurostat). Model 4 includes the share of individuals older than 65 years for each province which is expected to influence the demand for services, and thus for NRM jobs (Source: Census). In Model 5 we add number of universities to account for local human capital creation capacity.[15] After the inclusion of all the socio-demographic control variables, the main coefficient of interest in Model (6) remains positive and significant. In Models (7) and (8) we control for geographical factors by means of dummy variable, which is equal to 1 for large metropolitan areas as well as the interaction of the latter with mid-skill employment, and conclude that the effect of ROU employment on service jobs is not specific to the largest cities in Spain.[16] When the full set of controls is included, in Model (8), the main coefficient of interest is 30% higher than the basic specification (Model 1). Estimates in

[15] Information about the year of birth of the universities is available from individual university websites and the Official State Gazette (Boletín Oficial del Estado in Spanish).

[16] Metropolitan areas are: Barcelona, Madrid, Málaga, Las Palmas, Sevilla, Valencia, Vizcaya and Zaragoza. This categorisation is based on the functional urban areas (OECD, 2012) and includes metropolitan areas (with population between 500,000 and 1.5 million) as well as large metropolitan areas (with population above 1.5 million).

Panels B and C show that the main result does not hold when college and non-college service workers are considered separately.

In order to test the robustness of this result, we adopt an instrumental variable strategy that uses the long-term pattern of employment specialization as reflected in the organization of production across provinces (see Author and Dorn, 2013). To this end, we consider an augmented version of the previous model:

$$\Delta NRM_{jrt} = \alpha + \beta_1' ROU_{jt_0}^* + \beta_2' X_{jt_0}' + \beta_3' \nu_{j,t_{1967}} + \gamma_r' + \varepsilon_{jrt}' \qquad (3)$$

which includes the term $\nu_{jt_{1967}}$, an unobserved, time-invariant attribute that affects both provinces' routine occupation shares and ΔNRM_{jrt}. The instrumental variable is the share of industry workers in 1967, a key year in the long-term trajectory of the Spanish economy in that it marks the end of the first strategic plan implemented by Franco's government to kick-start manufacturing by mandate (Requeijo-González, 2005). We therefore replicate the previous set of estimates using 2SLS (Table 7).

TABLE 7 ABOUT HERE

The new estimates confirm the main result: the share of ROU employment at the beginning of the decade is a robust predictor of the growth of NRM service jobs. To illustrate, when the full set of control variables is included (Model 8), the point estimate of 1.043 of the main variable of interest suggests that through the entire period under analysis the growth of NRM employment in a province like Alicante (75th percentile of Routine Intensity) is eight percentage point higher than that of a province like Cadiz (25th percentile). Once again, large metropolitan areas do not drive the results (Models 7 and 8). On the other hand, the IV specification yields a positive, albeit small, effect for non-college workers only even after the inclusion of the full vector of socio-demographic characteristics (Panel C).

3.3. Do lovely and lousy jobs co-locate?

A further issue emerging from our analysis is the growing segmentation of labor markets between workers in high-skill non-routine cognitive jobs who are able to fully reap the benefits of their human capital endowment, and workers who are trapped in low-level jobs with limited returns. Borrowing the phrasing of Goos and Manning (2007), we are interested in understanding to what extent the growth of NRC employment drives the demand of low-skill tradable service jobs, and whether this is driven by a ‘large city effect’. The argument is that NRC workers earn high wages, especially in densely populated metropolitan areas, and that high disposable income is spent on demand for local non-tradable services which is expected open up employment opportunities mostly for existing residents given that geographical mobility is traditionally low in Spain (see e.g. Dolado et al, 2002; David et al, 2010).

To test this hypothesis, we employ the local multiplier approach by Moretti (2010) (see also Black et al, 2005; Moretti and Thulin, 2013; Marchand, 2012; Faggio and Overman, 2014; van Dijk, 2016; Vona et al, 2016). In particular, we regress growth of regional employment in NRC occupations on growth of local employment in non-tradable NRM controlling for unobserved region-specific fixed effects. This is implemented with the following model:

$$\Delta NRM_{r,t+10} = \alpha + \beta_1 \Delta NRC_{r,t+10} + \beta_2 TDUM + \varepsilon_{rt} \quad (4)$$

where $\varepsilon_{rt} = \mu_r + \nu_{rt}$, $\Delta NRM_{r,t+10}$and $\Delta NRC_{r,t+10}$ denote the ln employment of low-skill non-tradable and high-skill occupations, respectively, in province *r* and time *t+10*. TDUM is a time-dummy included to control for national shocks to employment in the NRM occupations. The error term ε_{rt} is assumed to consist of unobservable province-specific fixed effects, represented by μ_{rt}, and a truly random component ν_{rt}.

Further, to isolate exogenous shifts in the demand for labor in non-tradable industries, we use as an instrument the weighted average of nationwide labor demand composition by the distinction between the level of education of the workers (college and non-college), with weights reflecting the city-specific educational level at the beginning of the period. We adapt the strategy of Moretti and Thulin (2013) and Van Dijk (2016) to capture all the variations of the labor demand composition *j* (colleges VS non-colleges) in region *r*, time *t* as:

$$\sum_j NRC_{rjt_0} \left[ln\left(NRC_{jt_1} - NRC_{rjt_1}\right) - ln\left(NRC_{jt_1} - NRC_{rjt_1}\right)\right] \quad (5)$$

The shift-share instrument isolates the variation that comes from nationwide changes in level of education *j* (where nationwide changes are computed excluding region c). These nationwide changes affect different cities differently because of their level of education composition in the base year.

TABLE 8 ABOUT HERE

OLS estimates in Table 8 show that, in general, regions with higher increments in abstract jobs exhibit also growth of service non-tradable occupations (Column 1). Specifically, each 10 new high-skill abstract occupation create 1.5 new low-skill jobs. Again, this result is not specific to large Metropolitan Areas (Columns 2 and 3). Results are substantially similar in the IV specifications (Columns 4-6).[17] On the whole, we find a rather low job multiplier effect compared to most existing literature, with the exception of Faggio and Overman, 2014, irrespective of non-tradable employment and to the estimation technique.

Lastly, we disentangle the impact of the higher educated working population. Panel A(B) of Table 9 shows the effect of a change in colleges(non-colleges) employment on the change of low-skill non-tradable jobs.

TABLE 9 ABOUT HERE

To estimate the multipliers for NRC in equation 5 we use a group-specific version of the shift-share instrument. The IV estimates indicate that only college high-skill workers have a positive and significant effect on the demand for low-skill non-tradable service jobs. The point estimate of 0.202 in our favorite specification, column (6), indicates that each 10 high-skill jobs or a college worker create 1.3 service jobs in the local labor market. Again, this result is not specific to large metropolitan areas.

4. Concluding remarks and implications

This paper has analyzed the long-term transformation of the local labor markets in fifty Spanish provinces over three decades. Beneath the recurrent discourse on the struggle with high unemployment in this country stand arguably no less important transformations in the occupational structure which the present study analyzes by disentangling the forces underpinning the growth and decline of particular occupational groups. We contribute to this debate by focusing on structural change in the occupational composition of local labor markets what workers 'do' as opposed to what they 'make', our analysis adds to research in economic geography that advocates leaving behind industry classifications to capture regional specialization. This also adds to the debate on the analysis of regional human capital which, in our view, has neglected the influence of demand-side forces, and in particular the reality of local labor

[17] The multiplier is the product of the estimated elasticity and the median of the ratio between Non-tradable and Tradable employment.

markets. Last but not least, this paper enriches the growing catalogue of country-specific evidence on job polarization. At the same time, compared to the widely renowned cases of the US and Britain, Spain carries two important peculiarities: it has rigid labor markets and the transition to democracy is relatively recent.

Our empirical results are in line with previous literature in confirming that Spain follows the same pattern of other advanced economies, whereby demand for high- and low-skilled occupations has grown while demand for mid-skill routine jobs has declined. For what concerns the drivers of this polarization, the contraction of routine jobs is significantly associated with the diffusion of automation in production and service provision. Further, the expansion of low-skill service jobs is stronger in regions with initial high level of routine occupations. In the last part of the paper we assess the local job creation effect of high-skill workers and find overall modest positive spillovers into non-tradable service occupations. Finally, when we break down high-skill employment by educational attainment, we observe that college workers drive the positive, albeit low, local job creation effect. Noticeably, none of these results are specific to large metropolitan areas.

The picture that emerges from this analysis is that, as the general level of educational attainment rises and the number of mid-skill jobs falls, low-skill workers face increasing competition from the more educated workers who are unable to find employment at the top end of the occupational spectrum. This implies that low-skill workers, and especially young workers, may be crowded out from entry-level positions and that their upward career mobility may be severely constrained. Likewise, low-skill service jobs are non-tradeable, and thus highly dependent on physical proximity to their customers, which in turn reduces geographical mobility. In front of these challenges the generic policy prescription of enhancing access to education – which in the case of Spain would mean tackling high rates of school failure and dropouts (Fernández Enguita et al, 2010; UNESCO, 2012) – may sound redundant considering that there are not many jobs to go around, especially after the great recession, and, also, that the easy option for Spanish firms is taking chances on disadvantaged, young, and dislocated workers.

In our view, these circumstances call for the implementation of place-based active labor market policies. Regional policy makers can support the diffusion of successful best practices, for example by promoting labor resource management and partnership techniques with a view to assist firms in shifting from low labor costs strategies to competing in the global market. Also, close collaboration between local policy makers and business firms could enhance the quality of training programs that are needed to prevent or reduce the shortage of qualified personnel. Performance management systems in employment and training programs also need to focus on longer-term employment and earnings outcomes, especially in view of the potential conflicts of short-run job placement outcomes versus persistent labor market gains. In a similar vein, local policy makers have plenty of tools to promote the evaluation of pilot programs in employment and training activities. This would provide the opportunity to rethink program design and resource allocation in response to credible evidence.

It is hoped that the kind of empirical work presented in this paper provides a useful starting point for the future exploration of these and other policy options.

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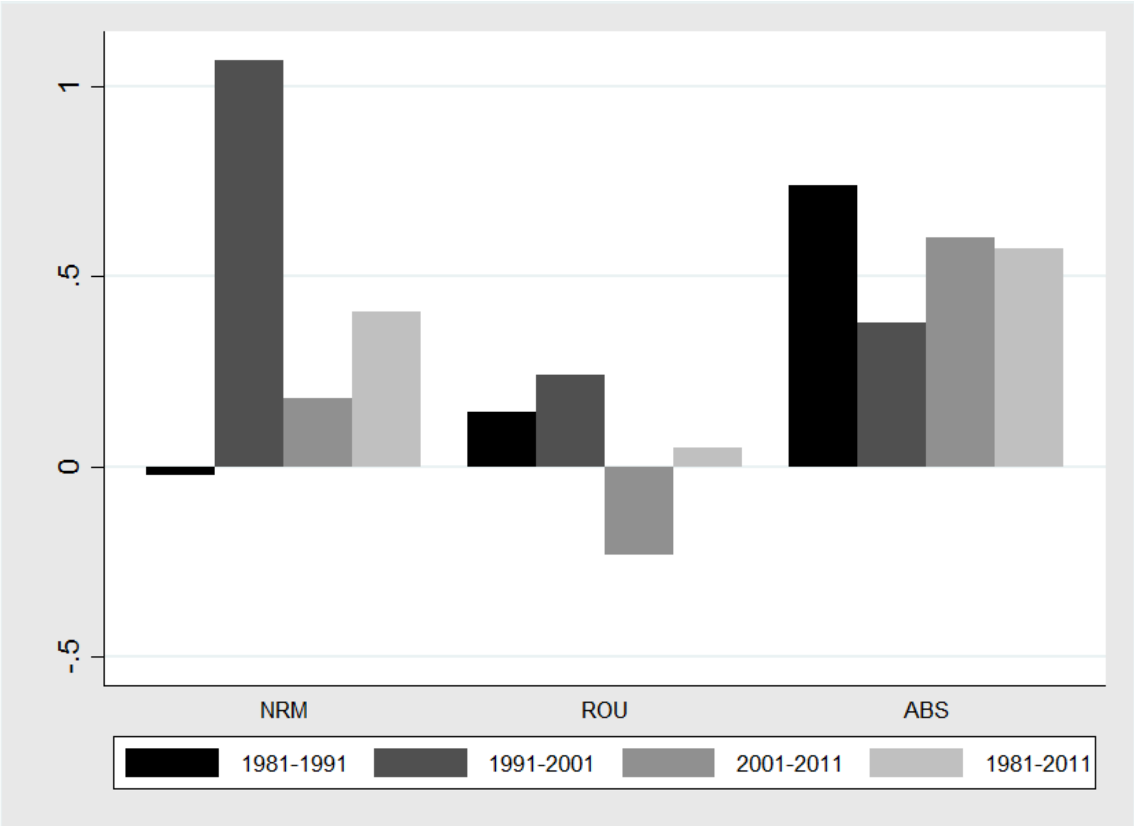
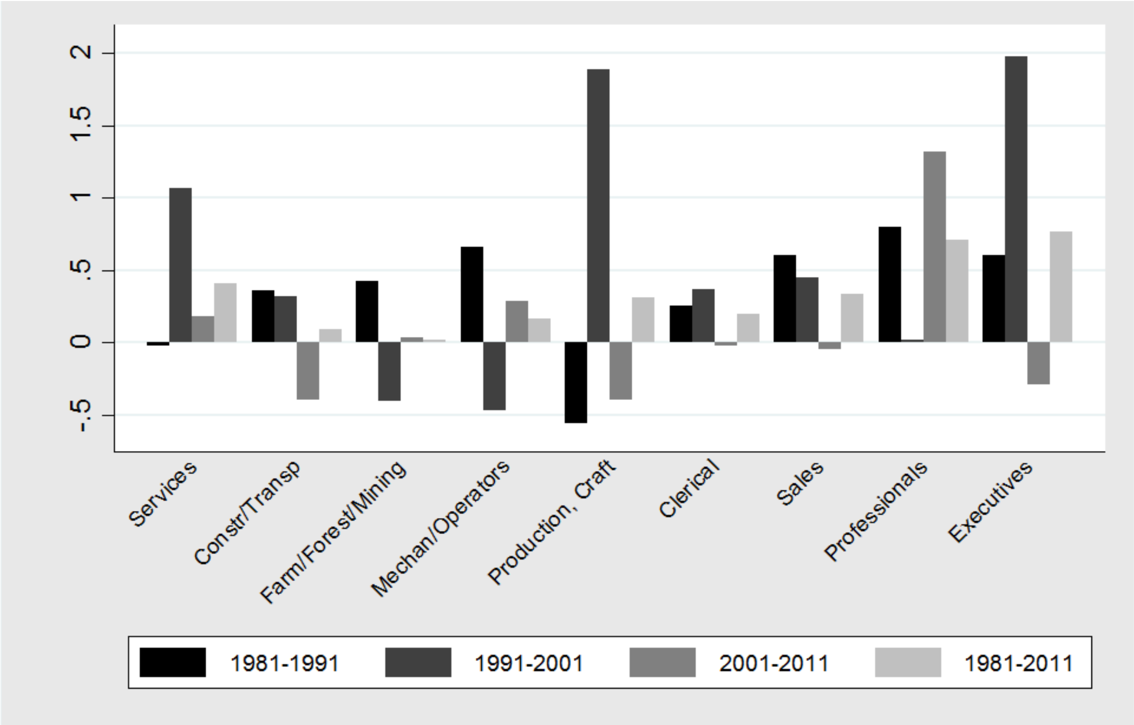
Figure 1: Changes (%) in aggregate employment shares (1981-2011)



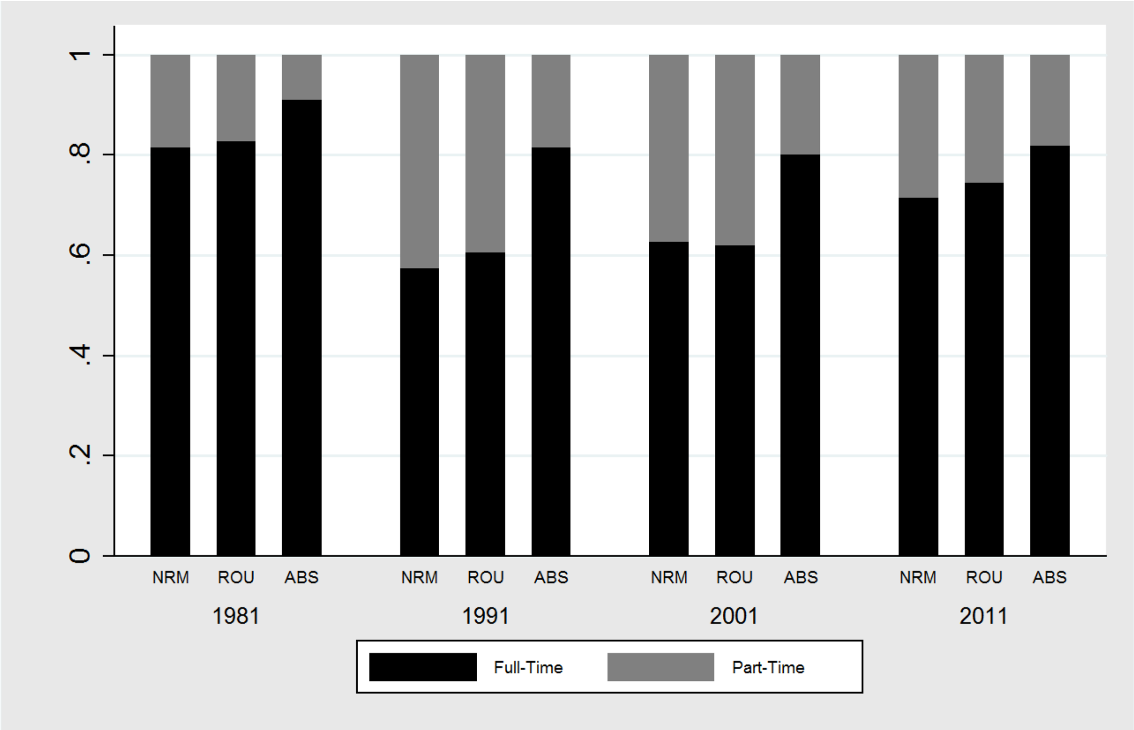
Source: Census (INE, 1981-2011). Note: 1981-2011 calculated as the average of the three decades.

Figure 2: Changes (%) in employment shares (1981-2011)



Source: Census (INE, 1981-2011). Note: 1981-2011 calculated as the average of the three decades.

Figure 3: Full-time and Part-time % by occupations (1981-2011)



Source: Census (INE, 1981-2011)

Table 1: Wage gap by occupation

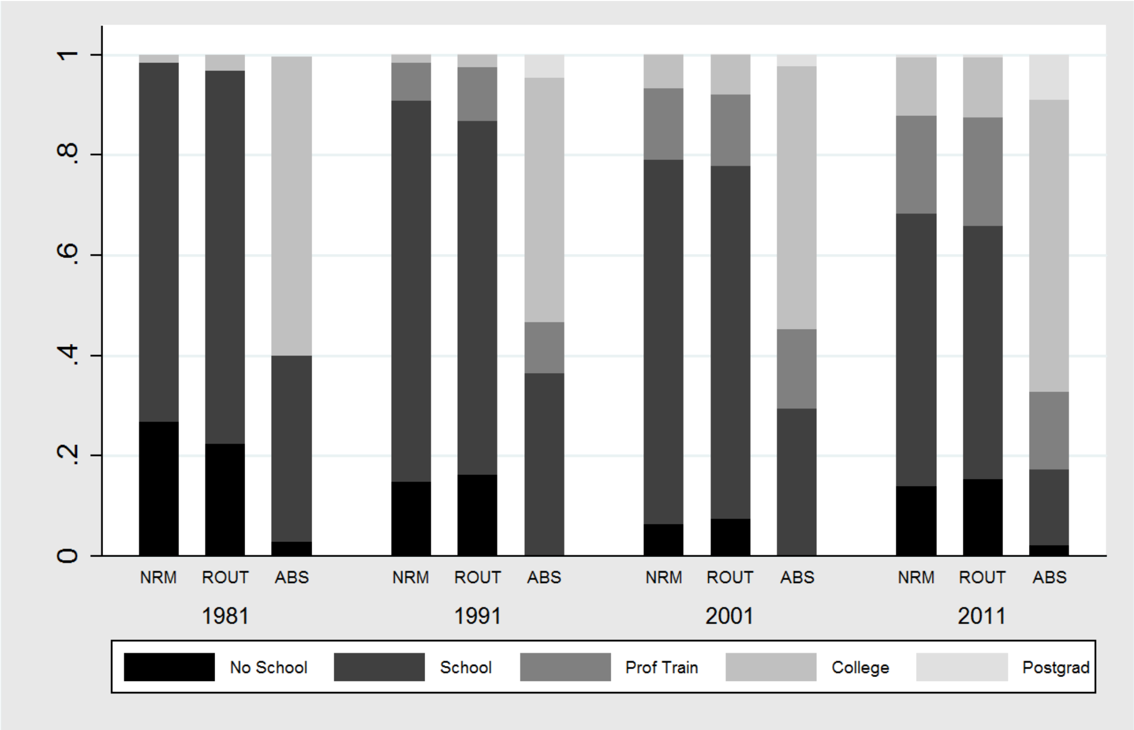
	Wage per hour				Δ wage per hour			
	1995	2002	2006	2010	Δ95-02	Δ02-06	Δ06-10	Δ95-10
NRM	5.85	6.77	7.58	9.97	15.7%	11.9%	31.6%	70.4%
ROU	9.09	10.78	11.59	14.56	18.6%	7.5%	25.6%	60.2%
NRC	19.41	20.53	21.70	25.44	5.8%	5.7%	17.2%	31.1%
ΔNRM/ROU	55%	59%	53%	46%				

Source: Spanish Salary Survey (INE, 1995-2010)

Table 2: % of workers in services by age

	% workers				Δ % workers			
	1981	1991	2001	2011	Δ81-91	Δ91-01	Δ01-11	Δ81-11
Young (16-29)	44.41%	45.09%	32.92%	19.36%	1.5%	-27.0%	-41.2%	-56.4%
Prime age (30-54)	41.48%	44.30%	58.56%	67.88%	6.8%	32.2%	15.9%	63.6%
Older (55-65)	12.76%	9.69%	7.54%	11.47%	-24.1%	-22.2%	52.1%	-10.1%

Figure 4: Evolution of the level of education within the occupations



Source: Census (INE, 1981-2011)

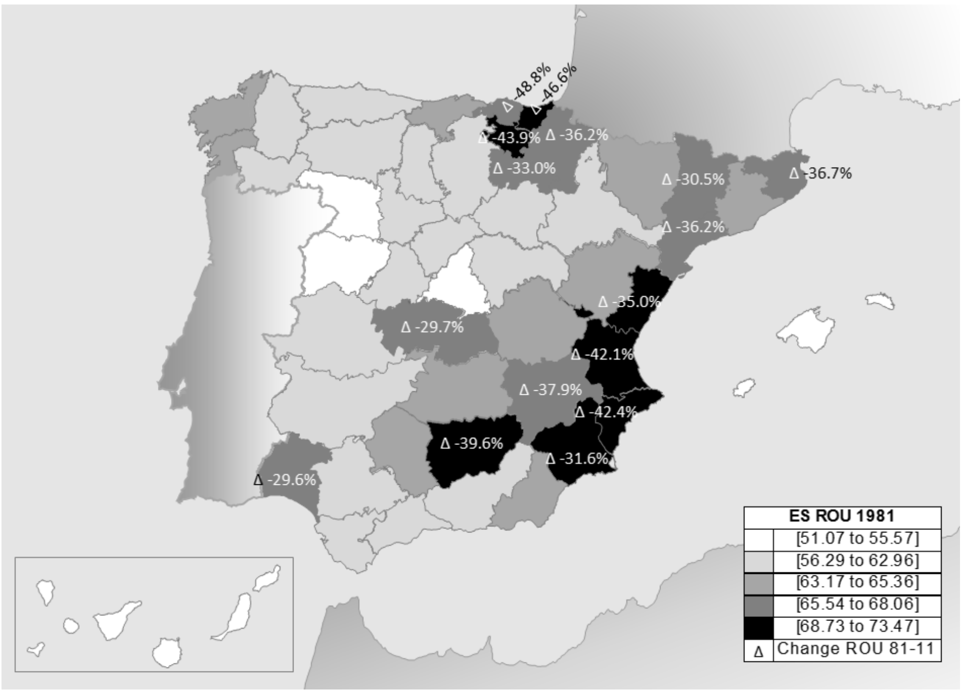
Table 3: Employment shares (%) by province and occupational group (1981 and 2011)

		1981			2011		
Province	Region	NRM	ROU	NRC	NRM	ROU	NRC
Alava	PAÍS VASCO	12.74	73.47	13.80	25.66	41.19	33.15
Albacete	CASTILLA-LA MANCHA	21.67	67.72	10.61	28.98	42.07	28.95
Alicante	C. VALENCIANA	17.75	71.24	11.00	32.04	41.05	26.91
Almeria	ANDALUCÍA	22.11	63.73	14.16	25.51	50.52	23.97
Asturias	ASTURIAS	21.54	62.96	15.50	31.73	36.51	31.76
Avila	CASTILLA Y LEÓN	29.85	56.36	13.79	32.53	40.94	26.53
Badajoz	EXTREMADURA	25.17	62.74	12.09	28.64	42.02	29.35
Baleares	BALEARS (ILLES)	33.01	55.57	11.42	36.02	35.13	28.85
Barcelona	CATALUÑA	18.29	65.36	16.36	26.80	35.52	37.68
Burgos	CASTILLA Y LEÓN	25.34	59.94	14.72	26.81	45.28	27.91
Caceres	EXTREMADURA	26.43	61.43	12.15	29.64	40.78	29.58
Cadiz	ANDALUCÍA	25.84	59.95	14.21	33.71	36.51	29.78
Cantabria	CANTABRIA	20.32	65.35	14.33	30.74	38.75	30.51
Castellon	C. VALENCIANA	16.28	72.97	10.75	25.38	47.45	27.17
Ciudad Real	CASTILLA-LA MANCHA	24.30	64.36	11.33	26.09	43.31	30.60
Cordoba	ANDALUCÍA	22.52	64.13	13.35	26.85	44.85	28.30
La Coruña	GALICIA	22.91	63.60	13.49	28.82	40.00	31.18
Cuenca	CASTILLA-LA MANCHA	23.41	65.22	11.37	26.76	49.73	23.52
Girona	CATALUÑA	21.99	67.44	10.57	29.84	42.66	27.50
Granada	ANDALUCÍA	23.89	58.83	17.28	30.31	36.96	32.73
Guadalajara	CASTILLA-LA MANCHA	24.53	61.03	14.44	26.16	43.91	29.93
Guipuzcoa	PAÍS VASCO	13.05	72.54	14.41	26.48	38.76	34.76
Huelva	ANDALUCÍA	21.52	66.71	11.77	28.01	46.96	25.02
Huesca	ARAGÓN	24.34	63.17	12.49	27.12	43.94	28.95
Jaen	ANDALUCÍA	19.88	68.84	11.29	26.55	48.47	24.98
Leon	CASTILLA Y LEÓN	23.93	58.59	17.48	33.29	39.71	27.00
Lleida	CATALUÑA	19.62	65.55	14.84	24.87	45.54	29.59
Lugo	GALICIA	25.67	58.15	16.18	30.26	43.38	26.36
Madrid	MADRID	25.30	53.87	20.83	29.47	30.15	40.39
Malaga	ANDALUCÍA	28.42	58.82	12.76	38.49	33.60	27.92
Murcia	MURCIA	18.53	68.73	12.74	26.48	46.99	26.53
Navarra	NAVARRA	16.56	68.06	15.38	23.59	43.44	32.98
Orense	GALICIA	27.91	57.71	14.37	31.85	41.98	26.17
Palencia	CASTILLA Y LEÓN	24.57	59.81	15.62	30.23	43.27	26.50
Palmas	CANARIAS	33.45	51.60	14.95	40.02	34.07	25.91
Pontevedra	GALICIA	22.74	65.20	12.06	26.87	42.88	30.25
La Rioja	RIOJA (LA)	18.31	65.99	15.70	25.35	46.67	27.98
Salamanca	CASTILLA Y LEÓN	29.43	53.73	16.84	33.36	36.01	30.63
S. Cruz Tenerife	CANARIAS	29.82	55.38	14.80	39.13	34.25	26.62
Segovia	CASTILLA Y LEÓN	28.56	56.29	15.15	29.78	43.71	26.51
Sevilla	ANDALUCÍA	25.47	58.20	16.32	28.94	37.18	33.88
Soria	CASTILLA Y LEÓN	23.07	60.42	16.51	28.39	46.36	25.26
Tarragona	CATALUÑA	21.25	65.78	12.96	25.75	41.99	32.27
Teruel	ARAGÓN	21.51	65.29	13.20	27.00	47.51	25.49
Toledo	CASTILLA-LA MANCHA	24.61	65.54	9.85	28.75	46.11	25.15
Valencia	C. VALENCIANA	16.68	69.93	13.38	26.71	40.46	32.84
Valladolid	CASTILLA Y LEÓN	23.65	61.02	15.33	28.39	38.33	33.28
Vizcaya	PAÍS VASCO	14.88	67.88	17.24	27.62	34.78	37.60
Zamora	CASTILLA Y LEÓN	31.64	51.07	17.29	30.50	44.32	25.18
Zaragoza	ARAGÓN	21.73	61.96	16.31	26.20	41.39	32.41

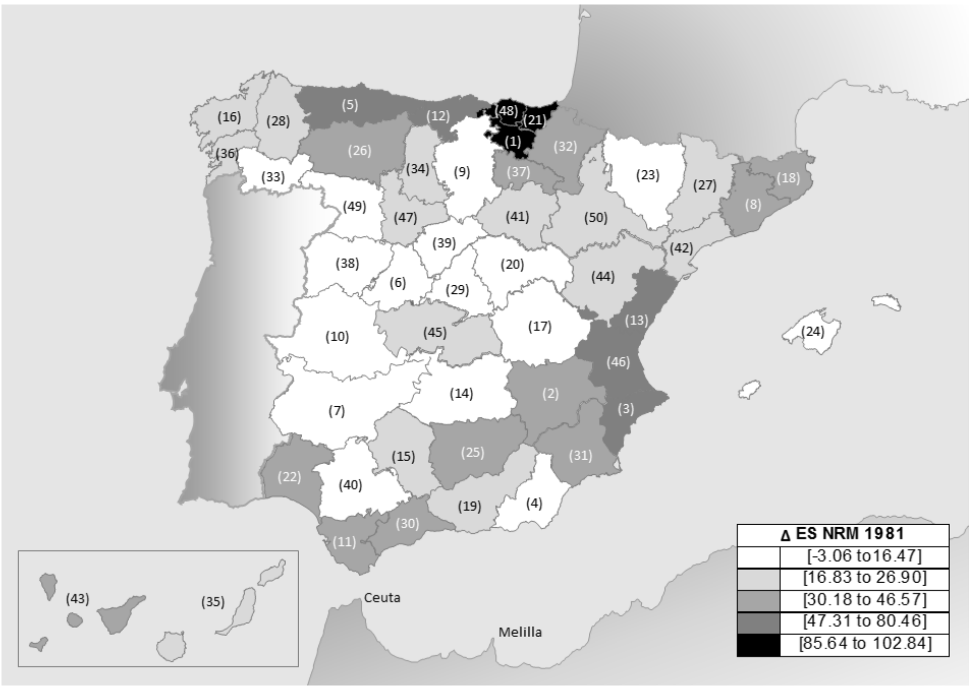
Note: NRM=Non-routine Manual; ROU= Routine; NRC=Non-routine Cognitive

Figure 5: Employment share in routine and non-routine jobs

Panel A: Employment share of ROU jobs in 1981



Panel B: Change in employment share of NRM jobs between 1981-2011



Legend: (1) Álava; (2) Albacete; (3) Alicante: (4) Almería; (5) Asturias; (6) Ávila; (7) Badajoz; (8) Barcelona; (9) Burgos; (10) Cáceres; (11) Cádiz; (12) Cantabria; (13) Castellón; (14) Ciudad Real; (15) Córdoba: (16) La Coruña; (17) Cuenca; (18) Gerona; (19) Granada; (20) Guadalajara; (21) Guipuzcoa; (22) Huelva; (23) Huesca; (24) Islas Baleares; (25) Jaén; (26) León; (27) Lérida; (28) Lugo; (29) Madrid; (30) Málaga; (31) Murcia; (32) Navarra; (33) Orense; (34) Palencia; (35) Las Palmas; (36) Pontevedra; (37) La Rioja; (38) Salamanca; (39) Segovia; (40) Sevilla; (41) Soria; (42) Tarragona; (43) Santa Cruz de Tenerife; (44) Teruel; (45) Toledo; (46) Valencia; (47) Valladolid; (48) Vizcaya; (49) Zamora; (50) Zaragoza

Figure 6: Change in NRM employment share by province, 1981-2011

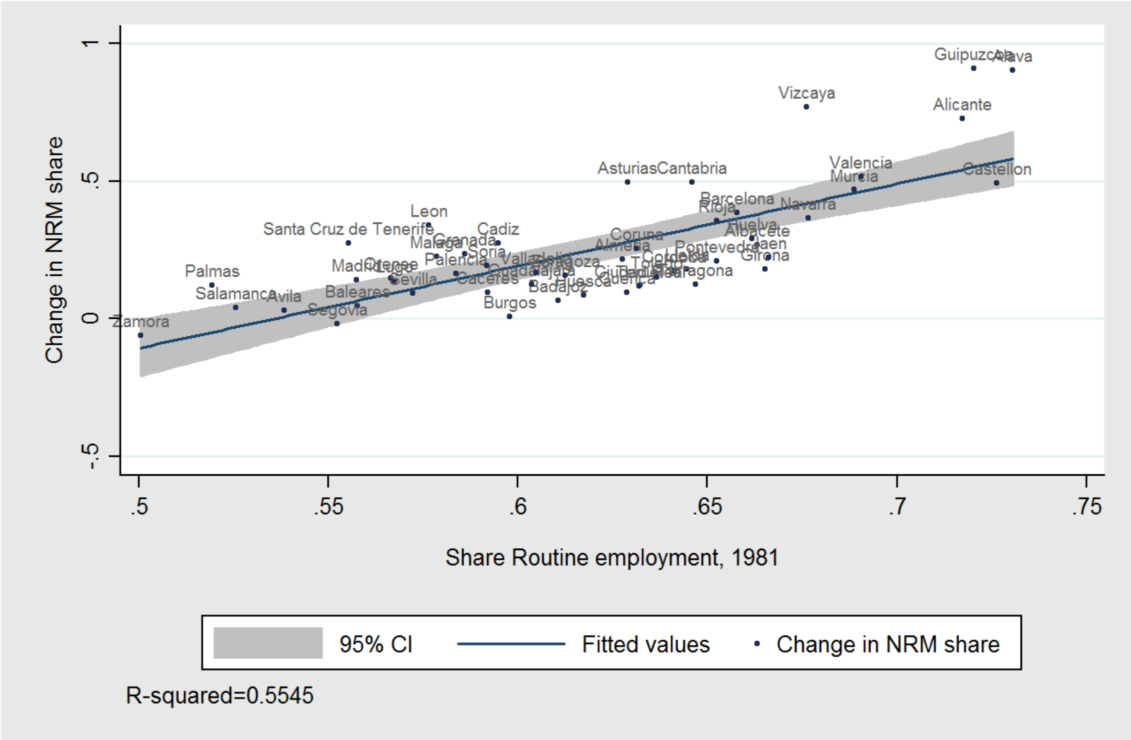


Table 4: Machinery adoption and Task specialisation (1981-2011)

	Δ Office Machinery	Δ Industry Machinery	Δ Total Machinery
Share of routine occs -1	1.703	1.230***	1.023**
	(1.363)	(0.397)	(0.351)
Constant	125.0	-41.62	-4.847
	(87.86)	(28.99)	(24.65)
R-sq	0.892	0.480	0.589
N	150	150	150

Note: N=150 (3 time periods x 50 provinces). All models include an intercept, region dummies and time dummies. Robust standard errors in parentheses are clustered on regions. Models are weighted by start of period province share of workforce. p-values: *<0.1; **<0.05; *** <0.01.

Table 5: Determinants of change in NRM employment by decade

	Δ NRM 1981-1991	Δ NRM 1991-2001	Δ NRM 2001-2011
Share of routine occs -1	0.0769	0.543*	1.401***
	(0.592)	(0.292)	(0.323)
Constant	-28.15	8.724	-62.87***
	(38.80)	(19.31)	(19.84)
R-sq	0.855	0.701	0.774
N	50	50	50

Note: N=150 (3 time periods x 50 provinces). All models include an intercept and region dummies. Robust standard errors in parentheses are clustered on regions. Models are weighted by start of period province share of workforce. p-values: *<0.1; **<0.05; *** <0.01.

Table 6: Routine employment share and growth of service jobs, OLS (1981-2011)

Panel A. Total	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	1.076***	1.099**	0.980***	1.059***	1.406***	1.315***	1.310***	1.423***
	(0.316)	(0.453)	(0.308)	(0.343)	(0.371)	(0.363)	(0.368)	(0.367)
College/no college -1		0.95				-2.791	-4.307	-2.531
		(7.552)				(5.472)	(7.247)	(7.371)
Unemployment rate -1			-0.826			-0.898*	-0.900*	-0.859*
			(0.487)			(0.488)	(0.476)	(0.486)
Age 65+/pop -1				0.26		0.0446	0.115	0.153
				(0.592)		(0.425)	(0.414)	(0.419)
Number of Universities -1					2.558	3.196*	2.919	2.817
					(1.696)	(1.63)	(1.813)	(1.905)
Metro Area (MA)							1.731	11.26
							(2.128)	(11.2)
Share of ROU occs -1* MA								-0.166
								(0.17)
R-sq	0.911	0.911	0.917	0.911	0.913	0.92	0.921	0.921
N	150	150	150	150	150	150	150	150
Panel B. Colleges	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	0.002	0.006	0.016	0.021	0.033	0.020	0.020	0.026
	(0.017)	(0.018)	(0.018)	(0.014)	(0.019)	(0.015)	(0.015)	(0.017)
R-sq	0.825	0.831	0.833	0.836	0.834	0.866	0.866	0.868
N	148	148	148	148	148	148	148	148
Panel C. No-Colleges	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	0.001*	0.001	0.001**	0.001**	0.001	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
R-sq	0.868	0.868	0.885	0.870	0.870	0.895	0.896	0.896
N	150	150	150	150	150	150	150	150

Note: N=150 (3 time periods x 50 provinces). All models include an intercept, region dummies and time dummies. Robust standard errors in parentheses are clustered on regions. Models are weighted by start of period province share of workforce. p-values: *<0.1; **<0.05; *** <0.01.

Table 7: Routine employment share and growth of service jobs, 2SLS (1981-2011)

Panel A. Total	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	1.068***	0.919*	1.059***	1.063**	1.114**	1.115**	1.063**	1.043*
	(0.395)	(0.489)	-0.383	-0.423	-0.495	(0.435)	(0.418)	(0.572)
College/no college -1		-1.065				-4.334	-6.245	-6.059
		(4.664)				(2.97)	(4.337)	(4.598)
Unemployment rate -1			-0.817*			-0.904**	-0.907**	-0.893**
			(0.443)			(0.426)	(0.411)	(0.429)
Age 65+/pop -1				0.259		0.0566	0.131	0.15
				(0.56)		(0.38)	(0.36)	(0.344)
Number of Universities -1					1.927	2.899**	2.546*	2.411
					(1.573)	(1.377)	(1.473)	(1.488)
Metro Area (MA)							1.764	5.43
							(1.915)	(17)
Share of ROU occs -1* MA								-0.0636
								(0.2)
R-sq	0.911	0.91	0.917	0.911	0.913	0.92	0.92	0.92
First stage statistic (F-test)[a]	38.4***	44.5***	34.6***	35.6***	10.5***	15.7***	15.7***	10.3***
N	150	150	150	150	150	150	150	150
Panel B. Colleges	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	0.019	0.005	0.021	0.020	0.029	0.018	0.017	0.025
	(0.028)	(0.037)	(0.029)	(0.025)	(0.033)	(0.027)	(0.026)	(0.040)
R-sq	0.825	0.831	0.832	0.836	0.834	0.866	0.866	0.857
First stage statistic (F-test)[a]	38.6***	50.4***	34.7***	35.6***	10.5***	15.1***	15.1***	17.3***
N	148	148	148	148	148	148	148	148
Panel C. No-Colleges	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of ROU occs -1	0.001	0.001	0.001*	0.001*	0.001	0.001**	0.001*	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-sq	0.868	0.867	0.885	0.870	0.867	0.894	0.895	0.895
First stage statistic (F-test)[a]	38.4***	44.5***	34.6***	35.6***	10.5***	15.7***	15.7***	10.3***
N	150	150	150	150	150	150	150	150

Note: N=150 (3 time periods x 50 provinces). All models include an intercept, region dummies and time dummies. Robust standard errors in parentheses are clustered on regions. Models are weighted by start of period province share of workforce. p-values: *<0.1; **<0.05; *** <0.01.

[a] The Kleibergen-Paap rk Wald F-statistic.

Table 8: Local multiplier for non-tradable NRM jobs

	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Emp of ABS occs	0.288***	0.275***	0.236***	0.241*	0.244*	0.212
	(0.059)	(0.068)	(0.079)	(0.139)	(0.138)	(0.145)
Metro Area (MA)		-0.015	-0.069		-0.016	-0.073*
		(0.012)	(0.051)		(0.009)	(0.038)
Change share ABS occ * MA			0.119			0.131
			(0.012)			(0.094)
Constant	-0.116**	0.087**	0.105**	0.102	0.101	0.116*
	(0.043)	(0.029)	(0.038)	(0.065)	(0.064)	(0.068)
R-sq	0.948	0.949	0.949	0.948	0.949	0.949
First stage statistic (F-test)[a]				43.9***	47.5***	50.1***
N	150	150	150	150	150	150

Note: Standard errors in parentheses are clustered by region. p-values: *<0.1; **<0.05; *** <0.01.
[a] The Kleibergen-Paap rk Wald F-statistic.

Table 9: Local multiplier for non-tradable NRM by education levels

	OLS			IV		
Panel A: College	(1)	(2)	(3)	(4)	(5)	(6)
Δ Emp of ABS occs	0.099	0.091	0.104	0.150**	0.149**	0.202**
	(0.063)	(0.065)	(0.069)	(0.074)	(0.074)	(0.080)
Metro Area (MA)		-0.025	0.027		-0.023**	0.379
		(0.015)	(0.051)		(0.011)	(0.049)
Change share ABS occ * MA			-0.106			-0.125
			(0.090)			(0.088)
Constant	0.004	0.152***	0.151***	0.112**	0.112**	0.085
	(0.036)	(0.043)	(0.048)	(0.051)	(0.051)	(0.053)
R-sq	0.944	0.945	0.946	0.944	0.945	0.945
First stage statistic (F-test)[a]				32.2***	31.9***	39.2***
N	150	150	150	150	150	150
Panel B: No-college						
Δ Emp of ABS occs	0.192***	0.182***	0.101	0.033	0.175	0.187
	(0.047)	(0.084)	(0.084)	(0.114)	(0.153)	(0.193)
Metro Area (MA)		-0.060	-0.060		0.020	-0.003
		(0.014)	(0.036)		(0.020)	(0.040)
Change share ABS occ * MA			0.119			0.069
			(0.083)			(0.089)
Constant	-0.103**	0.189***	0.214***	0.167***	0.133***	0.139***
	(0.047)	(0.014)	(0.028)	(0.019)	(0.032)	(0.046)
R-sq	0.948	0.950	0.950	0.932	0.935	0.936
First stage statistic (F-test)[a]				3.6	2.5	1.3
N	150	150	150	150	150	150

Note: Standard errors in parentheses are clustered by region. p-values: *<0.1; **<0.05; *** <0.01.
[a] The Kleibergen-Paap rk Wald F-statistic.

Annex A: Occupational classification and construction of key groups

Occupation	Key tasks	Occupational group
Executives	Plan, direct, coordinate and evaluate the overall activities of enterprises, governments and other organizations	Abstract (ABS)
Professionals	Increase the existing stock of knowledge, apply and teach scientific, technical or artistic concepts and theories	Abstract (ABS)
Sales	Design and implementation of marketing strategy to generate concepts, meanings for goods and services aimed at business or retail.	Abstract (ABS)
Clerical support	Record, organize, store, compute and retrieve information and perform clerical duties.	Routine (ROU)
Production, Craft and trades	Apply specific technical and practical knowledge and skills to work with metal, textiles and wooden, metal and other articles; set machine tools or make, fit, maintain and repair machinery and equipment.	Routine (ROU)
Plant and machine operators, and assemblers	Operate and monitor industrial and agricultural machinery and equipment; assemble products from component parts according to specification.	Routine (ROU)
Skilled agricultural, forestry and fishery	Grow and harvest tree, fruits and plants; breed, tend or hunt animals; produce animal husbandry products; cultivate, conserve and exploit forests; breed or catch fish.	Routine (ROU)
Construction and transport	Using hand-held tools and physical effort to construct and maintain buildings; drive and operate trains, motor vehicles and mobile machinery.	Routine (ROU)
Service	Provide personal and protective services related to travel, house-keeping, catering, personal care, protection against fire and unlawful acts.	Non-routine manual (NRM)

Note: Task information from International Standard Classification of Occupations (ILO, 2012)