Appl. Spatial Analysis (2018) 11:511–533
DOI 10.1007/s12061-017-9226-6

The Determinants of Local Employment Growth in Spain

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Received: 20 November 2016 / Accepted: 5 May 2017 /
Published online: 25 May 2017

Abstract During the last two decades, the Spanish economy has been growing both in terms of employment and economic activity, and the spatial distribution of both is very uneven. At a high level of disaggregation, when observing figures of local employment growth we find major changes between 1991 and 2001 and 2001–2011 decades. The aim of this paper is to provide a better understanding of the main determinants of local employment growth in Spain, including socio-economic factors as well as the structural characteristics of the area. Using spatial auto-regressive models combined with incremental distances to different population size tiers, we account for the spatial relationship between areas and for the influence of the urban hierarchy. Our spatial units of analysis are Local Labor Markets, since they comprise workers and work places within the same functional region. Our results for Spain confirm how sensitive the empirical analysis is and how the direct and/or indirect effect of some structural and socioeconomic factors over local employment growth may vary along time. The two decades under study reflect two very different patterns of local growth, supporting the idea of designing a la carte local policies, which should be reassessed timely.

Keywords Local employment growth · Incremental distances · Local labor markets · Local and regional policies · Spain

JEL Classification R11 · R12

Introduction

What places grow faster? What are the main factors explaining higher economic growth at local level? How important is the size of the local area or its location within a

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country? How relevant is the region they belong to? Is there any room for policies to promote local growth or is it determined by socio-economic or structural factors out of any policy scope? Although there is a large body of empirical and theoretical literature about growth, when we talk about growth at local level the empirical conclusions are still very limited and unclear.

Several reasons explain the limitations of the empirical analysis of local growth. First, for most countries there are strong data limitations. In Europe, any economic growth analysis based on domestic production becomes a challenging task if requiring highly spatially disaggregated data. A suitable alternative is to consider employment growth instead, which figures are generally available at a higher degree of spatial disaggregation. A second reason explaining the scarcity of studies on local growth is that, when they exist, their results are sometimes inconsistent with economic growth theories. Exceptions to the expected pattern tend to occur during periods of fast growth in resource dependent regions (as showed by Gunton (2003) in his study of the Canadian coal sector between 1970 and 2000); or during certain periods of time (for seminal examples see the works of Massey (1995), regarding the labor market in the UK between 1961 and 1975; Blien et al. (2006), about the West-German one from 1981 to 2001; or Shearmur and Polèse (2007), with respect to the local employment growth in Canada between 1971 and 2001), or only in certain area within a region (as explained by Strambach (2001) in her assessment of knowledge-intensive business services in Europe for 1996).

Bearing in mind the inconsistencies of the existing literature on local growth and the data limitations for domestic production beyond NUTS level 3 regions, in this paper we propose an empirical analysis of local employment growth for the whole Spanish territory, covering twenty years of growth. Spain might be an interesting case for several reasons. In the last two decades, the overall Spanish economy has experienced double digit growth figures (33.52% from 1991 to 2001 and 19.01% from 2001 and 2011) as well as strong employment growth (from 12.42 million employees in 1991 to 16.33 in 2001 to 17.51 in 2011), but growth was not evenly distributed either across space or time. Even more, the interest of the Spanish case rises when we work with data at local level and we perceive a high degree of spatial heterogeneity on employment growth within the regions. Figure 1 shows employment growth rates at regional level (NUTS 2 regions or *Autonomous Communities*) and at local level using the Local Labor Markets (or LLMs)[1] as the basic spatial unit for both decades. In the Spanish case, not only the overall employment growth picture differs depending on the spatial unit chosen (with local pockets of high employment growth in regions experiencing low growth rates and vice versa) but also over time, with deprived areas along the first decade performing relatively well in the second one (and vice versa). Among these remarkable differences in time and space, we can also identify spatial patterns that in principle are consistent with the Urban Economics and New Economic Geography literature (a review of the relevant works in these fields is presented in the next section): the faster growing regions and localities (both in terms of employment and GDP) are those identified as large urban areas and containing the main cities (labeled in the maps) as well as their neighbors, which suggests the importance of agglomeration effects and

[1] Local labor markets or LLMs are functional regions that internalize the travel-to-work daily movements. The use of this spatial unit will be explained and justified in Section 3.

location. Therefore, the spatial distribution of the most dynamic regions and local areas might not be random. The Mediterranean coast comprises many of the areas growing above the average in the first decade; together with Madrid, Bilbao and their surroundings. However, for the second decade, only a few places on the Mediterranean coast remain on the top positions and several high growth areas are contained in the North-East quarter enclosed by Bilbao, Madrid, Valencia and Barcelona.

Given the spatial and temporal heterogeneity observed in local employment growth figures, in this paper we intend to identify the existence of any empirical regularities regarding employment growth, paying special attention to the influence of structural factors (location, size and geography), as well as to the existing spatial interactions. Our aim is to uncover the relationship between an area's features and its employment growth, assessing which attributes might be strongly contributing to local employment growth. In order to do so, the variables included in the empirical model will play a crucial role, but also the spatial units and the econometric approach chosen. Eventually, the success of an area does not only depend on its own characteristics but also on the characteristics of its neighbors. Moreover, some of the characteristics will be subject to regional policy while some others can be considered as fixed (or only modifiable in the long term). The main contribution of this paper is to integrate the theoretical and econometrical advances that took place during the last decades in a synthetic empirical analysis of local employment growth for the Spanish case. New ideas, as the use of

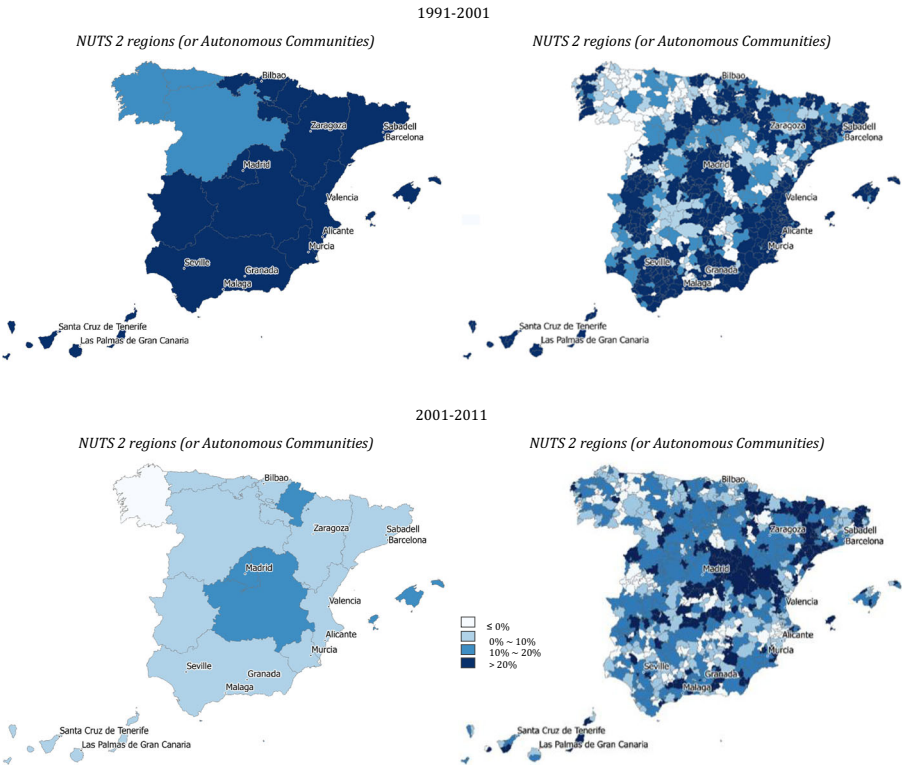

Fig. 1 Employment growth rates for Spanish NUTS 2 regions and Local Labor Markets

incremental distances, are combined with traditional concepts, as size and distance, to offer an empirical proposal that allows to assess the influence of the neighborhood linkages through spatial econometrics tools.

This paper is organized as follows. In the next Section we summarize the large literature on employment growth, trying to focus on the main contributions over the factors determining local employment growth. The review of existing empirical exercises will be used as a guide to the selection of variables and the spatial unit chosen, which will be the object of discussion of Section 3. In Section 4 we justify the use of a spatially autocorrelated model on the analysis of local employment growth in Spain. Section 5 explains our empirical results and finally Section 6 summarizes the main conclusions and policy implications of this paper.

Factors of Employment Growth: Literature Review

Economic growth is one of the main topics in Economics, and consequently, the amount of analysis previously undertaken is vast. If only focusing on local growth, the yet extensive number of relevant contributions could be easily summarized from an empirical perspective by classifying the type of factors explaining growth in three main groups.

The first group consist of factors considered difficult to measure and that include substantial qualitative components, making their effects also difficult to quantify and evaluate using a statistical approach (Doloreux et al. 2001). These factors encompass elements such as the local institutional context (Cooke et al. 2004), the presence of specific actors such as groups, organizations and communities (Galaway and Hudson 1994), or the existence of inter-firm dynamics and knowledge spillover (Malecki and Oinas 1999; Porter 1990). In particular, researchers in the field of innovation studies describe how certain regions have managed to develop local systems of innovation by combining these factors in particular ways (Cooke et al. 2004). Also, numerous case studies have described how such factors can induce employment growth at the local level. Although the nature of such studies does not enable extrapolation to general conclusions (Markusen 1999), they have been used to determine best practices that can serve as a basis for implementing policies in other regions.

The second group of determinants is comprised by factors that are also local in nature, but that can be quantitatively measured and are based upon general economic growth theory. The area's endowment of human capital (Florida 2002; Romer 1990), its industrial structure (Porter 1998), its relative costs (Weber 1929), or its level of industrial diversity (Jacobs 1984; Porter 1990) have all been theorized to be solid growth determinants. The effect of such factors upon employment growth, either at national and subnational level, can be verified by statistical analyses of various sorts. Usually a large group of regions or cities is considered, and either the effect of each factor upon the city or region's growth (Beckstead and Brown 2003; Florida 2002; Shearmur and Polèse 2007) or upon the entire nations (Barro and Sala-i-Martin 1995) is determined. From this type of analysis, some broad conclusions about local growth are typically drawn. Florida (2002), for instance, suggests that a highly educated local workforce is conducive to local growth of employment and income. Henderson (2003) shows that local specialization in certain industries tends to lead to employment growth

in those industries, while Quigley (1998) shows that a diverse economy tends to be associated with higher growth in the region.

However, analysis on growth factors are not always conclusive and can even be contradictory. As Blien et al. (2006) points out, there is an ongoing debate between researchers who defend that a diverse economy leads to growth (Jacobs 1984; Markusen 1996; Quigley 1998) and those who defend that specialization is conducive to growth (Porter 1996). Despite being to some extent compatible with human capital theory, Florida's (2002) results on the relationship between a regional educated workforce and regional growth is not supported by evidence –after controlling for other growth factors– in the Canadian case (Shearmur and Polèse 2007). Thus, despite the theoretical possibility of deriving conclusions upon local growth from analyses that use regional data, empirical results applied to regions has proven elusive so far.

The third group is comprised of factors that are structural, as they can be considered geographical and historical traits. Geographical location in particular, proximity to markets (Krugman 1995; Partridge and Rickman 2006), the center–periphery and urban–rural divides (Parr 2001), and historical events or tracks such as the US technological superiority (Krugman 1995; Davis and Weinstein 2002), have been suggested as having an effect upon employment growth outcomes.

Despite of the greater emphasis upon local economic development over the past twenty years (Martin and Sunley 1998; Parr 2001), policy makers have showed little interest in geographical and historical factors, which generally operate at greater scale than the local dimension (Eisinger 1988; Keating 1993). The failure in the 1960s and 1970s of top-down policies, which were aimed at balancing growth across wide geographical areas, explains only partially this temporary obscurity. Other factors include the fact that statistical models used to analyze geo-structural effects fell out of fashion over this period as they were claimed to be too simplistic –unable to deal with the qualitative factors that are also important for understanding economic development– and to make claims about development factors that did not bear out in practice (Philo et al. 1998). Moreover, these structural factors can be considered fixed in the short and medium run and are therefore unable to be substantially changed or affected by economic policies.

Ignoring these structural factors does not necessarily mean, however, that they do not affect local employment growth. One of those structural factors, the size of a region –commonly quantified in regional economics in terms of population–, classifies an area as rural or urban, and assists in determining the existence of agglomeration economies. Once regions are classified, a second dimension comes to place: the hierarchy within the urban system, as economic flows tend to favor larger cities (Parr 2002). Empirical analysis simultaneously considering these two dimensions, (i) the location –classifying the territory as central or peripheral– and (ii) the level of agglomeration economies –using the population size to sort the local areas–, repeatedly found comprehensive patterns of employment growth across space. See, for instance, Coffey and Polèse (1988), Coffey and Shearmur (1996) and Polèse and Shearmur (2004) for the case of Canada, Mackay (2003) for the case of UK or Polèse et al. (2006) for the Spanish case.

All these studies show how employment growth –particularly in strategic economic sectors such as high-order services– tends to concentrate in and around cities, and more specifically in and around large metropolitan areas.

Regarding location, the proximity to areas with important interregional and international trade flows could be relevant, as well as the proximity to the coast as it facilitates access to ports, thus reducing costs (Hummels 1999). This idea is reinforced by the fact that airports in coastal cities are normally the most important gateways to international air connections. The coast also includes spaces with a greater propensity to develop a standard type of tourism. Rappaport and Sachs (2003) studied the relevance of the coast in the US economy, finding clear correlations not only with population density, but also with productivity and growth.

As Polèse (2009) points out, not only absolute location matters since industries (and therefore economic activity and employment) are drawn to places best suited for commerce and interaction with markets. In this sense, proximity to size –relative location– also matters. Thus, spaces can be classified according to their size into rural and urban areas, and according to their proximity to major metropolitan areas into center or periphery. This classification is consistent with the classic idealized landscape described in Christaller (1935), Lösch (1938) and Von Thünen (1826). with one large marketplace at the center (the metropolis) surrounded by some areas of smaller population size that, depending on their respective distances to the metropolis, would be categorized as either central or peripheral.

The problem lies in how these spaces can be defined in terms of being located close or far from the system of metropolises. A way of solving this issue was proposed by Partridge et al. (2008, 2009) based upon Christaller's ideas regarding the hierarchy of places, and the connection suggested by Zipf (1949) between urban size and the hierarchal position of the cities. If it is assumed that only large cities are able to offer a full range of goods and services, and only the distance to the closest large metropolitan area (the one ranking highest in Christaller's hierarchy) is considered, the fact that certain goods and services are also offered in smaller and nearer cities is neglected. One way to address this issue is to define a set of incremental distances to each urban tier in order to measure the relative location of an area regarding larger agglomerations. Individuals and businesses need access to the higher-order services, urban amenities, high-qualified employment/labor and low-cost products that, due to the presence of strong agglomeration economies, are only present in highly populated places.

The review of the previous literature, especially in terms of empirical analysis, shows the complexity of identifying regularities in the effect of the factors explaining employment growth when their impact is analyzed at local level. Population size and location of the territories emerge as relevant factor in most of the studies, but the extent to which this factors determine local growth possibilities depends also on many other characteristics that vary from one place to another, and along time. Is in this context, the comparison presented in this study for the Spanish case contributes to the existing empirical literature on local employment growth by taking into account the spatial interrelationships at stake at a disaggregated level, and their changing nature.

The Spanish Case: Spatial Units and Availability of Variables

A first important decision when we work in the field of spatial analysis is the selection of the spatial unit of study. Many times this choice arises from the lack of alternatives or the impossibility to find a spatial unit consistent with the objective of the research, but

the main concern here is that underestimating the link between the purposes of the research and the spatial unit chosen could end in meaningless results.

As our aim is understanding what local factors determine employment growth, we should carefully define what "local" means in this study. According to Fox and Kumar (1965), Smart (1974), and Becattini (1962, 1975), the concept of a local area could be associated with a space that internalize the home-to-work journeys of its residents. Several techniques have been developed to set the boundaries of the local areas based on administrative data from municipalities or districts. One of the most accepted methodologies was proposed by Sforzi et al. (1997) and consists on a five stages algorithm to delimitate areas where most of the residents work and most of the workers reside. These areas, appointed as local labor markets (LLMs), were defined by Boix and Galletto (2006) to the Spanish case. Using the 8108 Spanish municipalities in 2001 as building blocks, the process used by this authors highlights candidates to be the center of a local labor market, and gradually adding other municipalities, it generates the spatial units used in this paper. They finally translate the 8108 municipalities into 677 LLMs. There are two principles underlying the algorithm which make possible to delineate functional regions: labor self-containment (a minimum of 75% of employed residents work within the area) and commuting (a maximum of 25% of employed residents commute to jobs outside of the area). Therefore, a LLM encompasses within the same unit the vast majority of labor and income-related movements, being areas with high internal homogeneity and, at the same time, high external heterogeneity (Rubiera and Viñuela 2012).

These travel-to-work areas have interesting characteristics for the purpose of our analysis. Recognizing that labor plays a basic role in the lives of individuals and guides their territorial behavior with regard to the election of the municipality where they live, LLMs have the advantage of including both locations (work and residence) within the same spatial unit. This is an important attribute when using databases at a very high level of disaggregation, as some information regarding the place of work can be censored for small municipalities due to confidentiality concerns. However, at municipal level the common figure provided by the Statistic National Institutes reflects the "municipality of residence of the employed population", but not the "municipality of work of the population residing in the municipality". Given these data restrictions, the use of LLMs as the spatial unit of analysis guarantees that the "employed population residing in the municipality" growth figures at local level will not vastly differ from the "employment growth" figures (or employees working in the municipality) (Sforzi 2012). Moreover, a LLM describes a place that corresponds to the area where the local population develops most of its economic and social relationships; it is a place where the common interest of the local population can be identified as a whole, and therefore it could be considered an appropriate level for implementing policies at local or regional level (Parr 2008). The implementation of such policies requires some degree of municipal cooperation or coordination, something theoretically simple that, however, for political reasons usually confronts lots of resistance.

We can classify the LLMs first according to size and then to distance to size, defined as the distance between a LLM and the nearest one in each size tier. The first column of Table 1 presents the distribution of Spanish LLMs by population size in four tiers. The first two tiers, LLM_1 and LLM_2, correspond to the largest metropolitan centers. Given the substantial size gap between Madrid and Barcelona metropolitan areas and those

Table 1 Distribution of LLMs by population size

Tiers	% population 1991	% population 2001	Category
$LLM_1 > 2{,}500{,}000$ inhabitants	20.59%	20.48%	Metropolitan areas (MAs)
$2{,}500{,}000$ inhabitants $\geq LLM_2 > 500{,}000$ inhabitants	16.76%	20.68%	
$500{,}000$ inhabitants $\geq LLM_3 > 50{,}000$ inhabitants	41.12%	39.01%	Urban areas (UAs)
$LLM_4 \leq 50{,}000$ inhabitants	21.53%	19.83%	Rural areas (RAs)
Total	38,871,359 inhabitants	40,847,385 inhabitants	

Authors' own elaboration using Spanish Census data (INE 2007)

classified as LLM_2 (with more than 500,000 but less than 2,500,000 inhabitants), we considered it appropriate to distinguish between these two levels. The next level (LLM_3) includes cities of more than 50,000 inhabitants but less than 250,000. Finally, those local labor markets with less than 50.000 inhabitants are considered rural areas (LLM_4).

Despite the severe limitations on statistical information at high levels of spatial disaggregation, the Spanish Censuses, administered by the National Statistics Institute of Spain (INE 1992, 2007 and 2012), provide information on several relevant economic variables that have been previously identified as local growth factors. Although there are partial updates every three years, a comprehensive database only becomes available every ten years.

Employment and population figures can be calculated for each of the 677 Spanish LLMs using the 1991, 2001 and 2011 Censuses. In our empirical proposal the dependent variable will be the logarithmic employment growth rate (G_{emp}) in each LLM, calculated as the difference between the logarithm of the employment in 2001 and the logarithm of the employment in 1991. We will use the logarithm of the population to preserve consistency as many other factors included are rates. The LLMs initial population size (*Pop*) and employment rate (*Emp*) are included as explanatory factors. Certainly, population and employment in a local area can have a bivariate causal relationship (Freeman 2001), but in this case we want to explore the effect of initial population on employment growth.

Another interesting variable provided by the Census is the municipal socioeconomic condition (*SC*) index, which combines information from the labor market status (employed, unemployed and inactive) with the professional classification to build a measure of the average social position, which can be interpreted as an indicator of the living standards of the area. The Censuses also offer data regarding the highest level of education reached by the resident population at the local level. Thus, in order to capture the effect of human capital endowment in the LLM, we use the percentage of the population living in a particular LLM in 1991 and 2001 who holds a secondary and a tertiary degree (*SecEd* and *TerEd*). Other demographic information on the area that can be valuable for our study is any aspect associated to the economic dynamism, such as the initial percentages of foreign population (*Fpop*), the proportion of young people (less than 16 years of age)(*Ypop*) and old people (over 65 years of age) (*Opop*).

The economic structure of the area is also another factor explaining employment growth. Data regarding employment by sector is available from the Censuses and location quotients (*LQ*) can be calculated for each LLM and sector. The location quotients compare the employment share in one sector in a LLM with the equivalent share at national level, and therefore provide information about the specific sectors in which a LLMs is specialized. In this case, the agricultural, industrial and public services location quotients can also provide information about the rural or urban nature of the region. Moreover, following Shearmur and Polèse (2005) the degree of specialization/diversity of the LLM in the base year (*S*) is also included and calculated as the following specialization index:

$$S_r = \mathrm{Ln}\left[\frac{1}{\sum_{i=1}^{n}\mathrm{Emp_i}}\sqrt{\sum_{i=1}^{n}\left(\mathrm{Emp_i}(\mathrm{LQ_i}-100)\right)^2}\right] \quad (1)$$

where S_r is the specialization index for area *r*; LQ_i is the location quotient of sector *i* for area *r*; and E_i is the employment in sector *i* for area *r*. Accordingly, values tend to -∞ when the degree of specialization in the LLM is identical to that of the whole national economy; the value tends to +∞ as the specialization profile of the LLM diverges from the overall Spanish specialization (i.e., when the LLM is more specialized in one or more of the *n* sectors analyzed).

The linear distance to the nearest coast (*DistCoast*) and some climate related variables are also included as geo-structural factors. The distance to the coast reflects the proximity to a location that historically fosters population and employment growth, and is available from the Spanish National Centre for Geographical Research (IGN 2001). We also take into account some climatic features: the average annual rainfall (*Rain*), the minimum temperature in January ($Tmin_{jan}$) and the maximum temperature in July ($Tmax_{jul}$). These factors depict the impact of natural amenities, and can influence the attractiveness to certain economic activities. The climatological information introduced comes from the series (1987–2007) published by the Meteorological State Agency (AEMET 2011).

As a political factor, a dummy variable *Cap* is also included, taking the value 1 if the LLM contains an administrative capital of a province or an autonomous community, and the value 0 otherwise. This variable captures the influence of having been identified as the administrative center of the province, thereby concentrating a large proportion of public sector jobs and offering a large range of public services.

All the variables available at LLM level that will be used in the empirical model are summarized in Table 2.

Econometric Strategy: Spatial Durbin Model

The concept of local-labor-markets applied to the Spanish case results on 677 LLMs, that can be classified in terms of size and location (using the concept of incremental distances) as described in Table 1. Once the variables outlined in the literature as

Table 2 Variables and data

Variable	Term	Variable definition	Data source
Local employment growth	G_{emp}	Logarithmic Employment growth between 1991 and 2001 and 2001–2011)	1991, 2001 and 2011 Spanish Censuses. National Statistics Institute (INE).
Demo-Economic factors			
Initial employment	Emp	Employment rate	1991 and 2001 Spanish Censuses. National Statistics Institute (INE).
Initial population	Pop	Population size (ln)	
Socioeconomic condition	SC	Index of the average labor market status of the population	
Human Capital Endowment	SecEd TerEd	percentage of resident population with a secondary/tertiary degree	
Specialization/Diversification	S S^2	Specialization index	
Potential economic performance	Fpop Ypop Opop	Percentage of foreign population Percentage of young population Percentage of old population	
Type of Specialization	LQ_{agr} LQ_{ind} LQ_{PS}	Location quotients for agricultural and industrial activities, and public services	
Geo-Structural factors			
Distance to the Coast	DistCoast	Dummy variable. 1 if the LLM contains a coastal municipality	National Centre for Geographical Research (IGN).
Natural amenities	Rain	Average rainfall between 1987 and 2001	Meteorological State Agency (AEMET)
	$Tmax_{jul}$	Average higher temperature reached in July between 1987 and 2001	
	$Tmin_{jan}$	Average lower temperature reached in January between 1987 and 2001	
Relative Location	ID_{LLM1} ID_{LLM2} ID_{LLM3}	Incremental Distances from a LLM to the nearest LLM in each higher tier	National Centre for Geographical Research (IGN)
Political factors			
Capital city	Cap	Dummy variable. 1 if the LLM contains a provincial or Autonomous Community capital city	

growth determinants are calculated at LLM level from municipal data, the equation to be estimated would take the following form:

$$\begin{aligned} G_{emp} = {} & \alpha + \beta_1 Emp + \beta_2 Pop + \beta_3 SC + \beta_4 SecEd + \beta_5 TerEd + \beta_6 S \\ & + \beta_7 S^2 + \beta_8 Fpop + \beta_9 Ypop + \beta_{10} Opop + \beta_{10} LQ_{agr} \\ & + \beta_{11} LQ_{ind} + \beta_{12} LQ_{PS} + \gamma_1 DistCoast + \gamma_2 Rain \\ & + \gamma_3 Tmax_{jul} + \gamma_4 Tmin_{jan} + \gamma_5 ID_{LLM1} + \gamma_6 ID_{LLM2} \\ & + \gamma_7 ID_{LLM3} + \zeta_1 Cap + \varepsilon \end{aligned} \quad (2)$$

However, there is increasing evidence on the fact that economic growth tend to be spatially correlated, meaning also that employment growth is not randomly distributed among regions. Map 2 suggests that employment growth in Spain is not different in this respect, since certain clustering can be identified at a glance for both of the decades considered.

In order to confirm this conjecture and formally test for the existence of spatial association in the data, the Moran scatterplot is shown (Fig. 2) to check for the presence of a global spatial pattern, taking into account also the local magnitude of the spatial autocorrelation through a local indicator of spatial association (LISA). In this analysis, the definition of neighborhood relies on a second order queen contiguity matrix (geographical neighbors plus their neighbors), which is comparatively the best fit to the distribution of employment growth in Spain in the decades regarded. Figure 2 show the link between LLMs' employment growth in each period and employment growth of the neighbor LLMs. The slope indicates a positive relationship, being less pronounced in the second decade, which jointly with the lower value of the Moran's I statistic indicates a decrease in the level of global association. The LISA maps of Fig. 3 give support to the spatial clustering suggested earlier, showing for the 1991–2001 decade some groups of high growth LLMs across the Mediterranean Coast and the islands, and low growth LLMs in particularly in the North- West quarter of the country; meanwhile, the 2001–2011 decade shows high growth clusters concentrated in Madrid Metropolitan Area and surrounding LLMs as well as in the Ebro Corridor (i.e., from Barcelona to Zaragoza Metropolitan Areas).

In order to explain employment growth at local level in Spain, a methodology that accounts for the spatial concentration and allows the inclusion of the characteristics of the neighbors is required. A review of the various methods for addressing spatial processes can be found in the seminal works from Anselin (1988), Cliff and Ord (1981), Griffith (1988, 2003), Haining (1990), Anselin et al. (2004) and LeSage and Pace (2009). This papers contain several options to deal with spatial autocorrelation, being the most traditional ones:

(i) Spatial lag model (also called spatial autoregressive model (SAR)), considering the influence of the dependent variable of neighboring areas.

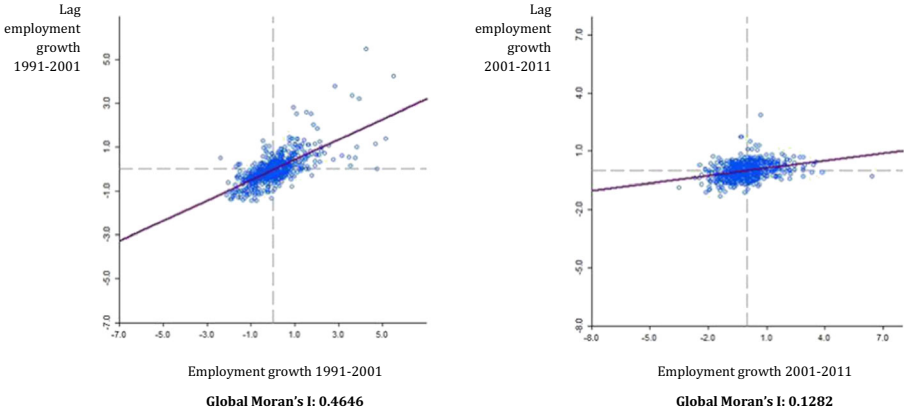

Fig. 2 Moran scatterplots for employment growth by LLMs in 1991–2001 (*left*) and 2001–2011 (*right*)

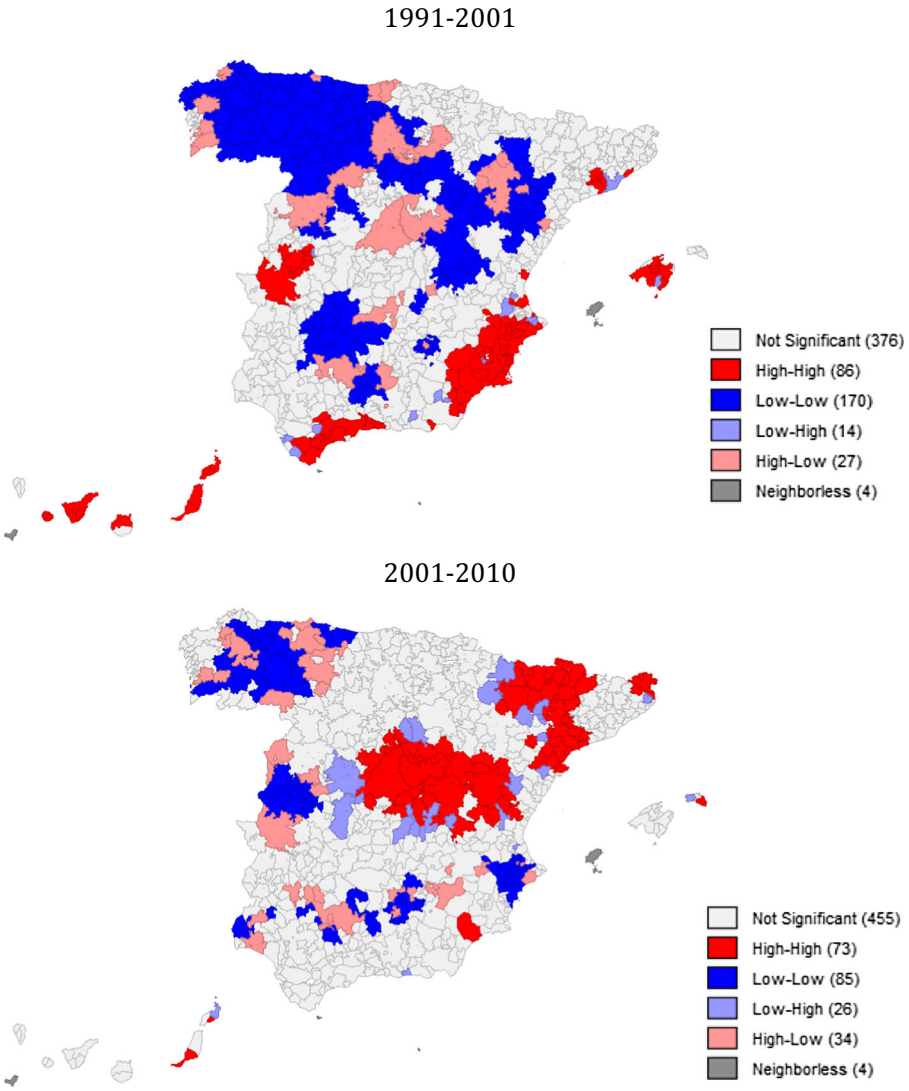

Fig. 3 LISA cluster maps of employment growth in Spanish LLMs, 1991–2001 and 2001–2011

(ii) Spatial error model (SEM), introducing a spatial auto-regressive component which allows for the existence of spatial dependence in the error term.
(iii) Spatial Durbin model (SDM), accounting for spatial dependence through the dependent and the independent variables simultaneously, trying to cope with the issue of omitted variables that might be behind spatially correlated errors.

The SDM, as advocated in the work of LeSage and Fischer (2008), is an appropriate specification for growth studies because it clarifies when the spatial autocorrelation is due to the clustering of high or low employment growth areas by means of a spatially lagged dependent variable. Moreover, this model tries to uncover the source of possible bias in the residuals related to the features of the neighbors through the inclusion of

lagged explanatory factors. This kind of models are meant to address specifically spillover effects, which is the main concern of this type of analyses, while others focus on the disturbances.

The general formulation of SDM is:

$$\begin{gathered} y = \alpha + \rho Wy + \beta X + \gamma WX + \varepsilon \\ \varepsilon \sim N\left(0, \sigma^2\right) \end{gathered} \tag{3}$$

Where in our case y is the employment growth (G_{emp}) experienced in each Spanish LLMs and the neighbors' employment growth is considered through the term Wy. The matrix containing the remaining explanatory variables related to the socio-economic, geographical and political characteristics of the LLM is named X and the term WX embraces the neighbors' characteristics to the model.

The parameters will be estimated through maximum likelihood, but their interpretation is subject to the feedback effects of the explanatory variables between a region and its neighbors, induced by the spatially lagged factors. This means that the change in a factor will have a direct effect on the employment growth of the own region, but also an indirect effect on the neighbors, implying that the marginal effects are not represented by the β coefficients as in linear models, and need to be calculated after the estimation of the parameters in order to draw correct conclusions about the relationship between employment growth and the rest of the variables.

Following the procedure developed by LeSage and Pace (2009), the figures that represent the actual effects of the factors in the SDM, and that will be interpreted in this study, can be summarized as:

(i) Average direct impact: mean of the impacts on the dependent variable in region *i* of a change in the *rth* factor of that same region. Technically, it equals the mean of the diagonal elements ($\partial y_i / \partial x_i^r$) of the partial derivatives matrix.
(ii) Average indirect impact: mean of the impacts on the dependent variable in region *i* of a change in the *rth* factor of the other regions ($j \neq i$). It translates into de mean of the off-diagonal elements ($\partial y_i / \partial x_j^r$) of the matrix mentioned before.
(iii) Average total impact: sum of the average direct impact and the average indirect impact.

Main Results: Regularities and Particularities of the Spanish Case

In this section we undertake the empirical analysis of local employment growth applying a spatial approach through the SDM, given the spatial dependence found in the preliminary section, pointing out to the existence of a functional relationship between processes occurring in a LLM and those occurring in neighboring LLMs. First, the linear estimation of the model will be briefly discussed as an initial step to diagnose spatial autocorrelation. Then, we will try to correct this bias by means of the SDM, and finally the marginal effects of this specification will be presented, describing first the impacts in 1991–2001 and 2001–2011 separately, and then comparing both periods.

The ordinary least squares (OLS) estimation of the empirical model follows the specification shown in [2] (see Annex for the complete results). The Moran's I test indicates that the null hypothesis of random spatial distribution of the dependent variable should be rejected in both decades (0.08 and 0.06 respectively, being both values significant at 0.01% level), corroborating the existence of spatial autocorrelation in the residuals and giving further statistical support to the use of spatial econometric models, eq. [3]. Under this circumstances, the lack of parameters that bring the spatial structure into the model deems the coefficients obtained in the OLS estimation as biased.

According to the suggestion made by LeSage and Fischer (2008), the specification of the employment growth model should include not only the neighbor's employment growth but also their characteristics, leading to the formulation of a SDM, which estimation is shown in Table 3. As noted in the previous section, the coefficients obtained at this stage should not be directly interpreted as marginal impacts of the factors on the dependent variable. Nonetheless, this first estimation provides useful information about the degree of spatial association, the bias correction achieved through the inclusion of the spatially lagged factors, and the relative performance of the model. For this reason, the preliminary results before adjusting the marginal effects are reported and discussed.

The rho coefficient is low for both decades, but it is only significant for the first one. It is worth recalling that the analogous linear models for each decade present spatially correlated error terms in both periods, showing also a lower degree of spatial association between 2001 and 2011. Interpreting both results jointly, it seems that the model deals with the spatial autocorrelation better in the 1991–2001 period, accounting entirely for it as indicated by the non-rejection of the null hypothesis (absence of spatial autocorrelation in the residuals) of the Lagrange Multiplier test. Interestingly, the Akaike information criterion and the log likelihood say that the specification explains better the employment growth during the second decade, despite there are still traces of spatial bias.

To find the marginal effects of the spatial spillover specifications, we followed the methodology described by LeSage and Pace (2009), as mentioned in Section 4. In Table 4 we show the direct, indirect and total effects derived from the SDM. Direct effects represent the impacts of the explanatory factors on employment growth, while indirect effects are the accumulative spillover impacts coming from the neighboring regions. Both impacts together result in the total effect of a given factor on the dependent variable.

Taking into account the socioeconomic factors, in the first decade (1991–2001) the initial employment rate has a negative total impact on the employment growth, driven mainly by the influence of neighboring regions (indirect effect). In magnitudes, a 1% increase in the initial employment rate translates into a 3.79% decrease in employment growth of which 2.19% comes from changes in the initial employment rate of the neighbors. The negative effect is also at work when the own initial population size is regarded, bearing a fall of 0.12%. This result, in combination to the previous one, might be a hint to the existence of agglomeration diseconomies that in turn could be signaling a convergence effect of smaller areas in terms of employment in the first decade.

However, when we look at the relative location of the LLM within the urban hierarchy (ID_{LLM1}, ID_{LLM2} and ID_{LLM3}), results show that the incremental distance

Table 3 Spatial Durbin Model estimation results, 1991–2001 and 2001–2011

	SDM 1991–2001				SDM 2001–2011			
	Factor		Spatial Lag		Factor		Spatial Lag	
Constant	0.247		–		-0.523		–	
Rho	0.319	***	–		0.108		–	
Initial Employment rate	−1.560	***	−1.018		−0.594	***	2.172	***
Population (ln)	−0.051	***	−0.032		−0.030	***	0.079	***
ID_{LLM1}	-0.011		0.024	**	−0.011		0.004	
ID_{LLM2}	-0.026		0.040		−0.012		0.026	
ID_{LLM3}	-0.164	***	0.016		−0.060		0.368	***
Socioec. condition index	0.745	***	1.223	***	−0.002		-0.997	***
Sec. education (%)	−0.074		−0.253		0.202	***	−0.412	
Ter. education (%)	1.390	***	2.400		0.826	***	2.352	***
Foreign pop. (%)	1.343	***	−2.721	***	0.095		−0.506	
Pop. under 16 years of age (%)	3.922	***	1.328		0.097		2.593	
Pop. over 65 years of age (%)	−0.830	***	1.572		−0.188		1.710	**
Specialisation index	0.089	***	−0.050		0.015		−0.144	
Specialisation index (square)	−0.014	***	0.006		−0.005		0.015	
LQ agriculture	−0.0002	***	−0.0002		−0.0002	***	0.000	
LQ industry	−0.001	***	0.001		−0.001	***	0.000	
LQ Public services	−0.002	***	−0.001		−0.0004		-0.004	***
Dist. Coast	−0.040		0.098	***	−0.022		−0.017	
Rain	−0.013	**	−0.007		−0.006		0.003	
Temp. max. July	−0.003		−0.007		0.012	**	−0.012	
Temp. min. January	0.003		0.018	***	−0.0003		0.015	**
Capital city (1/0)	0.015		−0.054		−0.031		−0.025	
Akaike Information Criterion (AIC)	*-660.05*				*−679.49*			
Log Likelihood	*375.02*				*384.74*			
Likelihood Ratio Test	*10.85*		***		*0.96*			
LM Test for residual sp. autocorrel.	*0.15*				*2.74*		*	

to the big metropolitan areas (Madrid and Barcelona LLMs) exerts a positive indirect effect over a LLM's employment growth and overall a positive total impact. Remarkably, the direct effect of the distance to the third urban tier (defined as LLMs between 500,000 and 50,000 inhabitants) is significant and negative (−0.16%), which might suggest that LLMs included in this category and also those ones relatively close to medium size urban areas and relatively far from the big metropolitan areas were benefitting from higher employment growth.

On the other side, the socioeconomic index (2.89%), the initial capital endowment, measured by the proportion of population with tertiary education attainment, (5.57%) and the share of young population (7.71%) have a relatively large positive total impact, driven mainly by the change in the neighbors' features of the two first factors (2.11% and 4.11% respectively). The shares of foreign and older population, the specialization

Table 4 Direct, indirect and total effects, 1991–2001 and 2001–2011

	SDM 1991–2001						SDM 2001–2011					
	Direct		Indirect		Total		Direct		Indirect		Total	
Initial employment rate	−1.593	***	−2.195	**	−3.788	***	−0.581	**	2.349	***	1.768	**
Population (ln)	−0.053	***	−0.071		−0.123	**	−0.030	***	0.085	**	0.055	
ID_{LLM1}	-0.010		0.030	**	0.020	**	−0.011		0.003		-0.008	
ID_{LLM2}	-0.025		0.046		0.021		−0.011		0.028		0.016	
ID_{LLM3}	-0.165	***	−0.052		−0.218		−0.058	*	0.403	***	0.345	***
Socioec. condition index	0.777	***	2.115	***	2.892	***	−0.009		−1.111	**	−1.120	**
Sec. education (%)	−0.080		−0.400		−0.480		0.199	*	−0.434		−0.235	
Ter. education (%)	1.452	***	4.116	*	5.569	**	0.841	**	2.720	**	3.561	***
Foreign pop. (%)	1.293	***	−3.318	**	−2.024		0.092		−0.552		−0.461	
Pop. under 16 years of age (%)	3.979	***	3.735		7.714	***	0.113		2.901		3.014	
Pop. over 65 years of age (%)	−0.801	**	1.891		1.090		−0.178		1.883	*	1.705	*
Specialisation index	0.089	**	−0.031		0.058		0.014		−0.159		−0.145	
Specialisation index (Square)	−0.014	***	0.003		−0.012		−0.005		0.016		0.011	
LQ agriculture	−0.0002	**	−0.0004		−0.001	*	−0.0002	**	−0.0002		-0.0004	*
LQ industry	−0.001	***	0.0004		−0.001		−0.001	***	−0.0001		-0.001	***
LQ Public services	−0.002	***	−0.002		−0.004	*	−0.0005		−0.004	***	-0.005	***
Dist. Coast	−0.038		0.123	**	0.085	***	−0.023		−0.022		−0.044	*
Rain	−0.013	*	−0.016		−0.029	***	−0.006		0.002		−0.003	
Temp. max. July	−0.003		−0.011		−0.015	*	0.012	*	−0.012		0.001	
Temp. min. January	0.003		0.027	***	0.030	***	−0.0002		0.017		0.016	**
Capital city (1/0)	0.014		−0.072		−0.058		−0.031		−0.032		−0.063	

index variables and the location quotient for industry have a significant direct impact, negative in the case of the older population and the industry indicator, while the indirect and total effects are not significant. The location quotients of agriculture and public services have significant negative direct and total effects. Regarding the sectorial structure, the employment concentration on the sectors included lessens local employment growth.

Looking at the geographical features, the average rain rate is the only factor showing a significant direct effect, with a negative total impact of 0.03% on employment growth. Conversely, the distance to the coast and the minimum temperature in January of the neighbors have a positive influence. The maximum temperature on July doesn't display a significant direct or indirect effect, but its total effect bears a decreasing impact of 0.01%.

In regards to the second decade (2001–2011), while the estimates for the initial employment rate and population of the LLM display a negative direct impact (0.58% and 0.03% decrease respectively), the indirect effect is positive, deriving in a positive total effect. On the other side, the spillover effects are positive and larger in value, contributing to employment growth at 2.35% and 0.08% respectively. Only the initial employment rate has a significant total effect, bearing a 1.77% increase in employment growth. Thus, in the second decade local growth seems to be concentrating in those areas that were already experiencing high employment rate figures, suggesting a distinct path towards economic divergence.

The relative location of the LLM in the urban hierarchy shows that LLMs near to small-medium sized urban areas, in combination with the effect of having neighbors spotted relatively far from them, result in a positive total effect of 0.34% over employment growth.

The average socioeconomic condition index has negative indirect and total impacts in this second decade, while the secondary and tertiary education have significant and positive effects. A 1% growth in secondary education attainment in the own region is responsible for a 0.19% increase on employment growth, a 0.84% in the case of tertiary education, which also has an indirect effect of 2.62% and a remarkable total effect of 3.56%. The increase in the share of older population in the neighbors has a positive effect of 1.88%, being the total impact of the factor 1.70%. The location quotients for agriculture, manufacturing and public services have a significant and negative total effect over local employment growth, but the magnitude of those effects is almost irrelevant.

Geo-structural factors reflect that, overall, proximity of a LLM to the coast and warmer weather conditions enhance employment growth in this period.

It is important to note that the current crisis hit Spain in 2008, affecting deeply the economic scenario. As an example, the change in the unemployment rate went from 10.94% in the first quarter of 2001, to 21.08% in the first quarter of 2011. Certainly, this fact affects the results of this study provided the lack of suitable local data for inter-census years, preventing us from accounting directly for such an important shock in the analysis. Provided the situation, caution is due in the interpretation of the effects during the second decade. Nevertheless, the framework depicted so far allows us to set a comparative scope between the two periods considered, and we believe that it adds to the understanding of the general picture of local employment growth in the country.

After applying the same model to both decades and comparing results, it can be seen that the Spanish case is sensitive to the period of analysis. Direct impacts are clearly dominant during the first decade, while the number of significant direct and indirect effects evens out in the second one. In other words, the spillover effects gain relative strength over local employment growth in the second period. Probably the inclusion of more features (own and spatially lagged) might reduce the remaining spatial autocorrelation.

The direct negative influence of initial employment rate and population is still operative in the second decade, but the indirect and total impacts turn positive in the second decade, implying that being large both in terms of initial employment and population deters employment growth. Unlike the first decade, being located close to other LLMs with a high score on those features is an advantage in the second decade. Thus, local employment growth in the second decade seems to be closely related to the proximity to size (or relative location of the LLM to the big metropolitan areas), while in the first decade both size and relative location exerted a negative effect over employment growth, suggesting that agglomeration diseconomies were in place during that decade.

A similar change is observed also in the socioeconomic condition index, which indirect and total effects become negative for the second decade, indicating that an increase in the socioeconomic condition of the neighbors hinders own employment growth, an opposite result than the one obtained for the previous decade. Although significant, the direct and indirect effect of the LLM's initial level of population with at least tertiary education diminishes in magnitude for the second decade. This circumstance also affects the shares of foreign and young population, which effects become insignificant in this decade. On the contrary, the positive spillover and total effects of the older population share become significant. The own sectorial specialization no longer affect local employment growth while the employment concentration in public services of the neighbors have a negative impact on it. In general, the variables related to natural amenities lose their influence in the second decade. Regarding the location with respect to the urban hierarchy, the impact of the relative proximity to the metropolitan LLMs existing in the first period, disappears in the next decade, while the indirect effect of the distance to the small-medium areas gain significant weight in the positive total outcome.

Conclusions and Policy Implications

The conclusions derived from the empirical analysis about the factors that explain local employment growth differences tend to be uncertain –and at times opposed–, as they rely heavily on the period of analysis, the level of disaggregation, the data limitations and the empirical approach embraced. Our results for Spain confirm how sensitive the empirical analysis is and the direct and/or indirect effect of some structural and socioeconomic factors over local employment growth may vary across time.

Given the regional and intertemporal heterogeneity observed in the Spanish case, in this paper we tried to identify some patterns on the distribution of local employment growth for two decades with persistent growth: 1991–2001 and 2001–2011. The empirical approach considered takes into consideration socioeconomic and structural

factors, as well as the regional context and their spatial interactions. Dealing with spatial autocorrelation and disaggregated local information, we built an empirical model where we calculate the contribution of the LLM's own and neighboring characteristics over employment growth for each decade.

Some of the local determinants included in this study show the expected positive effect over local employment growth and in line with endogenous growth theories, but their magnitude varies along time. Both your own initial human capital endowment (measured as percentage of population with tertiary education) and your neighbors' exerts a significant and positive effect over local employment growth in both decades; however, the overall effect is greater for 1991–2001, due probably to the dependence of Spanish economy's growth on the construction sector.

Nevertheless, some other determinants show the opposite (and significant) effect depending on the period under consideration, which requires a combined analysis for both decades. Results for the variables related to initial size and relative location of the Spanish LLMs show that local employment growth in the second decade is not apparently linked to size but it is indeed affected by the proximity to size. Surprisingly, in the first decade both size and proximity exert an adverse effect over employment growth. At first sight these results could suggest that during the two decades under analysis the Spanish cities were not necessarily the ones with better employment opportunities, more economic dynamism and growth. Working with local (instead of regional) data allows us to suggest the existence of agglomeration diseconomies (significant and negative effect of your own initial population size) but the use of incremental distances simultaneously unveils what urban size is yet relevant. In the 1990s, LLMs being far away from a large metropolitan areas (those LLMs with more than 2.5 million inhabitants) would affect the LLMs' employment growth in a positive way; in the 2000s, the more distance to a small-sized urban area (LLMs from 500,000 to 50,000 inhabitants) the higher local growth. Size by itself is not the driver of local employment growth.

So what were the local factor explaining local growth in these two decades?

While in the second decade local employment growth was positively and strongly affected by the initial levels of employment and labor conditions of the neighbor LLMs –but not by those of your own–, in the first decade the impact of the initial employment levels was significant and negative.

The aforementioned irrelevance of size in both decades, together with the regarding impact of the initial levels of employment suggest a differentiated local growth pattern for each decade. During the first decade local employment growth was positively affected by the proximity to small-medium sized urban areas that might benefit from the re-location of economic activities away from the influence of large neighbors. Even more, according to our results during the first decade the larger effect over local employment growth was exerted by the existence of low initial employment rates, a result in line with the suburbanization of the manufacturing industry to areas with lower labor and land cost. In the second decade, although the LLM's own initial employment level and (population) size continues to show a negative effect, the positive indirect effects suggest that, in regard to growth, it is convenient to be located close to large urban areas and to LLMs with a high employment levels.

Results on the variable reflecting the LLM's standards of living are perplexing – significant in both decades, but showing a negative effect over employment growth in

the second decade–, but however justified by the massive arrival of immigrant workers to Spain during the 2000s (more than 5 million in just a decade) and their settlement pattern, a question which merits further research. The two decades under study reflect two very different patterns of local growth: while in the first decade the economy grew at a remarkably high rate, the second decade is marked by the deep economic crisis, which fostered higher internal migration, higher international emigration (including return flows), and overall population loss. These distinct frames bear different effects over the demographic structure, the labor market, and ultimately, over the employment growth, as can be seen in the results of this study.

There are not universal recipes for local growth, and local policies must be designed paying attention to local characteristics. Besides considering the specific characteristics of the area, any effective local policy should also take into account the temporal dimension, as the influence of any factor over employment growth may vary (or even reverse) depending on the time frame chosen, and also the effect of the spatial structure reflected in the influence that neighboring areas may exert. The results found in this analysis go in line and call for the flexible framework set by the new European Union Cohesion Policy and the Smart Specialization philosophy (see McCann and Ortega 2013, 2015; and Thissen et al. 2013), stressing the necessity of development policy projects tailored at more local level and revised in shorter periods of time.

Appendix

Table 5 OLS estimation results

	OLS model 1991–2001		OLS model 2001–2011	
Constant	1.005	***	0.863	***
Employment rate	−1.614	***	−0.024	
Population (ln)	−0.056	***	-0.034	***
Socioec. condition index	1.181	***	−0.209	
Sec. education (%)	0.141		0.214	**
Ter. education (%)	1.404	**	1.171	***
Foreign pop. (%)	0.521	*	−0.054	
Pop. under 16 years old (%)	3.210	***	−0.465	
Pop. over 65 years old (%)	−1.099	***	−0.255	
Specialisation index	0.094	**	0.013	
Specialisation index ^{2}	−0.014	***	−0.005	
LQ agriculture	−0.0004	***	-0.0002	***
LQ industry	−0.001	***	-0.001	***
LQ Public services	−0.003	***	−0.001	**
Dist. Coast	0.074	***	−0.024	**
Rain	−0.023	***	-0.014	***
Temp. max. July	−0.016	***	0.001	

Table 5 (continued)

	OLS model 1991–2001		OLS model 2001–2011	
Temp. min. January	0.017	***	0.004	
Capital city (1/0)	0.039		-0.003	
ID_{LLM1}	0.011	***	-0.005	
ID_{LLM2}	-0.014	*	0.016	**
ID_{LLM3}	-0.153	***	0.006	
Adjusted R^2	*0.65*		*0.24*	
Akaike Information Criterion (AIC)	*-610.43*		*−649.01*	
F-Statistic	*60.04*	***	*10*	***
Moran's I test	*0.08*	***	*0.06*	***

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