Chapter 6
Agglomeration Economies and Employment Growth in Italy

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Abstract Using local labor systems (LLSs) data, we assess the effect of the local productive structure on employment growth in Italy during the period 1981–2008. Italy represents an interesting case study because of the high degree of spatial heterogeneity in local labor market performances and of the presence of strongly specialized LLSs (industrial districts). Building on semi-parametric geoadditive models, our empirical investigation allows us to identify important nonlinearities in the relationship between local industry structure and local employment growth to assess the relative performance of industrial districts and to control for unobserved spatial heterogeneity.

Keywords Employment dynamics • Geoadditive models • Industrial districts • Industry structure • Semi-parametric

JEL Classification R11, R12, C14

6.1 Introduction

In this chapter, we analyze the effect of industry structure on local employment growth in Italy. The hypotheses put into empirical test concern the role of many factors characterizing the local productive structure: (1) the presence of an *industrial district*; (2) the level of productive *specialization*; (3) the degree of sectoral *diversification*; (4) the population *density*; (5) the level of *local competition*; and (6) the average *firm size*. In this way, we follow the broad literature started by

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Glaeser et al. (1992) and Henderson et al. (1995).[1] Previous studies carried out for the case of Italy (Mameli et al. 2008; Paci and Usai 2008) report a negative impact of specialization externalities (notwithstanding the strong anecdotal evidence of the economic success of *industrial districts*, the places where Marshallian externalities are magnified) and a positive effect of diversification on local employment growth. Only Forni and Paba (2002) find a positive impact of both specialization and Jacobs externalities.

We claim that the results of previous studies may suffer from a number of model mis-specification issues. First, all of these studies measure Marshallian (or specialization) externalities using location quotients disregarding the fact that higher specialization levels may lead higher vulnerability to idiosyncratic shocks (such as a decline faced by the primary industry of the local area) and, thus, are likely to bolster asymmetric developments and differences in growth rates across local economies, unless some effective "risk sharing" mechanisms help "protect" the local economic environment against idiosyncratic shocks (Basile and Girardi 2010). In particular a form of insurance mechanism is represented by those socioeconomic factors which contribute to determine the "industrial atmosphere" theorized by Marshall as well as by several Italian economists (e.g., Becattini 1987; Becattini et al. 2003; Bellandi 2007). In a nutshell, if we want to empirically assess the existence of Marshallian externalities, we need to bear in mind that this kind of external economies are more likely to occur within industrial districts than anywhere else.

Second, most of the previous studies disregard the existence of nonlinearities in the relationship between industry structure and employment growth. De Lucio et al. (2002), Viladecans-Marsal (2004), and Illy et al. (2011) allow for nonlinearities by introducing quadratic terms in their models. Although this is the easiest way to deal with such a nonlinearity in a parametric framework, it is only one of several possible nonlinear parameterizations. Indeed, nonlinearities can be better accommodated in a semi-parametric framework, where the actual shape of the partial effect can be assessed using smooth functions.

Third, most of these studies do not control for unobserved spatial heterogeneity when specifying the local economic growth model, disregarding the role of "first nature" characteristics of local areas (Krugman 1993) in affecting their growth performance.

Using data for 686 local labor systems (LLSs) in Italy for both manufacturing and services and for three different periods (1981–1991, 1991–2001, 2001–2008), we contribute to the existing literature (a) by assessing the presence of nonlinearities in the relationship between industry structure and local-sector employment growth, (b) by comparing the relative performance of industrial districts, and (c) by controlling for spatial heterogeneity.

[1] See also, among others, Henderson (1997), Combes (2000), Rosenthal and Strange (2004), de Groot et al. (2009), and Melo et al. (2009). For a recent review of the literature, see Beaudry and Shiffauerova (2009).

To this aim, we develop a methodological framework which innovates with respect to the existent literature along several dimensions. First, we use a semi-parametric model that allows us to identify smooth non-linear effects of the growth predictors. Second, we include in our model a dummy variable, *ID*, which takes value 1 if the LLS belongs to an industrial district and zero otherwise. Specifically, we distinguish between the within-sector and the between-sector *ID* effects. Third, exploiting the longitudinal dimension of our dataset, we include in our model a geo-additive component (a smooth interaction between latitude and longitude) for each time period which permits us to control for time-varying unobserved spatial heterogeneity.

Our empirical evidences confirm that industrial districts have performed better than the other LLSs during the sample period, thus suggesting that Marshallian externalities exerted a positive role on local employment growth. Regression results also highlight a hockey stick-shaped relationship between specialization and local employment growth: net of the industrial district' effect, a higher specialization per se reduces the employment dynamics, but only up to a certain threshold after which specialization has no effect on growth. In line with previous evidence and corroborating Jacobs' theory, diversification boosts employment growth in manufacturing and reduces it in services. Allowing for nonlinearities and in keeping with theoretical predictions, we find a hump-shaped relationship between population density and local employment growth: the positive effect of overall population density fades as the density of economic activities reaches some threshold value, after which congestion costs overcome agglomeration externalities. Nonlinear effects are also evident for local competition and average firm size. Finally, the inclusion of a smooth spatial trend surface allows us to control for spatial heterogeneity due to the first nature features of the LLS.

The remainder of the chapter is organized as follows. Section 6.2 describes our modeling strategy. Section 6.3 provides information about data and variables. The results are presented and discussed in Sect. 6.4. Conclusions are reported in Sect. 6.5.

6.2 Modeling Regional Employment Growth

6.2.1 A Review of the Literature

Combes (2000) analyzes the relationship between industry structure and local employment growth by estimating the following log-linear reduced form:

$$\begin{aligned} y_{r,s,t} = {} & \beta_0 + \beta_1 \log(\text{spe}_{r,s,t-\tau}) + \beta_2 \log(\text{div}_{r,s,t-\tau}) + \beta_3 \log(\text{den}_{r,t-\tau}) \\ & + \beta_4 \log(\text{size}_{r,s,t-\tau}) + \beta_5 \log(\text{comp}_{r,s,t-\tau}) + \gamma_s + \delta_t + \varepsilon_{r,s,t} \end{aligned} \tag{6.1}$$

where $y_{r,s,t}$ is the employment growth rate of sector s in site r computed over a given period (between $t-\tau$ and t); $\text{spe}_{r,s,t-\tau}$, $\text{div}_{r,s,t-\tau}$, $\text{den}_{r,t-\tau}$, $\text{size}_{r,s,t-\tau}$, and $\text{comp}_{r,s,t-\tau}$ are the explanatory variables computed at the initial period $t-\tau$ and corresponding respectively, to specialization, diversity, population density, average size of plants, and local competition; β_0-β_5 are the parameters associated to the intercept and to the explanatory variables expressed in log terms; γ_s is a sector fixed effect; δ_t is a temporal fixed effect; and $\varepsilon_{r,s,t}$ is an error term assumed to be *iid*.[2] The variable *spe* should capture external economies which may occur among firms producing similar goods or services and operating in the same area. According to the Marshall–Arrow–Romer theory (the MAR-theory), formalized by Glaeser et al. (1992), within-sector pecuniary (static) and nonpecuniary (dynamic) externalities (knowledge spillovers) are the main sources of local growth. These external economies are known as *localization* or *specialization externalities* and are often measured with the degree of *sectoral specialization* of the region. Therefore, according to the MAR theory, the higher the degree of specialization of the region in a specific industry, the higher the growth rate in that particular industry within that region.

From a different perspective, Jacobs (1969) argues that the most important sources of pecuniary and nonpecuniary economies are external to the industry within which the firm operates. She suggests diversity rather than specialization as a mechanism leading to economic growth: a diverse sectoral structure increases the chances of interaction, generation, replication, modification, and recombination of ideas and applications across different industries; moreover, a diverse industrial structure protects a region from volatile demand and offers it the possibility of switching between input substitutes. *Urbanization* or *Jacobs externalities* are measured with the degree of *sectoral diversification* (*div*) of the local production structure. According to Jacobs theory, the higher the degree of diversification of the region, the higher its growth rate.

Empirical evidence provided by a large amount of studies in support of the Marshall and Jacobs theories yields mixed results. Beaudry and Shiffauerova (2009) review 67 studies and discuss their basic results. According to them, almost half of these studies report both MAR and Jacobs externalities. Both specialized and diversified local industrial structures may, therefore, be conductive to local economic growth. In line with this interpretation, Duranton and Puga (2000, p. 553) observe that there is “a need for both large and diversified cities and smaller and more specialized cities”. Although positive evidence for both types of externalities is reported, many of these studies also find negative impacts. However, the negative influence is observed much more often for Marshallian externalities than for Jacobs externalities (only in 3 % of all the studies). For the case of Italy,

[2] A similar specification has been used by Paci and Usai (2008) and Mameli et al. (2008). These authors also extend this model by introducing other explanatory factors (such as human and social capital) into the model framework, but they conclude that the baseline model (1) does not suffer from problems connected to omitted variables. On the basis of these evidences and because of the lack of complete information on further explanatory variables for the whole sample period, we do not consider additional factors in our empirical analysis.

Mameli et al. (2008) and Paci and Usai (2008) estimate a negative impact of sectoral specialization on local growth. Only Forni and Paba (2002) are able to corroborate the MAR hypothesis. All studies on Italy also find a positive impact of the degree of diversification on local employment growth, thus corroborating Jacobs theory. These findings suggest that, if diversification is always better for growth, regional specialization may hinder economic growth. According to Beaudry and Shiffauerova (2009, pp. 320–321) "this may be first related to the lower flexibility of the specialized regions and consequently to their decreased capacity to adjust to exogenous changes, which may prove critical if the main industry in the region declines." The evidence of a negative effect of specialization can also be interpreted in terms of a product's life cycle: products first develop in a few places (strong specialization) and then diffuse across space (Combes 2000), thus places with a higher specialization in a given sector, display lower (or more negative) growth rates. Finally, Paci and Usai (2008) observe that from the 1990s, the manufacturing industry in Italy has undergone a reorganization process which penalized more highly specialized LLSs.[3]

Besides the degree of specialization and diversification, the two alternative theories (MAR and Jacobs) also relate regional growth performances to the level of local competition, *comp*. According to the MAR theory, "local monopoly is better for growth than local competition, because local monopoly restricts the flow of ideas to others and so allows externalities to be internalized by the innovator" (Glaeser et al. 1992, p. 1127). Porter (1990) supports the Marshallian specialization hypothesis in identifying intra-industry spillovers as the main source of knowledge externalities but suggests that local competition rather than monopoly favors growth in specialized geographically concentrated industries. In line with Porter, Jacobs (1969) also suggests that a more competitive environment is more conductive to innovation and therefore to growth. According to Beaudry and Shiffauerova (2009), only 25 studies attempt to detect the three types of externalities: specialization,

[3]Cingano and Schivardi (2004) observe that the evidence of a negative effect of MAR externalities may be due to the choice of the employment growth as dependent variable. They show that, within the same sample, if the total factor productivity (TFP) growth is used in place of the employment growth as dependent variable, the sign of the MAR coefficient turns out to be positive. TFP measures have also been used in other recent studies on Italy (Cainelli et al. 2013), Spain (De Lucio et al. 2002), and Europe (Dettori et al. 2012). Although it is an unquestionable improvement of the analyses on the effects of agglomeration economies, the choice of productivity measures often creates additional inconvenience for researchers in terms of data availability. Paci and Usai (2008), for example, stated that the use of productivity measures may lead researchers to consider more aggregated geographical levels, with negative consequences in terms of assessment of local externalities (Dekle 2002; De Lucio et al. 2002) and of selection biases (Henderson 2003; Cingano and Schivardi 2004). For these reasons and in consideration of the fact that we are interested in evaluating long-term effects of agglomeration economies, we decided to use employment growth as variable of outcome in our analysis. Census data on employment at LLS level for a large number of sectors, indeed, allow us to consider a time span of about thirty years. Moreover, the use of employment growth also allows us to verify the existence of differences between Manufacturing and Service sectors, whereas studies on TFP only analyze Manufacturing sectors due to the difficulty of measuring TFP levels in service sectors.

diversity, and competition. Porter's view on competition is most often supported in conjunction with Jacobs theory, which is consistent with the Jacobsian model. For the case of Italy, Paci and Usai (2008) find a positive effect of market power (i.e., a negative effect of local competition) on local employment growth. Mameli et al. (2008) find a negative effect of local competition when using 2-digit sectoral level data and a positive effect of local competition when using 3-digit sectoral level data.

Urbanization economies are not only driven by the degree of diversity of an economy but also by the overall density of economic activity, *den*. Ciccone and Hall (1996) argue that an increase in economic density involves the accessibility to a broader supply of local public services and a higher local demand and this may foster local growth. However, a larger size of the local economy also entails congestion effects (higher land prices, higher crime rates, environmental pollution, traffic jams, and excess commuting), so that agglomeration diseconomies may dominate. In other words, regions tend to grow faster if, ceteris paribus, agglomeration economies overcome congestion costs. For the case of Italy, Mameli et al. (2008) report evidence of a positive linear effect of population density, while in Paci and Usai (2008) the effect of population density is positive for the whole sample (including both manufacturing and services) and null for the manufacturing sectors.

Finally, the presence of scale economies means that larger is the size of a plant, *size*, better the possibility to exploit fixed costs. This is the case, for example, in monopolistic competition models. A large size could be source of a more detailed division of labor, promoting specialization and productivity growth. However, a large firm size can lead to an increase in costs, for example, owing to the more difficult and slow information flow or related to managerial incapabilities. Mameli et al. (2008) find a negative effect of scale economies when using data at 2-digit sectoral level (in line with Paci and Usai 2008) and a positive effect of scale economies when using data at 3-digit sectoral level.

6.2.2 Critical Issues

Many empirical studies on local employment growth have used the log-linear model (1), including those on the Italian case (Cainelli and Leoncini 1999; Mameli et al. 2008; Forni and Paba 2002; Paci and Usai 2008). However, we claim that the results of these studies suffer from a number of model mis-specification issues.

First, as mentioned above, all of the previous studies on Italy measure Marshallian externalities, *spe*, with the location quotient (or Balassa index), and in most of the cases, they find a negative effect of specialization on employment growth, notwithstanding the strong anecdotal evidence of the economic success of *industrial districts*, the places where Marshallian externalities are magnified. Indeed, the Marshall's theory on external economies, revisited by Becattini (1979) to explain the successful performance of Italian industrial districts, does not only consider the degree of production specialization to describe the characteristics of industrial districts. The essence of the "industrial atmosphere" does not simply consist of "working on similar things", but it also depends on a number of other factors, such as the prevalence of small- and medium-sized firms often involving family ties, a high degree of mutual trust and tolerance among economic actors, and other socioeconomic factors which contribute to determine the social capital of the region. Additionally, the industrial districts' structures are supported by an infrastructure tailored to the particular needs of the district's industry. In a nutshell, a strong specialization per se might be very dangerous for a region since it may lead higher vulnerability to idiosyncratic shocks, unless other factors (those which contribute to determine the industrial atmosphere) are present in the region generating a sort of risk sharing insurance that protect local firms against these kind of shocks. Thus, in order to capture the effect of Marshallian externalities, a large number of socioeconomic variables should be included in the empirical model. However, this strategy is not always feasible because of the lack of relevant information, especially when, as in our case, the analysis covers a rather long time period. As it will be clarified in Sect. 6.2.3, to solve this problem, we exploit information on the identification of industrial districts in Italy.

Second, most of the previous studies disregard the existence of nonlinearities in the relationship between agglomeration economies and growth. However, nonlinearities are very likely to occur in regional growth.[4] For example, the prevalence of either positive or negative urbanization externalities may depend on the level of economic density (*den*) reached. Thus, one may expect the existence of an inverted U-shaped relationship between local growth and total employment density: below a certain threshold of economic density, positive urbanization externalities overcome congestion costs, while above the threshold, congestion costs prevail. To explore this issue, one may use a semi-parametric framework, where the actual shape of the partial effect can be assessed using smooth functions. Similar arguments can be raised to justify the existence of nonlinearities between growth and industry structure. As for local competition (*comp*), we may expect that, starting from low levels of market power (high levels of competition), an increase of sectoral concentration fosters local economic growth because it allows externalities to be internalized by the innovator (in keeping with the MAR theory), while starting from high levels of local market power, a more competitive environment is more conductive to innovation and, therefore, to growth (in line with Porter and Jacobs). A non-monotonic effect of scale economies (*size*) can also be easily predicted; starting from low plant sizes, a larger plant size may boost economic growth, through a

[4]As a first step in our empirical analysis, we have estimated the log-linear model (1) and obtained results very much in line with previous evidence reported for the case of Italy in studies which used LLS as territorial units of analysis (Paci and Usai 2008; Mameli et al. 2008) (these findings are available upon request). However, the results of a *RESET* test clearly informed us that the log-linear model is mis-specified due to the assumptions on the functional form.

stronger division of labor; above a certain threshold, however, a larger plant size can lead to an increase in information and managerial costs.

Third, most of the previous studies do not control for unobserved spatial heterogeneity when specifying the local economic growth model, disregarding the role of "first nature" characteristics of local areas (Krugman 1993) in affecting their growth performance. The marked unevenness of local development can be partly justified on the basis of space being not uniform: some areas are mainly agricultural systems and are scantly devoted to industrial and service activities; some others are plenty of mountains and are sparsely developed. However, panel-data studies using area fixed effects to capture any sort of localized advantage find that such permanent advantage leave substantial agglomeration effects unexplained.

All in all, in line with Briant et al. (2010), we argue that a number of model mis-specifications may have a much stronger impact on the econometric results than other issues related to the size and the shape of the geographical unit or to the level of sectoral aggregation adopted.

6.2.3 A Semi-parametric Geo-Additive Model

Taking into account all of the above-mentioned remarks, we propose an alternative specification of the empirical local employment growth model:

$$\begin{aligned} y_{r,s,t} = {} & \beta_0 + \theta_1 ID_{r,s} + \theta_2 ID_{r,s'} \\ & + f_1\left(\log(\text{spe}_{r,s,t-\tau})\right) + f_2\left(\log(\text{div}_{r,s,t-\tau})\right) + f_3\left(\log(\text{den}_{r,t-\tau})\right) \\ & + f_4\left(\log(\text{size}_{r,s,t-\tau})\right) + f_5\left(\log(\text{comp}_{r,s,t-\tau})\right) + \gamma_s + \Sigma_t h_t\left(n_r, e_r\right) + \delta_t + \varepsilon_{r,s,t} \end{aligned} \quad (6.2)$$

where f_k and h_t are unknown smooth functions of the covariates[5]; $ID_{r,s}$ is a dummy variable which takes value 1 if the region-sector (r, s) belongs to an industrial district specialized in the same sector (s) and zero otherwise; $ID_{r,s'}$ is a dummy variable which takes value 1 if the region-sector (r,s) belongs to an industrial district specialized in another sector (s') and zero otherwise; θ_1 and θ_2 are their associated parameters; and n and e indicate the latitude (*northing*) and the longitude (*easting*) of the region, respectively. This model provides a relatively flexible framework for the analysis of regional employment growth. First, the inclusion of smooth terms of the covariates allows us to identify non-linearities in the relationship between growth and industry structure without imposing any parametric polynomial form. Second, the inclusion of a geo-additive component (the smooth interaction between latitude and longitude) for each time period permit us to control for time-varying spatial unobserved heterogeneity and, thus, to abstract from heterogeneity of the underlying space. Finally, the inclusion of the dummy

[5]The technique used in this chapter to estimate semi-parametric geoadditive models is widely discussed in Basile et al. (2013).

variables $ID_{r,s}$ and $ID_{r,s'}$ allows us to assess the relative performance of industrial districts, the places where Marshallian externalities occur. Specifically, the two dummies permits us to distinguish between the within-sector and the between-sector *ID* effect. In other words, we suggest that the effect of Marshallian externalities may be simply captured by these dummy variables, while the variable *spe* only captures the vulnerability of the region to idiosyncratic shocks.

6.3 Data and Variables

6.3.1 Data

Following Mameli et al. (2008) and Paci and Usai (2008), the geographical units of observation considered in the present analysis are the LLSs. The number of LLSs in Italy has changed over time. We use the 2001 ISTAT classification which identified 686 LLSs.[6] ISTAT also categorizes LLSs according to whether or not they belong to an industrial district. In particular, it identifies 156 industrial districts in Italy. This piece of information turns out to be of relevance for our analysis, while the degree of urbanization and diversification allows us to put into a test the effect of Jacobs externalities on local labor market performance, the possibility of distinguishing between LLS belonging to an industrial district and other LLSs allows us to assess the role of Marshallian economies on employment dynamics at a very fine territorial level (Table 6.1).

Both manufacturing and service sectors are considered in our analysis. Many empirical studies on the local employment growth focus on the manufacturing sectors (Henderson et al. 1995; Forni and Paba 2002; Cingano and Schivardi 2004). However, modern economies are characterized by an increasing number of service activities that have become an important source of employment. Following the recent literature (Paci and Usai 2008), we take into account this process of structural change in employment dynamics. We consider 15 sectors (subsections of ATECO91-NACE rev. 1 classification; see Table 6.2 in the appendix): ten manufacturing sectors and five service sectors. The public sector is not included. Data on the number of employees and on the number of establishments (local units) in manufacturing and service sectors for the 686 LLS are taken from Italian Census

[6]As it is well known, ISTAT provides data on the number of employees and of establishments in manufacturing and services sectors over the period 1981–2008 by considering two different classifications of LLS, namely the 784 LLSs identified with the 1991s census data and the 686 LLSs identified with 2001s census data. As mentioned above, we use the 2001 classification (686 LLSs) for each decennial census considered in our analysis (1981–1991, 1991–2001, 2001–2008). However, we have also assessed whether the results of our analysis are robust to the choice of the LLS classification. Specifically, we have replicated the regression analysis using data on the 784 LLS (the 1991 criterion) for all the census periods. The results obtained (available upon request) are qualitatively very similar to those reported in the paper.

Table 6.1 Semi-parametric geo-additive model

	Whole economy	Manufacturing	Services
Parametric terms	*Coefficients (s.e. in parentheses)*		
(Intercept)	0.328*** (0.063)	0.468*** (0.097)	0.067 (0.045)
$ID_{r,s}$	1.905*** (0.281)	2.210*** (0.346)	
$ID_{r,s'}$	0.172* (0.092)	0.399** (0.146)	0.195*** (0.067)
Non-parametric terms	*F test and edf (in square brackets)*		
f_1 (log(spe))	229.204*** [3.860]	132.286*** [3.732]	247.476*** [3.893]
f_2 (log(div))	20.962*** [2.481]	39.871*** [1.942]	12.108*** [2.053]
f_3 (log(den))	7.547*** [2.657]	2.167* [1.781]	32.368*** [3.204]
f_4 (log(size))	45.925*** [2.872]	32.663*** [2.896]	19.059*** [2.914]
f_5 (log(comp))	8.115*** [2.872]	6.348*** [2.400]	43.349*** [1.003]
h_{1981} (no, e)	7.190*** [7.190]	8.314*** [6.217]	8.547*** [11.184]
h_{1991} (no, e)	17.292*** [5.472]	11.667*** [5.308]	22.092*** [8.132]
h_{2001} (no, e)	1.851* [6.242]	2.109** [6.715]	9.160*** [11.306]
No. of obs.	27,257	17,006	10,251
$R^2_{\text{adj.}}$	0.094	0.091	0.197
REML	85,784	56,815	23,734

Notes: The dependent variable is the relative employment growth rate: difference between the annual employment growth rate of the s-th sector ($s = 1, , 10$) in the r-th LLS ($r = 1, , 686$) computed for three successive periods (1981–1991, 1991–2001, and 2001–2008) and the annual national employment growth rate of this sector during the same periods. All estimates includes time-fixed effects. Approximated F-tests and associated p-values for the significance of the univariate and the bivariate smooth terms are reported.

of Industries and Services for 1981, 1991, and 2001. These data are obtained through the consultation of the Italian Statistical Atlas of Municipalities (*Atlante Statistico dei Comuni*). Data from the 2008 are taken from the Statistical Register of Active Enterprises (ASIA). Both sources of data are provided by ISTAT. Population and areas data come from ISTAT Population Census.

6.3.2 Variables

As in Combes (2000), each variable used in our empirical analysis is normalized by the value it takes at the national level for the considered sector: this allows us to control for unobserved time-varying sectoral effects. Thus, the dependent variable, $y_{r,s,t}$, is the difference between the annual employment growth rate of the s-th sector ($s = 1, \ldots, 10$) in the r-th LLS ($r = 1, \ldots, 686$) computed for three successive periods (1981–1991, 1991–2001, and 2001–2008) and the annual national employment growth rate of this sector during the same periods:

$$y_{r,s,t} = \log(E_{r,s,t}/E_{r,s,t-\tau}) - \log(E_{s,t}/E_{s,t-\tau}) \tag{6.3}$$

where E stands for employment and t corresponds to the final year of each period (1991, 2001, and 2008), while $t - \tau$ is the initial year of each period (1981, 1991, and 2001).

All explanatory variables refer to the beginning of each period in a way consistent with the idea that agglomeration forces manifest their impact on regional growth after a consistent time lag (Combes 2000). Specifically, we include five explanatory variables capturing the role of (1) specialization, (2) diversification, (3) density, (4) plant size, and (5) local competition. Following the main literature, we measure specialization externalities, $\text{spe}_{r,s}$, by means of the location quotient. This index measures the relative concentration of a sector in an LLS with respect to the average concentration of the same sector in Italy. It can be expressed as follows:

$$\text{spe}_{r,s} = \frac{E_{r,s}/E_r}{E_s/E} \tag{6.4}$$

The r-th LLS is specialized in the s-th sector if the value of $\text{spe}_{r,s}$ is higher than 1, showing that in the LLS considered, the weight of the sector is greater than its weight in the whole country. Values for $\text{spe}_{r,s}$ lower than 1 are evidence of a despecialization. According to the traditional view, a positive effect of $\text{spe}_{r,s}$ would support the MAR theory.

We also try to capture the effect of MAR externalities by directly including the dummy variable $ID_{r,s}$, on the basis of the consideration that Marhsallian economies mainly occur within industrial districts. We also include the dummy $ID_{r,s'}$ to evaluate the impact of industrial district specialized in a given sector s into the employment growth rate of other sectors.

As it is common in the literature, we measure Jacobs or diversification externalities by means of the inverse of the Hirschman–Herfindahl index normalized by the same variable computed at the national level:

$$\text{div}_{r,s} = \frac{1/\sum_{s' \neq s}[E_{r,s'}/(E_r - E_{r,s})]^2}{1/\sum_{s' \neq s}[E_{s'}/(E - E_s)]^2} \tag{6.5}$$

Own-industry employment is excluded because the values of this indicator for the sectors in each LLS differ. A high value of $\text{div}_{r,s}$ means that the r-th LLS has a comparative advantage in a significant share of different sectors (i.e., its production structure is diversified). A low value of $\text{div}_{r,s}$ means that the r-th LLS is specialized in a few industries. Thus, a positive effect of $\text{div}_{r,s}$ would support Jacobs theory.

Total population density, den_r, is used to measure the *scale* of urbanization externalities:

$$\text{dens}_r = \frac{P_r}{A_r} \tag{6.6}$$

where P_r indicates the population in the r-th LLS, and A_r indicates the area in km^2. A positive effect of den_r implies that positive urbanization economies dominate over negative congestion effects.

Following Combes (2000) and O'hUallachain and Satterthwaite (1992), internal economies of scale, $\text{size}_{r,s}$, are measured by the average plant size in the s-th sector located in the r-th LLS compared to Italy as a whole:

$$\text{size}_{r,s} = \frac{E_{r,s}/F_{r,s}}{E_s/F_s} \tag{6.7}$$

where F indicates the number of local units (plants). A positive coefficient associated to $\text{size}_{r,s}$ indicates that the positive effect of a higher division of labor within the firm dominates over the negative effect of higher information and managerial costs.

Following Illy et al. (2011), we measure local competition, $\text{comp}_{r,s}$, using the following normalized Herfindahl index:

$$\text{comp}_{r,s} = \frac{\Sigma_{g=1}^{G}\left(\left(\frac{E_{r,s,g}/F_{r,s,g}}{E_{r,s}}\right)^2 * n_{r,s,g}\right)}{\Sigma_{g=1}^{G}\left(\left(\frac{E_{s,g}/F_{s,g}}{E_s}\right)^2 * n_{s,g}\right)} \tag{6.8}$$

where n is the number of firms, and g indicates the size class of firms in terms of employees. Seven size classes are considered, namely: 1–5, 6–9, 10–19, 20–49, 50–99, 100–499, and more that 500 employees. A negative effect of $\text{comp}_{r,s}$ would support Porter's hypothesis, while a positive effect of $\text{comp}_{r,s}$ would support MAR theory.

6.4 Econometric Results

6.4.1 Evidence from Semi-parametric Models

In this section, we discuss the estimation results of the semi-parametric Model (2), which includes the dummy variables $ID_{r,s}$ and $ID_{r,s'}$ to capture the average within-sector and between-sector "industrial district" effects, smooth univariate terms to identify possible nonlinear effects of agglomeration economies, and the smooth interaction between latitude and longitude to control for unobserved spatial heterogeneity (Table 6.1).

As discussed in the previous session, empirical studies on Italy have reported a negative effect of *spe* both in manufacturing and in services. However, a higher specialization per se does not necessarily mean higher Marshallian economies, while the "industrial district" effect may better identify positive Marshallian externalities.

Indeed, as shown in Table 6.1, the coefficients associated with $ID_{r,s}$ and $ID_{r,s'}$ are always positive and significant, indicating that industrial districts (the places where Marshallian externalities are magnified) perform better, in terms of job creation, than the other LLSs. This is consistent with a huge amount of empirical evidence on the growth success of industrial districts in Italy. However, not surprisingly, the magnitude of the coefficient associated with $ID_{r,s'}$ is much higher in the case of manufacturing than in the case of services.

The middle part of Table 6.1 reports the F-tests for the overall significance of the smooth terms as well as their effective degrees of freedom (*edf*). Each univariate smooth term is specified as a cubic regression spline, while the smooth interaction between *latitude* and *longitude* is specified as a tensor product. F-tests indicate that all terms enter the model significantly. The *edf* is a measure of the term's nonlinearity. If the *edf* is equal to one, a linear relationship cannot be rejected. Evidence reveals that the *edf* is equal to one only for f_5 (log(comp)) in services. The spatial trend term ($h\,(n_r, e_r)$) also is highly significant in all sectors and in all periods, suggesting the presence of an unexplained spatial heterogeneity in local employment growth.

Figures 6.1, 6.2, 6.3, 6.4, and 6.5 portray the smoothed partial effects of univariate terms. The shaded areas highlight the 95 % credibility intervals. The

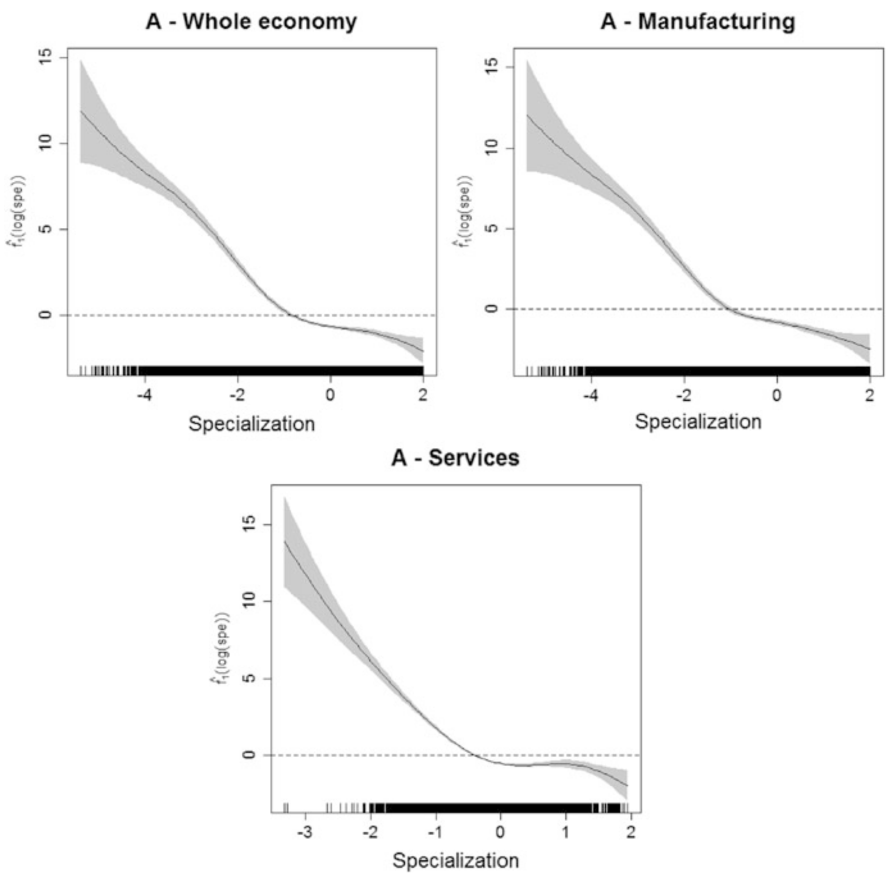

Fig. 6.1 Smooth effect of *spe*

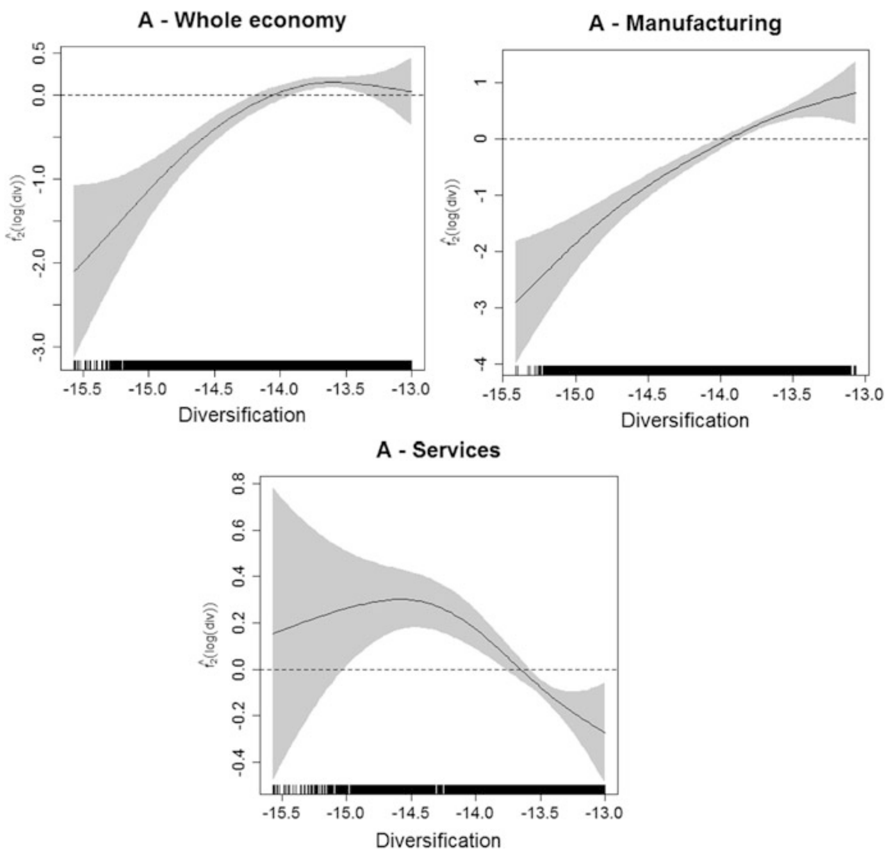

Fig. 6.2 Smooth effect of *div*

log(spe)-plot (Fig. 6.1) confirms that, ceteris paribus, local areas with lower specialization in a sector tend to grow faster in that sector. However, the effect of a decline in specialization always appears to be nonlinear. In particular, we find a hockey stick-shaped relationship between specialization and local employment growth; a higher specialization reduces the employment dynamics due to a higher vulnerability to idiosyncratic shocks, but only up to a certain threshold, after which the relationship between employment growth and *log(spe)* becomes null or negligible.

The effect of diversification is monotonically positive in manufacturing (Fig. 6.2) in line with previous evidence and corroborating Jacobs' theory. For services, it emerges a nonlinear relationship; the effect of diversification on employment growth is null up to a certain threshold, after which it turns to be negative.

Allowing for nonlinearities, we find a hump-shaped relationship between population density, *log*(*den*), and local employment growth (Fig. 6.3); the positive effect of overall population density fades as the density of economic activities reaches some

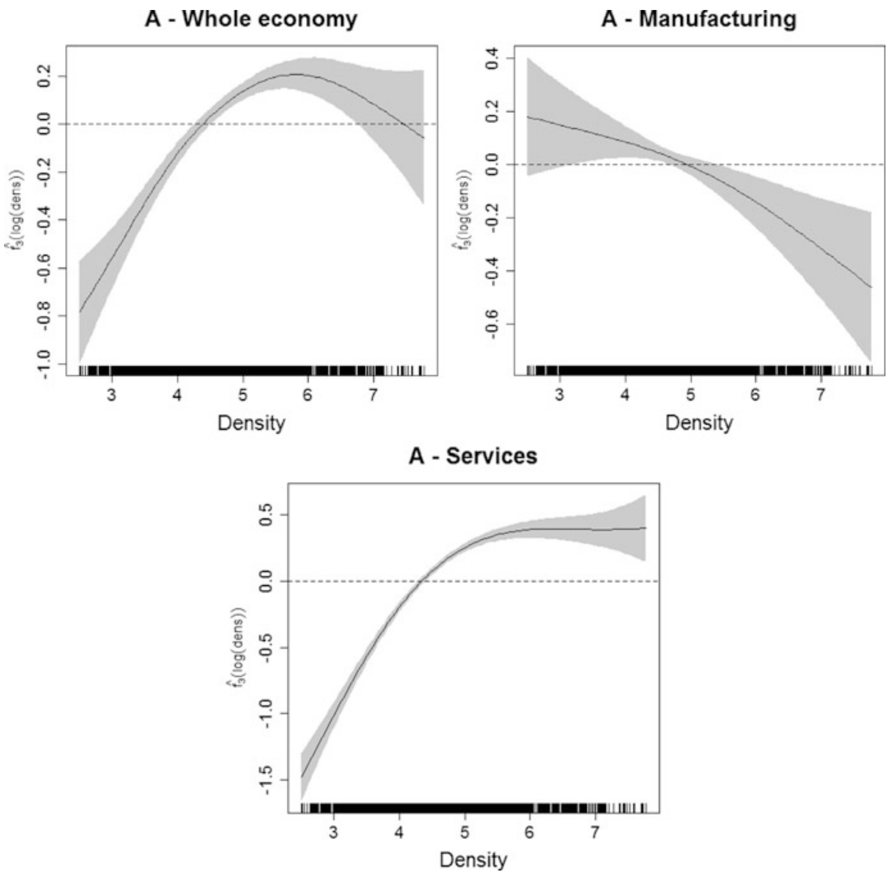

Fig. 6.3 Smooth effect of *den*

threshold value, after which congestion costs overcome agglomeration externalities. This outcome is consistent with the hypothesis that a denser economic activity can exert a positive externality that promotes local growth, but when the level of agglomeration becomes too high, congestion costs kick in and gradually reduce the growth performance. It is worth noticing that in the case of services, the positive treat of the hump-shaped curve prevails over the negative one; the opposite occurs in the case of manufacturing.

We also find evidence of a hump-shaped relationship between employment growth and $log(size)$ (Fig. 6.4); starting from low levels of $log(size)$, an increase in plant size has a positive effect on growth due to, for example, a more detailed division of labor; after a certain threshold (that is starting from high values of $log(size)$), however, an increase in plant size has a negative effect on growth due to an increase in information and managerial costs. The log-linear model masks

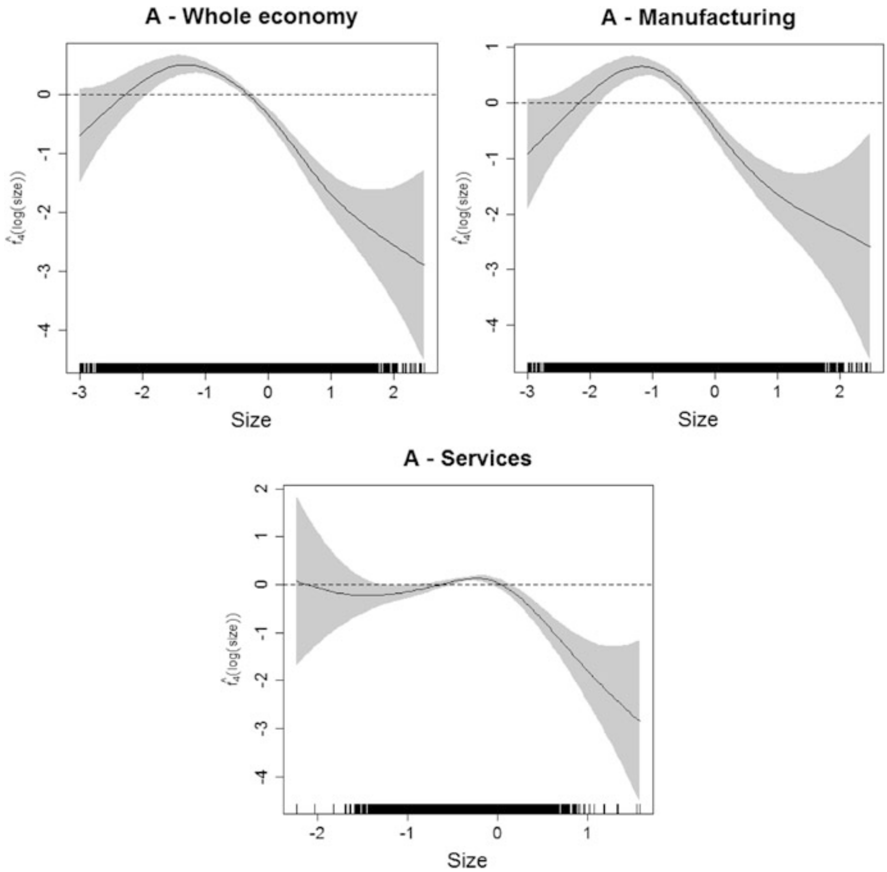

Fig. 6.4 Smooth effect of *size*

these nonlinearities and brings us to conclude for a negative effect of *log*(*size*) both in manufacturing and for a null effect of this variable in services.

The relationship between growth and *log*(*comp*) (Fig. 6.5) is linear and negative in the case of services, indicating that local competition is always better for growth, in accordance with the Porter's theory. In the case of manufacturing, our semi-parametric estimates provide evidence of a nonlinear relationship between growth and *log*(*comp*); starting from low levels of *log*(*comp*) (i.e., from high levels of local competition), an increase in market power has a positive effect on growth, corroborating the MAR theory; after a certain threshold (that is starting from high levels of *log*(*comp*)), a decrease of market power favors local growth. In other words, our results suggest that the validity of Jacobs–Porter hypothesis (according to which local competition is a driving force to urban growth) or of the MAR theory (according to which local competition is an obstacle to urban growth) depends on some cutoff level reached by the degree of local competition.

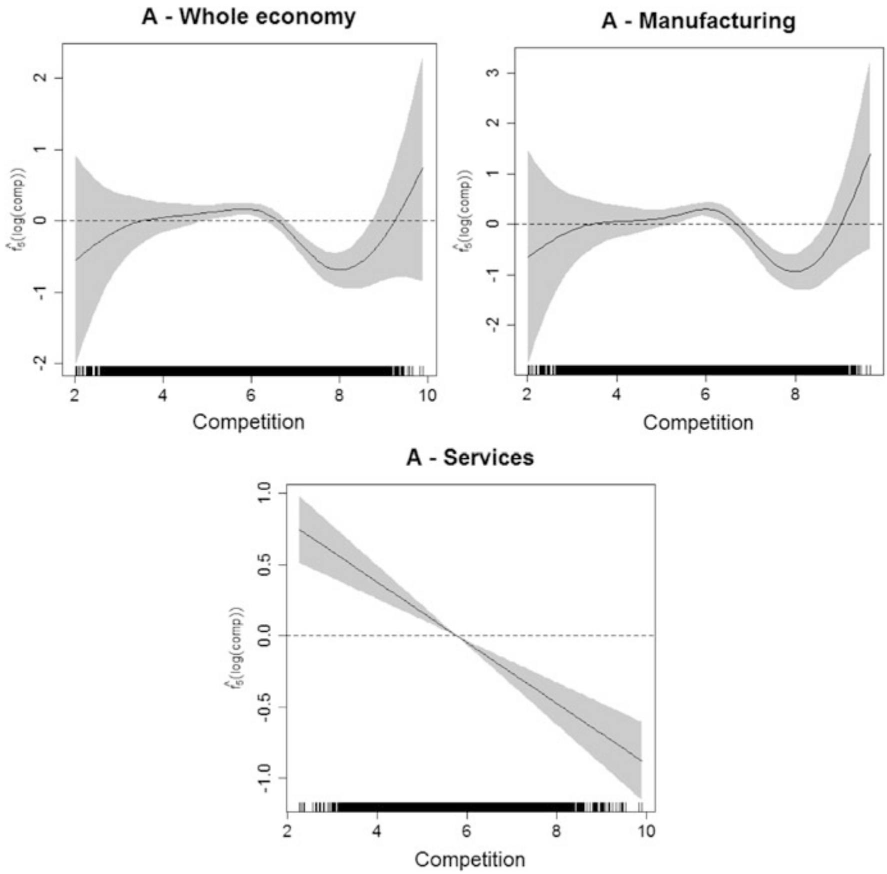

Fig. 6.5 Smooth effect of *comp*

6.5 Conclusions

In this paper, we propose a semi-parametric geo-additive model to analyze the effect of localization and urbanization externalities, local competition, and internal scale economies on sector-region employment growth. This specification allows us to simultaneously address some important issues, such as nonlinearities in the effect of agglomeration externalities and residual spatial heterogeneity. We apply this model to Italy's LLSs data collected for three successive periods (1981–1991, 1991–2001, and 2001–2008).

Moreover, we claim that the variable commonly used to capture the effect of specialization externalities, that is the location quotient, is not suitable to effectively capture Marshallian externalities. Higher specialization levels are indeed an indicator of higher vulnerability to idiosyncratic shocks. In fact, it would be a very hard task to capture Marshallian externalities through a single variable since the essence of the Marshallian externalities depends on a large number of socioeconomic factors. In order to overcome this problem, we exploit the availability of a classification of LLSs in Italy as industrial districts and nonindustrial districts.

Our empirical evidences confirm that industrial districts have performed better than the other LLSs both in manufacturing and service sectors, thus confirming that Marshall externalities exert a positive effect on local employment growth. Moreover, a higher specialization per se has a negative (albeit nonlinear) impact on employment dynamics. A higher diversification, instead, has a positive effect on employment growth in manufacturing sectors corroborating Jacobs theory and a negative effect in services.

The flexibility of the semi-parametric approach also allows us to appreciate that some local characteristics have a nonlinear effect on employment growth. In particular, in keeping with theoretical predictions, the positive effect of urbanization externalities (captured by population density) appears to fade as the density of economic activities reaches some threshold value (in the case of service sectors). Moreover, a hump-shaped relationship between average firm size and local employment growth emerges. Nonlinearities are also evident for the relationship between the level of local competition and employment growth. Besides, a geo-additive model, which incorporates a smooth spatial trend surface, is able to capture residual spatial heterogeneity.

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Appendix

Table 6.2 Sector disaggregation

NACE rev. 1	Sectors
	Manufacturing
DA	Manufacture of food products, beverages, and tobacco
DB	Manufacture of textiles and textile products
DC	Manufacture of leather and leather products
DD	Manufacture of wood and wood products
DE	Manufacture of pulp, paper, and paper products; publishing and printing
DF	Manufacture of coke, refined petroleum products, and nuclear fuel
DG	Manufacture of chemicals, chemical products, and man-made fibers
DH	Manufacture of rubber and plastic products
DI	Manufacture of other nonmetallic mineral products
DJ	Manufacture of basic metals and fabricated metal products
DK	Manufacture of machinery and equipment n.e.c.
DL	Manufacture of electrical and optical equipment
DM	Manufacture of transport equipment
DN	Manufacturing n.e.c.
	Services
G	Wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods
H	Hotels and restaurants
I	Transport, storage, and communication
J	Financial intermediation
K	Real estate, renting, and business activities

Notes: data for the sectors DB, DC, DD, DE, DF, DG, DH, and DI have been merged in pairs. n.e.c. stands for Not Elsewhere Classified

References

Basile, R., & Girardi, A. (2010). Specialization and risk sharing in European regions. *Journal of Economic Geography*, *10*(5), 645–659.

Basile, R., Mnguez, R., Montero, J. M., & Mur, J. (2013). Modeling regional economic dynamics: Spatial dependence, spatial heterogeneity and nonlinearities. *MPRA Paper*, N. 47618. http://www.mpra.ub.uni-muenchen.de/47618/.

Beaudry, C., & Shiffauerova, A. (2009). Who is right, Marshall or Jacobs? The localization versus urbanization debate. *Research Policy*, *38*(2), 318–337.

Becattini, G. (1979). Dal 'settore' industriale al 'distretto' industriale: Alcune considerazioni sull'unità d'indagine dell'economia industriale. *Rivista di Economia e Politica Industriale*, *1*, 7–21.

Becattini, G. (1987). *Mercato e forze locali: Il distretto industriale.* Bologna: il Mulino.
Becattini, G., Bellandi, M., Dei Ottati, G., & Sforzi, F. (2003). *From industrial districts to local development. An itinerary of research.* Cheltenham: Edward Elgar.
Bellandi, M. (2007). Industrial districts and waves of industrialization: A rich and contested terrain. *Scienze Regionali*, *6*(2), 7–33.
Briant, A., Combes, P. P., & Lafourcade, M. (2010). Dots to boxes: Do the size and shape of spatial units jeopardize economic geography estimations? *Journal of Urban Economics*, *67*(3), 287–302.
Cainelli, G., & Leoncini, R. (1999). Externalities and long-term local industrial development: Some empirical evidence from Italy. *Revue d'Economie Industrielle*, *90*, 25–39.
Cainelli, G., Ganau, R., & Iacobucci, D. (2013). Do geographic concentration and vertically-related variety foster firm productivity? Micro-evidence from Italy. *Growth and Change* (forthcoming).
Ciccone, A., & Hall, R. E. (1996). Productivity and the density of economic activity. *American Economic Review*, *86*, 54–70.
Cingano, F., & Schivardi, F. (2004). Identifying the sources of local productivity growth. *Journal of the European Economic Association*, *2*, 720–742.
Combes, P. P. (2000). Economic structure and local growth: France, 1984–1993. *Journal of Urban Economics*, *47*, 329–355.
De Groot, H. L. F., Poot, J., & Smit, M. J. (2009). Agglomeration, innovation and regional development: Theoretical perspectives and metaanalysis. In R. Capello & P. Nijkamp (Eds.), *Handbook of regional growth and development theories* (pp. 256–281). Cheltenham: Edward Elgar.
Dekle, R. (2002). Industrial concentration and regional growth: Evidence from the prefectures. *Review of Economics and Statistics*, *84*, 310–315.
De Lucio, J. J., Herce, J. A., & Goicolea, A. (2002). The effects of externalities on productivity growth in Spanish industry. *Regional Science and Urban Economics*, *32*, 241–258.
Dettori, B., Marroccu, E., & Paci, R. (2012). Total factor productivity, intangible assets and spatial dependence in the European regions. *Regional Studies*, *46*, 1401–1416.
Duranton, G., & Puga, D. (2000). Diversity and specialisation in cities: Why, where and when does it matter? *Urban Studies*, *37*(3), 533–555.
Forni, M., & Paba, S. (2002). Knowledge spillovers and the growth of local industries. *Journal of Industrial Economics*, *50*, 151–171.
Glaeser, E., Kallal, H., Scheinkman, J., & Shleifer, A. (1992). Growth in cities. *Journal of Political Economy*, *100*, 1126–1152.
Henderson, V., Kunkoro, A., & Turner, M. (1995). Industrial development in cities. *Journal of Political Economics*, *103*, 1067–1090.
Henderson, V. (1997). Externalities and industrial development. *Journal of Urban Economics*, *42*(3), 449–470.
Henderson, V. (2003). Marshall's scale economies. *Journal of Urban Economics*, *53*(1), 1–28.
Illy, A., Schwartz, M., Hornych, C., & Rosenfeld, M. T. W. (2011). Local economic structure and sectoral employment growth in german cities. *Tijdschrift Voor Economische en Sociale Geografie*, *102*, 582–593.
Jacobs, J. (1969). *The economies of cities*. New York: Random House.
Krugman, P. (1993). First nature, second nature, and metropolitan location. *Journal of Regional Science*, *33*, 129–144.
Mameli, F., Faggian, A., & McCann, P. (2008). Employment growth in Italian local labour systems: Issues of model specification and sectoral aggregation. *Spatial Economic Analysis*, *3*(3), 343–360.
Melo, P. C., Graham, D. J., & Noland, R. B. (2009). A meta-analysis of estimates of urban agglomeration economies. *Regional Science and Urban Economics*, *39*, 332–342.
O'hUallachain, B., & Satterthwaite, M. A. (1992). Sectoral growth patterns at the metropolitan level: An evaluation of economic development incentives. *Journal of Urban Economics*, *31*, 25–58.

Paci, R., & Usai, S. (2008). Agglomeration economies, spatial dependence and local industry growth. *Revue D'Economie Industrielle*, *123*, 1–23.

Porter, M. E. (1990). *The competitive advantage of nations*. London: MacMillan.

Rosenthal, S. S., & Strange, W. C. (2004). Evidence on the nature and sources of agglomeration economies. In V. Henderson & J. Thisse (Eds.), *Handbook of regional and urban economics: Cities and geography* (pp. 2119–2171). Amsterdam: Elsevier.

Viladecans-Marsal, E. (2004). Agglomeration economies and industrial location: City-level evidence. *Journal of Economic Geography*, *4*, 565–582.

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