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# EXTERNALITIES AND LOCAL ECONOMIC GROWTH IN MANUFACTURING INDUSTRIES

**Abstract**
The growing interest on the economic geography issues has provided new vigour to the research efforts aiming at explaining economic phenomena without neglecting space. In particular several studies have focused on the role of spatially bounded externalities on firms agglomeration processes at the local industry level. This paper has a twofold objective. Firstly, we outline a general eclectic model of local economic growth to provide the theoretical background to guide the econometric analysis. The model includes a general taxonomy of different factors which may explain economic growth in a specific industry and location. Secondly, we assess the role of a large set of potential determinants of the process of local agglomeration of economic activity and we address the issue of spatial association of the local growth processes.
We apply our model to the case of Italy making use of a very ample database on socio-economic indicators for 784 Local Labour Systems and 97 manufacturing sectors over the period 1991-96. Our econometric results show that local growth in Italy is not a homogeneous process. On the contrary, it is characterized by significant differences across macro regions with respect to the relevance of the explanatory factors. Among the most important determinants of local industry growth, it is worth mentioning the positive role of the diversity externalities. We also find robust evidence of the negative influence of specialisation externalities on labour dynamics at the local industry level. Moreover, we have assessed the effects of other determinants of local growth like: human capital, social environment and public infrastructures. The analysis of spatial dynamics, carried out for the North-East and Centre-North, shows that at the local industry level there are polarisation phenomena at work and that employment dynamics are self-contained within the boundaries of local labour systems once we have controlled for a large set of local determinants.

*JEL*: R11, R12, L60, O52
*Keywords*: Local growth, Externalities, Spatial agglomeration, Italy.

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## 1. Introduction*

The recent revival of interest on the issues of economic geography has provided new vigour to the research efforts aiming at explaining economic phenomena without neglecting space. Such a revival has mainly two causes as pointed out by Fujita, Krugman and Venables (1999): on the one hand the real-world concerns arising with the ongoing processes of regional integration, especially in Europe; on the other hand, from the theoretical point of view, the availability of the analytical tools necessary to deal with increasing returns bounded in space which characterise agglomeration forces.

Theory and empirics have, however, developed quite apart (see surveys by Ottaviano and Puga, 1998 and Bruhlart, 1998). Most importantly, empirical works have become increasingly interested in testing for the effectiveness of externalities, even though lacking an appropriate investigation of the different mechanisms which are behind such phenomena (Breschi and Lissoni, 2001). Moreover, such empirical testing has been too often carried out with quite a partial perspective despite the issue of local economic growth proves complex and multifaceted.

This paper has a twofold objective. Firstly, we outline, as a synthesis of previous contributions, a general eclectic model of local economic growth to provide the theoretical background which should allow us to be as explicit as possible about what can be really inferred from our results and under what assumptions. The model includes a general taxonomy of different factors which may explain economic growth, measured by employment dynamics, in a specific industry and location. Secondly, we intend to assess within a wide-ranging framework the role of a large set of potential determinants of the process of local agglomeration of economic activity.

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In particular, the crucial mechanism which explains why firms tend to concentrate in a certain local industry is represented by technological change at the local level. The idea is that technology is not completely exogenous and freely available in the whole economy but it is spatially bounded (Jaffe *et al.*, 1993; Lawson and Lorenz, 1999). As a result, its level and growth rate depend on several elements which are specific to each industry and location. Firms take advantage of the external economies created by the presence in certain local industries of a high technological level which increases firms productivity.

The crucial issue we address in the paper is therefore the identification of a variety of factors which determines technology in the local industry and consequently influences local economic growth.[1] We introduce a useful classification of determinants of local technology in order to provide a general setting for testing different scenarios. Such a classification includes the usual distinction among several types of externalities, such as specialization, urbanisation and network economies. In this respect, it is more difficult to discriminate among knowledge and rent externalities, that is those ones which are due to pure diffusion of information and those ones which are mediated by the market, respectively. Our general framework allows us to consider also other elements which do not enter directly as inputs in the production function of firms but which certainly influence local technology and therefore firms productivity: the availability of human capital, the characteristics of the social environment, the accessibility to public infrastructures.

This paper is very much intended as a further step in the research path started by Glaeser *et al.* (1992) with their seminal contribution on the economic growth of US cities and followed by many studies on other countries' experiences. Henderson *et al.*

[1] An alternative way is to use a direct measure of technology and therefore to investigate on the association between production and technology at the local level. A similar approach has been followed by Feldman and Audretsch (1999) Kelly and Hageman (1999) and Paci and Usai (2000a, 2000b).

(1995), for example, extended the study on a number of sectors of US Metropolitan areas. Other interesting contributions are Combes (2000b) and Funke and Niebuhr (2001) who study employment zones' dynamics in France and Germany respectively. As for Italy there have already been some important contributions along this line of research, such as those by Cainelli and Leoncini (1999), Cunat and Peri (2000), Forni and Paba (2001).

Our original contribution rests mainly on the attempt to widen and generalise the framework of analysis and to assess the relative importance of explanatory factors in different settings. In order to do this, we apply our model to the case of Italy which probably represents the most interesting experience of multifaceted economic development at the local level: the spatial dualism between the rich North and the underdeveloped South, the industrial districts based on a network of small and medium sized firms, the development poles built around large companies in the heavy industries. Our empirical analysis makes use of a very ample database on socio-economic indicators for the Italian Local Labour Systems (LLS). LLS are 784 groupings of municipalities, which cover the whole national territory, characterised by a high degree of self-contained flows of commuting workers (Sforzi, 1997). This high level of geographical breakdown appears particularly fruitful for the analysis of local growth since the production activities have, by construction, a high degree of self containment that makes it easier the identification of the explanatory factors at the local level. The information on local labour systems is also disaggregated with respect to 97 manufacturing sectors. The data refer to the five-year period from 1991 to 1996 due to the fact that the territorial units under examination are, by definition, not fixed across time[2]. This limited temporal extension obviously introduces a bias in our empirical analysis which, consequently, has just a short-run scope.

All in all, the available databank consists of 76,048 observations. Thanks to such a large set we can show that local

[2] In 1981, 944 LLS were identified in Italy.

economic growth is not a homogeneous phenomenon, especially with respect to the geographical dimension. In other words, across the Italian macro regions several patterns of territorial development emerge in the nineties, characterized by significant differences in the relevance of the explanatory factors.

The outline is as follows. The second section presents the main stylised facts which come about from the descriptive analysis of manufacturing employment growth. In the third section we present a simple eclectic model to orientate the empirical analysis. Section 4 contains a more detailed discussion of the explanatory variables included in the model. The econometric estimations are presented and interpreted in section 5. In section 6 we directly address the issue of spatial autocorrelation in the growth process. Section 7 concludes.

## 2. Descriptive analysis

The performance of the Italian manufacturing employment in the nineties has been dismal as pointed out in several studies (Cunat and Peri, 2000). In particular, manufacturing industries have lost from 1991 to 1996 some 370,000 jobs out of around 5,200,000, with an average fall per year of 1.47%. However, the most striking feature of this industrial decline has been its considerable variety in terms of spatial distribution. As a result, geographical heterogeneity is one of our main focus.

First of all, it is worth noting that the distribution of workers in the local labour systems has become less polarised along time: concentration indexes show less dispersion in 1996 with respect to 1991. Nonetheless, employment dynamics follows the usual North-South pattern, even though some important qualifications emerge from the data especially among northern regions, as it is shown in Map 1. As a matter of fact, it is useful to distinguish between the following six macro areas (with the included NUTS 2 regions between parenthesis):

- *North-West* (Lombardia, Piemonte, Val d'Aosta, Liguria)

- *North-East* (Trentino, Friuli, Veneto, Emilia)
- *Center-North* (Toscana, Umbria, Marche)
- *Center-South* (Lazio, Abruzzo, Molise)
- *South* (Campania, Puglia, Basilicata, Calabria)
- *Islands* (Sicilia, Sardegna).

From Table 1 it is therefore possible to note that there is a dualism within the North itself: the North-East shows a relatively good performance of manufacturing employment growth with "only" a fall of –0.69% per year, whilst the North-West stays below the national average due to a fall of 1.78% per year.

Such a variation is mainly the outcome of different stories of development. The one of the North-West is very much the development history of the Italian industrial system of large heavy industries with Turin, Milan and Genoa as main metropolitan centres, giving rise to the so called "industrial triangle". The one of the North-East is, on the contrary, a more recent story of industrial and service development based on local networks of small and medium dynamic firms and plants scattered throughout the area. This is the widely studied development model of the "industrial districts" (see, among many others, Brusco, 1982; Piore and Sabel, 1984). The regions of the Centre-North have a similar performance suggesting that the Italian model of small and medium enterprises agglomeration systems, typical of these two areas, have been rather successful in going through such a troublesome period.

At the other extreme, the South and the Islands show the worst performance with a loss of almost 3% of employees per year during the period from 1991 to 1996. Again this may be interpreted, as the result of the path followed so far by such regions: heavy induced process of industrialisation and crowding out of the weak domestic network of firms. The structural crisis of such heavy industries and the slow process of recovery and growth of a renewed structure of endogenous firms are behind such negative records.

It should be, however, remembered that we are just focusing on manufacturing and that the dynamics of total employment may be different. In particular the analysis of manufacturing sectors may be partial anytime the process of deverticalisation and outsourcing is carried out by involving the service sector. An analysis of the interaction of the dynamics of the two macro sectors is beyond the objectives of this study but it is certainly worth doing in the future.

It is also interesting to look at individual cases to spot "miracles" as much as "disasters" as reported in Table 2. Miracles seem to be concentrated in the South. They refer mostly to small areas where the location of new firms have a very strong impact. The most remarkable success is the one of Melfi which is easily associated to Fiat, which played the role of the so called "large developer" by building a plant for the production of vehicles, thanks to the financial and fiscal incentives available to the Objective 1 regions of the EU. Among the disasters we may find some cases which are due to structural crisis both in the South (i.e., La Maddalena which has paid the price of the crisis of a military arsenal) and in the North (Ivrea which has followed the decline of Olivetti). Obviously miracles and disasters are often the result of idiosyncratic shocks affecting specific sectors which are more prevalent in certain areas rather than others. As a matter of fact, Table 3 shows that there is as much variability from sector to sector as from one area to another one. The most successful sector is Rubber and Plastic with almost 2% of annual growth. Only two more sectors (Machine and Instruments and Other manufacturing) display a positive growth rate. The worst performance is shown by the Transport sector which loses 4% of its employment each year from 1991 to 1996. In this paper the focus is on the geographical rather than on industrial heterogeneity, the latter being a subject which deserves an analysis on its own[3].

[3] Interesting examples of such analyses are Combes (2000b), who directly investigates the different performance of the manufacturing and the service sectors in France and Pagnini (2001), who focus on manufacturing sectors in

Finally, as for the problem of spatial dependence, we find contrasting evidence. At the global level, the Moran index for the whole country reported in Table 4 indicates the presence of spatial dependence among nearby local labour systems. However, when one looks at the local level by means of the LISA (local indicator of spatial autocorrelation) reported in Map 2, one discovers that there are only 211 LLS out of 784 which are spatially associated in a statistically significant way at the 10% level. Moreover, Map 2 shows clearly that a cluster of significant associations is polarised in the North-East. One possible reading is that spatial correlation is not necessarily a uniform phenomenon and that it may depend on several geographical factors. As a matter of fact, in Table 4 the Moran statistic for the first order contiguity proves statistically significant at the 1% level only for the macro-areas in the North.

This evidence is a further hint of the necessity of an appropriate division of the national territory in some sub-regions for a careful look at geographical specificities.

## 3. The model

The main hypothesis under examination may be summarised in a simple economic model, based on previous contributions proposed by the literature on local growth[4], that will serve as a guide for the econometric analysis. Suppose that a firm in industry *j* and location *i* follows a production function given by:

$$Y_{ij} = A_{ij} (L_{ij})^{1-a} \qquad (1)$$

where $0<\alpha<1$, $Y$ is the level of output, $A$ represents the state of technology and $L$ are units of labour. This production function does not include capital input and as such is not able to take into

Italy at the provincial level. Moreover, it might prove interesting to focus on specific sectors as it is done in Maggioni (2000) who studies the dynamics of high tech sectors.

[4] In particular, the model shares some features with Glaeser *et al.* (1992), Henderson *et al.* (1995), Cunat and Peri (2000).

account innovations which are labour saving or which imply capital accumulation.

For each local industry *ij* the equilibrium employment level requires the value of labour marginal product to be equal to the wage rate, that is:

$$A_{ij}\,[(1-a)(L_{ij})^{-a}]P_{ij} \;=\; W_{ij} \qquad (2)$$

where $P_{ij}$ and $W_{ij}$ are, respectively, the price and the nominal wage rate of sector *j* in location *i*. Let us focus on the dynamics by introducing the temporal dimension *t* and rewriting (2) in terms of growth rate of employment thanks to the transformation in logarithms:

$$a\log(L_{ijt+1}/L_{ijt}) = \log(A_{ijt+1}/A_{ijt}) + \log(P_{ijt+1}/P_{ijt}) - \log(W_{ijt+1}/W_{ijt}) \qquad (3)$$

We now concentrate on the determination of the technology growth rate in a certain local industry *ij*. It is important to remark that this variable stands for several elements which, although not directly included as inputs in the production function (1), still play a crucial role in determining the external environment and therefore firms productivity. The growth rate of technology in a local industry $A_{ij}$ can be decomposed into three components: i) specific to the local industry, $\overline{A}_{ij}$; ii) specific to the area, $A_i$; iii) specific to the industry, $A_j$. In other words we can write:

$$\log(A_{ijt+1}/A_{ijt}) = \log(\overline{A}_{ijt+1}/\overline{A}_{ijt}) + \log(A_{it+1}/A_{it}) + \log(A_{jt+1}/A_{jt}) \qquad (4)$$

Let us now briefly examine the determinants of each channel of the overall growth rate of technology, while a more detailed discussion of each variable is postponed to section 4. First of all, technological change has to be attributed to various factors which are specific to each industry and to each location. Among these variables we assume that the key role is played by specialisation externalities (*SE*) and scale effects and the degree of competition (*SC*), which can be summarised in a linear function such as:

$$log(\overline{A}_{ijt+1}/\overline{A}_{ijt}) = \chi_0 + \chi_1 SE_{ijt} + \chi_2 SC_{ijt} \quad (5)$$

Secondly, the changes of technology in a certain location *i,* common to all industries, may be due to some features which characterise the whole local labour system or even a bigger territorial unit which contains it, such as the province or the region. Local factors refer to a large set of socio-economic phenomena which influence firms performance in the area. Among them, diversity externalities *(DE)*, network externalities (*NE*), human capital (*HK*), social capital (*SK*) and public capital (*PK*). This translates in the following specification:

$$log\,(A_{it+1}/A_{it}) = \beta_0 + \beta_1 DE_{it} + \beta_2 NE_{it} + \beta_3 HK_{it} + \beta_4 SK_{it} + \beta_5 PK_{it} \quad (6)$$

The third component, the growth of the sectoral technology, is specific to each industrial sector while it is common to all areas. It can be attributed to technological progress and opportunities within each industry at the national level (*STP*). The specification is as follows:

$$log(A_{jt+1}/A_{jt}) = \gamma_0 + \gamma_1 STP_{jt} \quad (7)$$

Finally, as for the last two elements of equation (3), price changes depend on the conditions prevailing in the output market (*OMC*), whereas wage changes are a function of labour market conditions (*LMC*). As a result we define them as follows:

$$log(P_{ijt+1}/P_{ijt}) = \phi_0 + \phi_1 OMC_{ijt} \quad (8)$$

$$log(W_{ijt+1}/W_{ijt}) = \delta_0 + \delta_1 LMC_{ijt} \quad (9)$$

Finally, the combination of (3) and (4), taking into account (5) through (9), gives rise to the following specification of employment growth which is suitable for estimation:

$$log(L_{ijt+1}/L_{ijt}) = \eta + \chi_1 SE_{ijt} + \chi_2 SC_{ijt} + \beta_1 DE_{it} + \beta_2 NE_{it} + \beta_3 HK_{it} + \\ + \beta_4 SK_{it} + \beta_5 PK_{it}\, \gamma_1 STP_{jt} + \delta_1 OMC_{ijt} - \phi_1 LMC_{ijt} \quad (10)$$

where $\eta$ is a combination of the intercepts in equations 5-9.

A final caveat has to be brought up again for a correct understanding of the empirics based on this model. In the production function there is no room for capital since data on local output and capital stocks do not exist. Consequently, capital deepening innovations are not taken into account. As in all previous similar studies, one hopes that this does not too much perturb the interpretation of main results.

An important by-product of the model is a taxonomy of five types of determinants of local employment growth:

1) Local and industry specific factors
2) Local specific factors
3) Industry specific factors
4) Output market conditions
5) Labour market conditions

## 4. Determinants of local growth: a further discussion

In this section our aim is to discuss in more details the rationale for the inclusion of the above mentioned factors as determinants of local growth and the choice of the proper indicators to measure those factors. A table with the source of the data and the definition of each indicator is reported in Table A.1 in the appendix.

The process of local growth is given by the average annual growth rate of employment for each 97 3-digit manufacturing industries in 784 LLS over the period from 1991 to 1996. To obtain the dependent variable for the econometric analysis this indicator is normalised by the value it takes at the national-industry level. The normalisation is obtained by subtracting the national value from the local value so that we can directly investigate the relative performance of each local industry with respect to the national average.

With regard to the explanatory variables let us discuss them following the taxonomy presented in the previous section.

1. Local industry factors stand for the idiosyncratic variables for each sector and LLS which affect employment growth. Following a long standing tradition, we start considering Marshall externalities measured by an index of production specialisation, SE.[5] This variable measures pecuniary and localisation externalities such as a suitable supply of labour force and primary and intermediate goods (Ellison and Glaeser, 1999), the provision of specific goods and services (Bartelsman *et al.* 1994), the availability of specific infrastructures and networks. However, this specialization index takes also into account the intra-industry flows of knowledge which occurs among similar firms located in the same area (Henderson *et al.*, 1995, Maskell and Malmberg, 1999). In general, the specialisation or Marshallian externalities capture the advantages gained by small and medium sized firms producing similar products within a bounded geographical location.

The second variable is the average dimension of plants *(SC)* which has been included in previous studies to consider two effects. First, the inverse of *SC*, that is the number of firms over workers, is interpreted by Glaeser *et al.* (1992) as a direct measure of the degree of local competition. Secondly, the number of employees per firm can be seen, more straightforwardly, as a proxy for economies of scale which may affect labour productivity (O' hUallachàin and Satterthwaite, 1992). In principle, it would be better to distinguish between the two effects defining two different indicators and including both of them in the estimated equation. Unfortunately, the lack of data on employment of individual firms does not allow the construction of a concentration ratio as a more

[5] The index of relative specialisation for sector *j* and LLS *i* based on employment is computed as: $SE_{ij} = \frac{E_{ij}}{\sum E_i} \Big/ \frac{\sum E_j}{\sum E}$. The index has been standardized within the range –1: +1.

appropriate indicator of local competition. The interpretation of this indicator remains, therefore, ambiguous.

2. Local specific factors refer to a large set of externalities and other indicators of market conditions which are distinctive to each area and affect in the same way all industries located in that area. More precisely we have included in the model some proxies for diversity and network externalities, human capital, social capital and public capital.

Diversity externalities (DE) in the production activities (also known in the literature as Jacobs or urbanisation externalities; Jacobs, 1969) are measured by the inverse of the Herfindal index applied to employment.[6] They are expected to positively influence local growth under the hypothesis that a firm located in a certain area can benefit from the presence in the same area of a wide range of other firms operating in different sectors since it can enjoy inter-industries cross fertilisation.

The second factor is represented by network externalities which are intended to take into account the influence of the absolute size of the economic system, measured by the resident population in each LLS, where a firm is located (Ciccone and Hall, 1996). We expect a positive effect on local growth when a larger population means a higher local demand and the availability of a wider supply of local public services. At the same time, we may have a negative effect if congestion effects prevail giving rise to pollution and higher rents[7]. We have also included a second proxy

[6] The diversity externalities for LLS *i* and sector *j* has been computed as the inverse of the Herfindal index based on the employment shares in all other industries *k* except the one considered. The index has been also normalised by the same index computed for the Italian case as follows:

$$DE_{ij} = \frac{1/\sum_k \left(E_{ik}/\left(E_i - E_{ij}\right)\right)^2}{1/\sum_k \left(E_k/\left(E - E_j\right)\right)^2}$$

[7] This variable is also meant as a control variable to take into account for the high heterogeneity in the dimension of local labour systems which include both

for network externalities which focuses on the supply side taking into account the presence of small firms within the local economy. The idea is that a larger share of small firms is helpful for local growth since they often have to find outside their optimal production scale through cooperation and integration with other firms at the local level. This stimulates the creation of local externalities. The opposite happens with large firms which are more vertically integrated and therefore are less involved in local networks.

The third factor included as a determinant of technology in the local area is the stock of human capital. The literature has emphasized the positive role of human capital on growth (Mankiw *et al.*, 1992) although the correlation between economic development and education attainment has often turn out to be weak (Benhabib and Spiegel, 1994). In our case we have included two proxies to measure the availability in the local area of labour forces with different levels of education: the share of population with just the primary education and the share of population with a university education. The hypothesis is that the former variable measures low level education and therefore should affect negatively local growth, while a higher availability of well educated labour forces represents an advantage for the localization of firms thus fostering local growth.

Another important element often indicated by the literature as a key determinant of local growth is social capital.[8] Also in this case it is not an easy task to find the proper indicators for this very complex and intangible phenomenon. To measure the degree of trust in the local society we include an index of the propensity to cooperate among firms based on the number of inter-firms agreement and participations in consortia surveyed by

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urban and rural areas. For a comprehensive debate on the importance of controlling for the size of the area (instead of the size of the local industry) one may refer to Combes (2000a).

[8] The classical references on the role of social capital are Coleman (1990) and Putnam (1993). See also Temple and Johnson (1998).

the industrial census at the provincial level. The idea is that a higher degree of propensity to cooperate among firms in a certain area helps local growth since it facilitates knowledge diffusion, decreases transaction costs, and enables firms to take advantage of local externalities. We also introduce a second indicator to capture the characteristics of the social environment: an index of the existence of organised crime at the provincial level. In this case, the hypothesis is that a high level of crime is detrimental for local development since it increases firms' costs and reduces expected revenues.[9]

The last local specific variable we consider is public capital, given by a synthetic indicator of physical infrastructures at the provincial level. Following a large body of literature, we assume that a higher availability of infrastructures in a specific area encourages the localization of firms and thus influences positively local growth.[10]

3. As we have pointed out in the previous section, the growth rate of technology in a local industry may also be affected by factors which are idiosyncratic to each industrial sector. To capture these nationwide effects we include the sectoral differences in technological progress and opportunities which are assumed to be identical across the country. The index is a stock measure of patenting activity per sector at the European Patent Office (EPO).

4. Output market conditions are measured by price changes. Due to the lack of data at the product and LLS level, we use price changes for nine macro-sectors at the regional level. From the profit maximizing condition (2), we expect them to produce a positive influence on growth.

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[9] The existence of a negative relationship between crime and growth has been suggested by Murphy *et al.* (1993).

[10] Several papers have highlighted the positive effect of infrastructures on local growth; see, among many others, Aschauer (1989), Eberts (1990) and Munnell (1990).

5. Labour market conditions are measured by wage changes. Again, for similar reasons we use data for macro-sectors at the regional level. From the model, they are assumed to affect negatively local growth.

Concerning the latter two variables we believe that the regional level may prove more appropriate than local labour systems as the proper geographical unit to approximate output and labour market conditions. The macro-sector level, on the contrary, is believed to be too large and, therefore, its average may conceal some relevant information. Consequently, more research on this point is required.

Following the previous empirical literature the variables which are expressed by an index (that is, all indicators but two: the population and the stock of patents) are normalised with respect to the national value.

## 5. Econometric estimation

Unlike previous studies, in this work we attempt to simultaneously consider different factors which are bound to affect local economic growth thanks to the broad perspective suggested by our theoretical framework. Actually, in the search of the best specification we do not apply the usual general to specific approach which consists of a sequence of deletions of variables which are found not significant from a statistical point of view. On the contrary, we carry out an analysis of parameter stability with respect to different subsections of our main sample. In other words we apply the same general specification to sub samples identified with respect to geographic features to establish if there is any difference in the value, sign and significance of the estimated coefficients.

We have estimated our panel using the Generalised Least Squares (GLS) which implies the insertion of cross section weights to correct for the presence of heteroskedasticity[11]. To take into

[11] Heteroschedasticity is also taken into account by using White-robust standard errors.

account the risk of variables omission with respect to the industry dimension we include sectoral fixed effects. We have also tried to control for local fixed effects but they turn out to generate problems of multicollinearity given the simultaneous presence of several explanatory variables specific to each area.

*Aggregate results*

Results of the GLS estimation of equation (10) at the national level (with 76,048 panel observations given by 97 manufacturing sectors and 784 LLS) are reported in the first column of Table 5. Most explanatory variables are significant at the 1% level[12] and show a plausible sign.

The first interesting outcome is the absence of externalities due to productive specialisation: the coefficient of SE is negative and highly significant. Such a result is, to some extent, not surprising given that it has been found in the US (Glaeser *et al.*, 1992), in France (Combes, 2000b) and, most importantly, in Italy at both the provincial (Forni and Paba, 2000) and regional level (Cainelli *et al.*, 2001). Nonetheless, the absence of Marshallian externalities also at the local labour system level is a notable and rather unexpected result. On this respect it is worth reminding that our analysis covers a short time period characterised by a bad economic crises. It is, therefore, possible that our findings are capturing the reorganization processes which have occurred in the local productive systems. At the same time, we may note that most highly specialised local production systems in Italy operate in traditional and mature sectors and that the negative relationship between initial specialisation and employment growth can also be linked to a product cycle mechanism.

As for the average firm size, this is found positively related to local growth. This result can be interpreted as evidence in

[12] It is always problematic to fix a level of significance to assess the reliability of econometric results. Consequently we label all the coefficient with three possible levels: 1%, 5% and 10%. Nevertheless it should be borne in mind that with very large samples, such as in this case, it is rather common to reject the null hypothesis and a significance level of 1% may prove more sensible.

favour of either economies of scale enhancing local growth or of competition hindering it. In the following section we attempt to provide some interpretative elements to disentangle this ambiguity.

As far as local specific determinants are concerned, it has to be noted that positive diversity externalities appear strong and stable, substantiating most of the evidence collected by previous studies.[13] In particular, the coexistence of a positive effect due to diversity and a negative one due to specialisation, confirms previous results (see Paci and Usai, 1999, 2000b). Most importantly, this reveals the need for appropriate indicators to evaluate such effects independently. As for network externalities, the size of the local system measured by resident population is negatively linked to employment dynamics signalling that congestion effects are restraining the growth of LLS in Italy. A positive and significant influence on local growth is also associated to the presence of a relatively higher quota of small firms in the area.

All these results reinforce the idea that - especially in a period of negative business cycle like the one considered - it may prove crucial to rely on a production system based on a diversified network of small flexible firms.

The indicators referring to the different qualities of capital (human, social and public) show interesting composite results. First, both primary and university education emerge as relevant determinants of local growth: the former with a negative impact and the latter with a positive one. However, this relationship proves more complex (as it is also shown in Lodde, 2000 and Di Liberto, 2001) when one moves to a more detailed geographical analysis (see next section). Secondly, the importance of social capital is not signalled by the coefficient of the variable which

[13] Forni and Paba (2001) suggest the relevance not just of variety per se but also of a specific type of variety defined in terms of input-output linkages. In a different setting the same result is obtained by Cunat and Peri (2000). Such specification, particularly problematic at this level of disaggregation, is an objective for future research.

measures cooperation among firms[14]; on the contrary, the relevance of social environment appears in the negative and significant sign of the crime index[15]. Thirdly, the indicator of infrastructures, that is public capital, proves positively related to local economic growth and but it is not significant.[16]

Finally, the last three indexes prove rather fragile. In particular, technological progress specific to a certain industry either does not seem to diffuse nationwide in any homogenous way or simply does not affect employment growth. A possible explanation is that our indicator for national technology – i.e. the stock of Italian patents at the European Patent Office - may be inadequate in taking into account the complex nature of technological progress. Moreover, we may have multicollinearity problems with the sectoral fixed effects included in the regressions. As for output and labour market conditions, both indicators show coefficients with the wrong sign – negative and positive, respectively. However, only the price growth rate is significant but just at the 5% level. As we have previously remarked this may depends on an inappropriate measurement of these variables at the sectoral level.

*Results for macro regions*

The descriptive analysis in section 2 and evidence in Table 1 suggest the presence of diversified patterns of development in

[14] On the importance of social capital in the regional growth process in Italy see, Helliwell and Putnam (1995). A complete array of interesting findings at the provincial and city level can be found in the works by Peri (1997) and Forni and Paba (2000).

[15] The complex relationship between criminal and economic activity has been thoroughly analysed in Marselli and Vannini (1999). In particular, empirical evidence on the link between crime and economic growth in Italy can be found in Attanasio and Padoa-Schioppa (1991) and in Forni and Paba (2000).

[16] The positive effect of public infrastructures on economic growth for the Italian regions has been shown by Paci and Pigliaru (1995) and Picci (1999).

Italian macro regions which hints at parameters variability with respect to geographical divides[17].

In Table 5, columns 2 to 4 summarise the results of GLS estimations for three macro regions which have been singled out thanks to some preliminary regressions applied to the macro-areas included in Table 1. Such preliminary regressions have allowed to ascertain that the North-East and the Centre-North have homogenous patterns of employment dynamics with similar sets of coefficients and therefore have been aggregated into the macro region NEC. The same happens for the Centre-South, the South and the Islands aggregated into the macro area CSI. The third region we consider is the North-West which presents a rather peculiar growth pattern. It is immediately clear that there appear significantly different impacts, in qualitative and quantitative terms, with respect to such territorial division.

In particular, we have the confirmation that productive specialisation accounts for negative effects on growth in all areas. Nonetheless, the impact on labour dynamics is relatively stronger in the CSI region (-0.335) with respect to the North (-0.188 for NW and –0.168 for NEC). This result may have several readings. On the one hand, it is possible that the histories of specialisation of these areas are affecting the current dynamics in a path-dependent fashion. In other words, it can be argued that areas in the North have selected their specialisation path following their competitive advantage whilst in the South most local labour systems have been imposed the industrial specialisation pattern trough public intervention[18]. Once the public intervention has evanished, the exogenously imposed productive specialisation has

[17] Cunat and Peri (2000) analyse aggregate economic growth in LLS introducing differences among macro-areas. However, such differences are assumed to be caught just by considering changes in the coefficient of macro-regional dummies with respect to different specifications of the estimated model. Consequently, no structural differences in parameters are directly taken into account.

[18] In the two decades from 1971 to 1991 it has been shown that the productive structure of the South has become more and more similar to the one of the North mainly as a result of public intervention (Rombaldoni and Zazzaro, 1997)

no more carried out a positive influence on local growth. On the other hand, we might recall the short-run nature of our data. On this aspect, Combes (2000b) asserts that there may be asymmetric effects associated to specialisation: it enhances local growth during expansions but favours employment declines during recession, such as in the nineties, due to inflexibilities and rigidities. According to Brusco (1982), firms of the industrial districts in the North-East and in the Centre-North are more apt at reacting to the downturns of business cycles thanks to their high flexibility. Quite the contrary applies to the local systems located in the South and the Islands, where the productive structure is either based on medium and large plants which depends on sub-contracting with firms located in the North; or, alternatively, on a high number of small and medium firms unable to constitute a real systemic network.

Along this line of interpretation, it is worth noting that the average firm size in the NEC, contrary to all the other areas, has a negative impact on employment dynamics. This is probably because in such a macro-area economies of scale are not achieved within the plant but within a network of several plants and firms located in the area. At the same time, this result can be interpreted as a sign of the positive outcome of competition which enhances efficiency and innovation. In this light, one may also note that the presence of small firms is a strong positive determinant of growth in the NEC and in the NW. By contrast, small firms have a neutral role in the CSI (positive coefficient but not significant) confirming the well known fact that small firms in the South are often isolated entities which are relatively unable to exploit external economies available in the local system thanks to inter-firm interactions.

Other interesting considerations come about from the analysis of the effects of diversity, that is urbanisation economies. They have a positive effect on local growth in all macro-areas. In particular, it is worth noting that diversity proves particularly effective in improving local growth perspectives in the South (0.91) with respect to the North (0.24 in the NW and 0.29 in the NECN).

The presence of high rates of primary education has a negative impact in the NEC, whilst it is not effective in the NW and in the macro-areas of the South. In this latter area university education proves especially important. Infrastructures are a positive discriminatory factor only in the CSI[19] even though the level of significance is only 10%. This indicator remains not significant in the regions of the North.

One other notable difference concerns the significance and sign of social capital, when measured by the cooperation index. Interestingly, cooperation proves extremely important in the NEC whilst it is neutral in the NW and in the CSI (negative and not significant). This brings further support to the role played by the favourable social settings and institutions in the success of industrial districts in the NEC (Becattini, 1991). As for the other indicator of social environment - the degree of diffusion of the organised crime in the area - this proves important in discriminating local system growth only in the South where it has the expected negative sign and significance at 5% level.[20]

Finally, it is to be noted that price growth rate is positive and significant at the 5% level in the NEC and that wage growth rate is positive and significant in the NW.

## 6. Spatial dynamic model: an extension

The evidence of Table 4 and Map 2 shows the presence of spatial interdependence at the aggregate level, that is there seems to be an interaction among the dynamics of manufacturing employment of contiguous local labour systems. The high number of observations and the panel structure of the dataset do not allow the implementation of the usual spatial statistics to the specification in column 1 for the whole of Italy. Consequently, we

[19] A higher effectiveness of public infrastructures in Central and Southern Italian regions with respect to Northern ones has been found also by La Ferrara and Marcellino (2000).

[20] Other indexes of criminal activity have been used, such as number of homicides and crimes against property. Results are almost identical.

decide to focus on just one macro-area and we opt for the case of NEC because we believe it can show revealing about the reasons of a successful story of local economic growth. Most importantly, a story which represents a specificity of the Italian economy with its production system based on a diffused network of industrial districts. Moreover, Table 4 shows that although Moran indicators at the aggregate level displays spatial interdependence, this is not a homogenous phenomena. It clearly emerges only in the North and almost disappears in the Centre and in the South. In Map 2 this result is confirmed given that significant LISAs are clustered especially in the North-East and the Centre-North. As a matter of fact the Moran index applied to the residuals obtained in the GLS regression for the NEC (Z=29.7) clearly shows the presence of spatial autocorrelation[21].

When autocorrelation is in action two alternative solutions are available. First of all, one can apply a spatial lag model, that implies the inclusion of the spatially lagged dependent variable in the specification under study. This solution is interpreted as a proper substantive spatial model because it directly incorporates spatial interaction. Alternatively, one can implement a spatial error model, where the spatial dependence is referred to the disturbance term correcting what is called nuisance dependence.

Our choice is constrained to the former model given that the latter can not be implemented because of practical constraints imposed by the available software which can not deal with panel data. Actually, we prefer the former solution because it allows a direct assessment of the existence, nature and strength of spatial interaction. Unfortunately, the spatial lag model is not without problems itself. As a matter of fact, it cannot be estimated with the usual OLS (or GLS) given that the spatial lagged dependent variable is endogenous, which makes the estimated coefficients biased and inconsistent. Common solution to this problem is the

[21] It should be remembered that panel data have two dimensions and that autocorrelation of residuals may have not just a spatial component but also a sectoral one. In this analysis we focus on just spatial autocorrelation.

implementation of an alternative estimation technique chosen among maximum likelihood (ML), generalised method of moments (GMM) or the two stage least squares (2SLS). Given that the former is not applicable due to the large size of the sample[22], the only viable options are the implementation of either the GMM or the 2SLS with the traditional software. In such a case the spatial lagged variables are generated thanks to the distance matrix created through a geographic information system combined with a spatial econometric software.[23] One last operational issue is the fact that these two techniques involve the use of a selection of instrumental variables. In the spatial context such a selection is, however, not an issue given that, following Keleijan and Robinson (1993), one may make use of the spatial lags of explanatory variables.[24]

Main results of a selection of specifications of GMM[25], differentiated in terms of settings of explanatory variables, are reported in Table 6. Most results confirm GLS estimations which prove, in general, rather robust. Among robust coefficients we find those associated to specialisation and diversity externalities, scale economies and competition effects, primary education and cooperation propensity. On the contrary, the sign and the significance of the coefficient for size is rather unstable but never reaches a level of significance higher than 10%. There are no

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[22] Anselin (1999) notes that "the main practical problem is encountered in maximum likelihood estimation where the Jacobian determinant must be evaluated for every iteration in a non linear optimisation procedure" which requires a lot of memory. As a result, "while much progress has been made, considerable work remains to be done to develop efficient algorithms and data structures to allow for the analysis of very large data sets" (pp. 22-23).

[23] The GIS software is Arcview while the spatial econometrics one is Spacestat. It should be also noted that the matrix has been constructed in such a way to take into account the panel structure of data. In other words the same distance setting has been replicated for 97 times, that is the number of sectors.

[24] We do not insert too many instruments (spatial lags higher than one) because this is likely to create problems of multicollinearity (see Fingleton, 2001).

[25] We prefer GMM with respect to 2SLS because it is the most general method and does not imply any assumption on the distribution of residuals. However, we have estimated also 2SLS and results are almost identical.

congestion effects at work as much as there is no strong evidence of a local demand impact. Both results are consistent with evidence on the industrial districts in this area which are, on the one hand, usually away from big cities and, on the other hand, well known for being oriented to world markets. Moreover, there are some indicators which became statistically significant in these specifications while they were not in the GLS estimation: the indicators of output and labour market conditions become both significant and with the correct sign.

With regard to the spatial dynamics in the three regressions there appear interesting results which deserve special consideration. In all the regressions the first-level spatial lag of the dependent variable comes out negative and significant. Whilst it is positive and non significant the second level. This outcome, albeit peculiar, may be interpreted as a consequence of the bi-dimensional nature of our data, which are both local and sector specific. In other words, when each growth rate is referred to a local industry, and most importantly homogeneous territorial units are correctly identified by means of employment flows, phenomena of polarisation are likely to emerge. Such phenomena may give rise to a negative relationship between the dynamics of one sector in a local system and the dynamics of the same sector in contiguous areas. In regression three the insertion of the population of the contiguous area proves not significant while leaving other results unchanged.

## 7. Conclusions

This paper contributes to the literature which aims at unravelling the complex issue of local economic growth. We present a theoretical model which is meant to put on the right track, in terms of hypotheses to be tested and of implied assumptions, our empirical analysis. Such analysis refers to the case of Italy in the nineties which proves to be an extremely interesting and revealing case study.

Results prove quite interesting in particular because they suggest that local growth in Italy in the nineties has been a process characterized by significant differences across macro regions. First of all, we find robust evidence on the negative influence of specialisation externalities on labour dynamics at the local industry level, especially for the Southern regions. The absence of Marshallian externalities in the local industry, although consistent with previous empirical results, is quite a puzzling outcome. A possible explanation is related to the short period considered, characterised by a process of reorganisation of local manufacturing systems. Moreover, most highly specialised local production systems in Italy operate in traditional and mature industries and therefore the negative relationship between initial specialisation and employment growth can also be linked to the product cycle mechanisms. As for the average firm size, this is found positively related to local growth. This result can be interpreted as evidence in favour of either economies of scale enhancing local growth or of competition hindering it.

Among the most robust determinants of local industry growth, it is worth mentioning the positive role of the diversity externalities. The presence in a certain location of a production system characterised by a wide range of other firms operating in different sectors produces positive effects on labour dynamics since it favours inter-industries cross fertilisation and protects from sector idiosyncratic shocks.

As for network externalities, the size of the local system measured by resident population is negatively linked to employment dynamics signalling that congestion effects are restraining the growth of LLS in Italy. A positive and significant influence on local growth is also associated to the presence of a relatively higher quota of small firms in the area. The other determinants of local industry growth exert the expected role: a negative impact on labour dynamics is found for low education and crime rate, while a positive one is detected for university education, cooperation propensity, infrastructures.

However, it is important to remark that the significance of these factors present a high variation across macro regions. For instance, the average firm size in the North-East and Centre-North, contrary to all the other areas, has a negative impact on employment dynamics which can be interpreted as evidence of external economies of scale and of a growth-enhancing effect of competition. Another notable feature of the macro area of the North-East and Centre North is the relevance of social capital, measured by the level of cooperation among firms. This confirms the importance of favourable social settings and institutions in the success of industrial districts in this area.

As for the spatial dynamics the analysis is carried out only for the North-East and Centre-North where the employment dynamics of the nineties has been relatively successful and where most industrial districts are located. The GMM estimation, while confirming most results of the GLS estimation, reveals some interesting, and unexpected, circumstances. The spatial lag of the dependent variable enter the regression always with a negative sign. This implies that at the local industrial level there are polarisation phenomena at work and that positive externalities are self-contained within the boundaries of local labour systems once we have controlled for a large set of local determinants.

This work clearly suggests that it is difficult to find a general explanation of local economic growth suitable for the entire country and that it is crucial to test for the robustness of the determinants especially with respect to geographical elements. However we have neglected a detailed investigation on industrial heterogeneity which deserves a thorough study on its own. In this vein it is crucial the extension of the analysis to the service sector in order to analyse the cross effects among industries. At the same time it may prove rather intriguing to implement the same analytical and empirical framework to specific sub samples of industries, such as, for example, high tech sectors.

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**Table 1. Manufacturing employment growth in macro regions**

| | Employees (000) | | Annual average variation |
|---|---|---|---|
| | **1991** | **1996** | |
| North West | 2069 | 1896 | -1.75 |
| North East | 1406 | 1359 | -0.69 |
| Centre North | 683 | 649 | -1.04 |
| Centre South | 364 | 331 | -1.89 |
| South | 511 | 457 | -2.24 |
| Islands | 194 | 166 | -3.14 |
| Italy | 5228 | 4857 | -1.47 |

**Table 2. Manufacturing employment growth in selected areas**

| Local Labour System | Region | Employees | | Annual average variation |
|---|---|---|---|---|
| | | *1991* | *1996* | |
| **A. Top 10 LLS** | | | | |
| Melfi | Basilicata | 2659 | 9713 | 25.9 |
| Lungro | Calabria | 77 | 151 | 13.5 |
| Palomonte | Campania | 100 | 196 | 13.5 |
| Belvedere Marittimo | Calabria | 494 | 903 | 12.1 |
| Taverna | Calabria | 44 | 80 | 12.0 |
| Custonaci | Sicilia | 305 | 505 | 10.1 |
| Sant'Agata de' Goti | Campania | 669 | 1105 | 10.0 |
| Frasso Telesino | Campania | 169 | 265 | 9.0 |
| Morcone | Campania | 256 | 391 | 8.5 |
| Apice | Campania | 96 | 143 | 8.0 |
| **B. Worst 10 LLS** | | | | |
| La Maddalena | Sardegna | 763 | 187 | -28.1 |
| Samugheo | Sardegna | 416 | 140 | -21.8 |
| Naro | Sicilia | 242 | 110 | -15.8 |
| Montebello Ionico | Calabria | 640 | 304 | -14.9 |
| Tarquinia | Lazio | 1506 | 748 | -14.0 |
| Manfredonia | Puglia | 2237 | 1180 | -12.8 |
| Santa Teresa di Gallura | Sardegna | 230 | 123 | -12.5 |
| Pisticci | Basilicata | 4149 | 2257 | -12.2 |
| Accadia | Puglia | 172 | 96 | -11.7 |
| Tricarico | Basilicata | 258 | 144 | -11.7 |

**Table 3. Manufacturing employment growth in macro sectors**

| Sectors | Employees (000) | | Annual average variation |
|---|---|---|---|
| | *1991* | *1996* | |
| Food, beverages and tobacco | 476 | 446 | -1.34 |
| Textiles and clothing | 823 | 692 | -3.48 |
| Leather | 244 | 230 | -1.12 |
| Wood | 186 | 170 | -1.79 |
| Paper and printing | 284 | 260 | -1.76 |
| Coke and petroleum | 29 | 24 | -3.71 |
| Chemical | 239 | 209 | -2.67 |
| Rubber and plastic | 179 | 198 | 1.96 |
| Non metals | 276 | 252 | -1.85 |
| Metals | 785 | 761 | -0.62 |
| Machine and Instruments | 541 | 553 | 0.45 |
| Electrics and Electronics | 491 | 457 | -1.45 |
| Transport | 358 | 287 | -4.48 |
| Other manufacturing | 315 | 318 | 0.22 |
| All sectors - Italy | 5228 | 4857 | -1.47 |

**Table 4. Moran test on spatial autocorrelation of manufacturing employment growth among LLS**

| Contiguity order | Italy | North-West | North-East | Centre-North | Centre-South | South | Islands |
|---|---|---|---|---|---|---|---|
| **First order contiguity** | | | | | | | |
| standardized Z values | 6.43 | 4.22 | 4.76 | 1.11 | 0.98 | 1.79 | 0.74 |
| probability level | 0.00 | 0.00 | 0.00 | 0.14 | 0.17 | 0.04 | 0.23 |
| **Second order contiguity** | | | | | | | |
| standardized Z values | 6.49 | 2.93 | 3.94 | 0.61 | 1.03 | 2.34 | -0.23 |
| probability level | 0.00 | 0.00 | 0.00 | 0.26 | 0.15 | 0.01 | 0.41 |
| **Third order contiguity** | | | | | | | |
| standardized Z values | 5.36 | 1.68 | 2.50 | 0.76 | 0.63 | 1.05 | -0.06 |
| probability level | 0.00 | 0.05 | 0.01 | 0.23 | 0.27 | 0.16 | 0.48 |

**Table 5. Econometric results**

Dependent variable: employment growth in the local sector, annual average 1991-1996 (LG) Estimation method: GLS (cross section weights) with industry fixed effects; White robust standard error Level of significance: a=1%, b=5%, c=10%

| **Variables** | | | **Italy** | **North-** | **North-East,** | **Centre-South,** |
|---|---|---|---|---|---|---|
| Local and industry specific variables | SE | specialisation externalities | -0.243 [a] | -0.188 [a] | -0.168 [a] | -0.335 [a] |
| | SC | scale effect - competition | 0.000 [a] | 0.000 | -0.004 [a] | 0.001 [b] |
| Local specific variables | DE | diversity externalities | 0.071 [a] | 0.024 [a] | 0.029 [a] | 0.091 [a] |
| | NE1 | size (population) | -0.027 [a] | -0.031 [a] | -0.003 | -0.004 |
| | NE2 | small firms | 0.013 [a] | 0.017 [a] | 0.010 [a] | 0.004 |
| | HK1 | primary education | -0.020 [a] | -0.029 | -0.021 [a] | -0.009 |
| | HK2 | university education | 0.029 [a] | 0.011 | 0.001 | 0.027 [a] |
| | SK1 | cooperation propensity | -0.060 | -0.086 | 0.280 [a] | -0.229 |
| | SK2 | crime rate | -0.001 [b] | -0.001 | -0.004 | -0.001 [b] |
| | PK | infrastructure | 0.001 | -0.008 | 0.001 | 0.013 [c] |
| Industry specific | STP | sectoral technological | 0.022 | -0.000 | 0.015 | 0.000 |
| Output market cond's | OMC | price growth rate | -0.003 [b] | -0.001 [c] | 0.006 [b] | -0.001 |
| Labour market cond's | LMC | wage growth rate | 0.000 | 0.003 [a] | 0.000 | 0.000 |
| | | **no of observations** | 76048 | 13580 | 24444 | 38024 |
| | | **Adj. R-squared** | 0.15 | 0.13 | 0.15 | 0.25 |
| | | **S.E. of regression** | 0.39 | 0.41 | 0.40 | 0.37 |

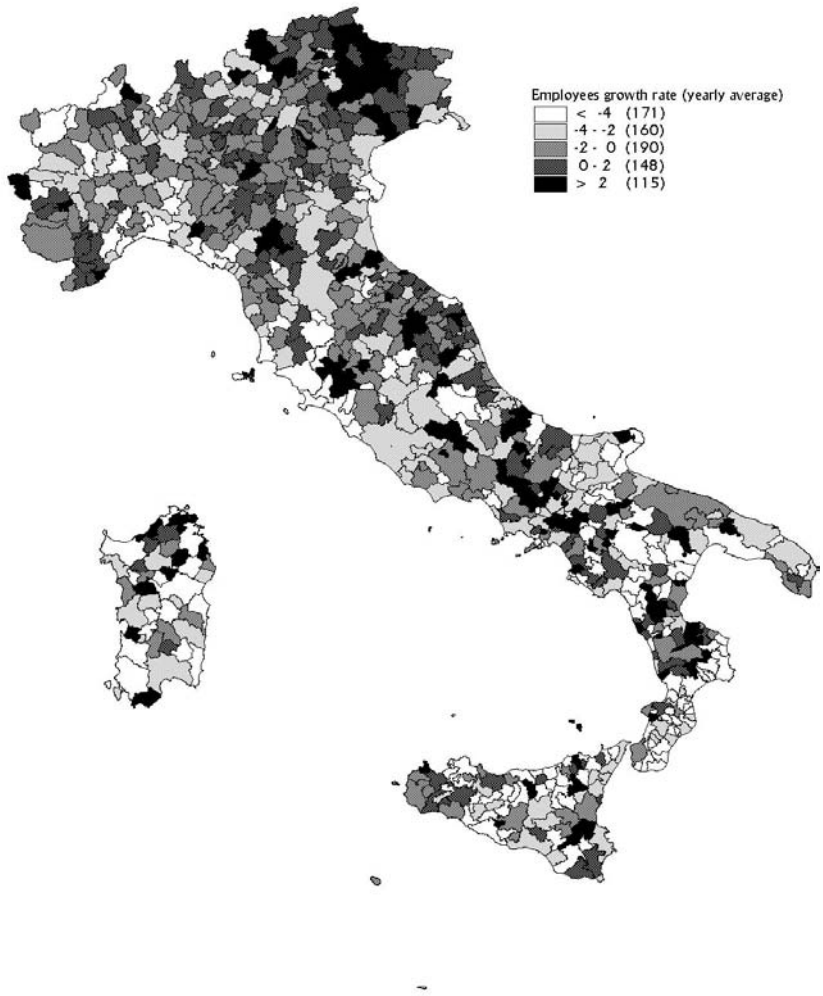
**Tab. 6 Spatial dynamic models: North East and Centre North**

Dependent variable: employment growth in the local industry, annual average 1991-1996 (LG) Estimation method: GMM with spatial lag variables and industry fixed effects, White covariance Instruments: spatial lag explanatory variables with 1st order contiguity

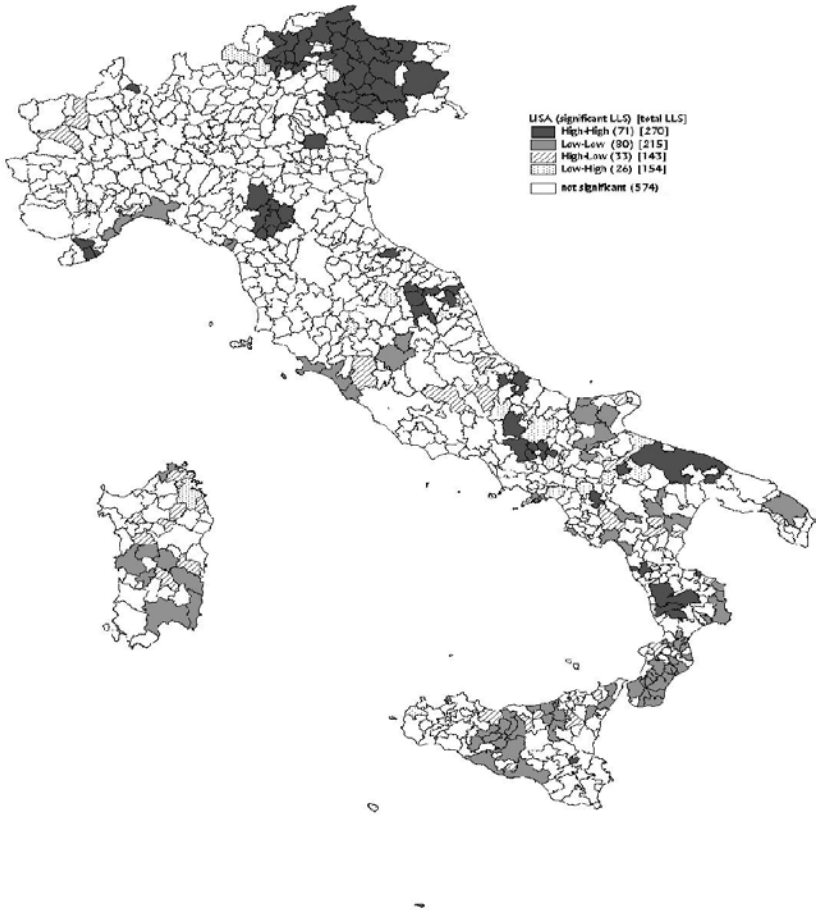
Level of significance: a=1%, b=5%, c=10% Number of observations: 24444

| **Variables** | | | **Regr 1** | **Regr 2** | **Regr 3** |
|---|---|---|---|---|---|
| Local and industry specific variables | SE | specialisation externalities | -0.225 [a] | -0.224 [a] | -0.224 [a] |
| | SC | scale effect - competition | -0.003 [b] | -0.003 [b] | -0.003 [b] |
| Local specific variables | DE | diversity externalities | 0.061 [a] | 0.063 [a] | 0.067 [a] |
| | NE1 | size (population) | 0.006 [c] | 0.005 [c] | 0.005 [c] |
| | NE2 | small firms | 0.018 [b] | 0.017 [c] | 0.018 [c] |
| | HK1 | primary education | -0.155 [a] | -0.154 [a] | -0.156 [a] |
| | HK2 | university education | 0.003 | 0.003 | 0.002 |
| | SK1 | cooperation propensity | 1.430 [a] | 1.397 [a] | 1.580 [a] |
| | SK2 | crime rate | -0.008 | -0.007 | -0.007 |
| | PK | infrastructure | -0.004 | -0.002 | 0.002 |
| Industry specific variables | STP | sectoral technological progress | 0.000 | 0.000 | 0.000 |
| Output market cond's | OMC | price growth rate | 0.028 [a] | 0.025 [a] | 0.025 [a] |
| Labour market cond's | LMC | wage growth rate | -0.002 [b] | -0.002 [b] | -0.003 [b] |
| Spatial lag variables | W_LG | employment growth rate, 1° contiguity | -0.546 [a] | -0.557 [a] | -0.560 [a] |
| | W2_LG | employment growth rate, 2° contiguity | | 0.215 | 0.231 |
| | W_POP | contiguous LLS population | | | -0.006 |

**Map 1. Manufacturing employment dynamics in the Local Labour Systems in Italy**
**(1991-1996)**



**Map 2. Local Indicators of Spatial Association (significant at 10%) of employment dynamics in the Local Labour Systems in Italy (1991-1996)**



**Appendix.**

**Table A.1 Variables description and sources**

| Variables | Index | Level of aggregation | | Sources |
|---|---|---|---|---|
| | | area * | sector ** | |
| **Dependent variable** | | | | |
| - *Local sector growth* | annual average growth rate of employment (S) | LLS | 3-digit ateco91 | 1991 - 1996 Industrial |
| **1. Local and sector specific variables** | | | | |
| - *Specialisation externalities* | index of employment relative specialisation (S) | LLS | 3-digit ateco91 | 1991 Industrial Census |
| - *Scale effects, competition* | Number of employees over number of plants (S) | LLS | 3-digit ateco91 | 1991 Industrial Census |
| **2. Local specific variables** | | | | |
| - *Diversity externalities* | inverse of Herfindal index for employment (S) | LLS | - | 1991 Industrial Census |
| - *Network externalities* | | | | |
| Size | number of resident population | LLS | - | 1991 Population Census |
| Small firms | quota of workers in firms with less than 50 | LLS | - | 1991 Industrial Census |

**Tab. A.1 cont.**

| | | | | |
|---|---|---|---|---|
| - *Human capital* | | | | |
| Primary education | population with primary education / pop > 9 (S) | LLS | - | 1991 Population Census |
| University education | population with university education / pop > 24 (S) | LLS | - | 1991 Population Census |
| - *Social capital* | | | | |
| Cooperation propensity | quota of firms with inter-firms agreements (S) | province | - | Industrial Census Long |
| Crime rate | index of organised crimes (S) | province | - | Censis |
| - *Public capital* | general index of phisical infrastructure (S) | province | - | UnionCamere |
| **3. Sector specific variables** | | | | |
| - *Sectoral technological progress* | stock of sectoral patents, cumulative value 1978- | - | 3-digit ateco91 | CRENoS databank on |
| **4. Output market conditions** | | | | |
| - *Price growth rate* | value added deflator, annual variation | region | macrosectors | CRENoS REGIO-IT |
| **5. Labour market conditions** | | | | |
| - *Wage growth rate* | gross wages, annual variation | region | macrosectors | CRENoS REGIO-IT |

(S) means that the indicator has been standardised to the national value

* Local Labour System=784; Province= 92; Region=20.