LOCAL PRODUCTIVE STRUCTURES, SPATIAL DEPENDENCE AND EMPLOYMENT DYNAMICS

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1. Introduction[1]

In the literature on economic geography, one finds two distinct and important theoretical approaches. One shows how the characteristics of local industrial structures can determine growth differentials across locations, under the assumption that these localities can be considered closed economies. In this context, it has been discussed whether a diversified mix of products or a high degree of specialization in a single economic activity can foster growth at local level. The second field of research deals with the correlation of the economic performance of different locations across space. In technological diffusion models, for instance, locations near the region that has introduced the innovation may have benefits in terms of their own growth prospects. In the former approach, it is assumed that externalities are produced and exert their effects *within* the same location, while in the latter *across*-locations externalities prevail, with their effects varying inversely with distance.

In most cases, these two topics have been dealt with separately. One of the aims of this paper is to analyze them within the same model. In fact, it is very difficult to make precise statements about the geographical scope of the spillover effects by assuming that they stop outside a previously defined geographical region. From this point of view, it is much better to make the more general assumption that the two different kinds of externalities may coexist in the same model. A further advantage of a joint analysis is that it reduces the problem of the so-called border effects in the econometric models. These effects manifest themselves when geographical units are defined according to some administrative needs and not according to some meaningful economic criteria. In these cases, some areas may

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include locations that should have been kept separated or, vice versa, they may unify locations that it would be better to consider separate from an economic point of view. It is evident that not controlling for these border effects can have important consequences on the structure of the error term in a regression analysis using spatial data.

Moving from these considerations, in the methodological section of the paper we extend a well-known model by Glaeser *et al.* (1992) on the determinants of local growth to take account of across-regions spatial externalities. Subsequently, we use this model to study the determinants of long-term employment growth in manufacturing in Italy.

The industrial development of the Italian economy in the last forty years is a good case study to test the validity of local growth models.

On the one hand, the Italian economy exhibits sharp differences in growth rates at local level. It is well known that growth has been particularly rapid in some non-urban regions of the country, the so-called industrial districts (ID), and that these locations feature the presence of a network of small and highly specialized firms, generating both static and dynamic externalities at local level.[2]

On the other hand, the gradient of Italian development has followed a precise spatial pattern, moving from the previously industrialized north-western regions to regions located in the North-East and the central part of the country. However, this industrial take-off has not extended to the rest of the country. In fact, many southern regions continue to show low levels of entrepreneurial activity, low participation rates and high unemployment rates. Thus, we want to investigate whether these coarse observations on the spatial patterns of regional growth rates are confirmed by a more rigorous econometric analysis.

In the empirical part of the paper we use a database by the Italian National Institute for Statistics (Istat) reporting employment data broken down by sector and geographical units (about 8,000 Italian municipalities) in the years 1961, 1971, 1981 and 1991. Adopting a geographical classification based on Italian provinces, we estimate a model of local employment growth with spatial interactions using three-stage least

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2 For a long-term analysis of ID in Italy see Brusco and Paba (1997). A vast empirical research on IDs covering both the real and financial aspects of their economies can be found in Signorini (2000).

squares. We find a significant effect of spatial spillovers: provinces located near fast-growing locations tend to grow more. These effects, however, are weaker in large geographical units. Moreover, we obtain these spatial spillovers by controlling for the potential influence of common unobserved shocks interesting nearby provinces. Hence, we argue that this spatial dependence may reflect a genuine contagion between nearby provinces.

We also find that sectoral specialization and the density of economic activity are detrimental to future employment growth, while a diversified mix of economic activities has a positive effect. We also verify that these relations hold across different cyclical phases of the Italian economy.

The rest of the paper is organized as follows. In section 2 we illustrate a simple model of employment growth at local level. Sections 3 and 4 explain the source of data, the characteristics of the specification used in the regression analysis and some methodological issues concerning the estimation strategy. Section 5 reports the main empirical findings. Alternative specifications for spatial effects are illustrated in section 6. Concluding remarks and suggestions for future research are discussed in section 7.

2. Modelling employment growth at sectoral and local level

In a ground-breaking article, Glaeser *et al.* (1992) study factors determining growth at local and sectoral level. Assume the following production function: $y_{ijt} = A_{ijt}(\cdot)\, f(l_{ijt})$, where y_{ijt} represents production in sector i, (i=1,…,S) and in location j (j=1,..,R) at time t, l_{ijt} is the labour input and $A_{ijt}(\cdot)$ is total factor productivity. This in turn is a function of a vector of variables varying both at sectoral and geographical level to be explained later. The production function exhibits decreasing marginal productivity of labour, as for instance in the traditional Cobb-Douglas case, with $y_{ijt} = A(\cdot) \cdot l_{ijt}^{1-\alpha}$ and $\alpha < 1$.

From the first order conditions for profit maximization and using a Cobb-Douglas function, we get $A_{ijt}(\cdot) \cdot (1-\alpha) \cdot l_{ijt\,l}^{-\alpha} = w_{ijt}$, where w_{ijt} is the real wage rate paid in sector i, location j at time t. Now solving this equation for l, taking logs and first differences, we obtain:

$$\log\left(\frac{l_{ijt+1}}{l_{ijt}}\right) = -\frac{1}{\alpha}\cdot\log\left(\frac{w_{ijt+1}}{w_{ijt}}\right) + \frac{1}{\alpha}\cdot\log\left(\frac{A_{ijt+1}}{A_{ijt}}\right) \quad (1)$$

The final step to complete the model consists in specifying what variables affect the growth of total factor productivity (TFP). Following Glaeser *et al.* (1992), we assume that the growth of TFP for sector *i* and location *j* can be represented by the following equation:

$$\log\left(\frac{A_{ijt+1}}{A_{ijt}}\right) = \beta_1 \log(spec_{ijt}) + \beta_2 \log(div_{ijt}) + \beta_3 \log(com_{ijt}) + \beta_4 \log(l_{ijt}) + \varepsilon_{ijt} \quad (2)$$

where $spec_{ijt}$, is a specialization index for the presence of industry *i* in region *j*, div_{ijt} measures the degree of diversity of region *j* in terms of sectoral composition excluding sector *i*, com_{ijt} denotes competitiveness prevailing in sector *i* and region *j*, lastly l_{ijt} represents the initial level of local sectoral employment.

Substituting expression (2) for TFP growth into equation (1) we get:

$$\begin{aligned}\log\left(\frac{l_{ijt+1}}{l_{ijt}}\right) &= -\frac{1}{\alpha}\cdot\log\left(\frac{w_{ijt+1}}{w_{ijt}}\right) + \frac{1}{\alpha}\cdot\left(\beta_1 \log(spec_{ijt}) + \beta_2 \log(div_{ijt}) + \beta_3 \log(com_{ijt}) + \beta_4 \log(l_{ijt})\right) \\ &= -a_1\cdot\log\left(\frac{w_{ijt+1}}{w_{ijt}}\right) + a_2 \log(spec_{ijt}) + a_3 \log(div_{ijt}) + a_4 \log(com_{ijt}) + a_5 \log(l_{ijt}) + \varepsilon_{ijt}\end{aligned} \quad (3)$$

with $a_1=1/\alpha$, $a_2=\beta_1/\alpha$, $a_3=\beta_2/\alpha$, $a_4=\beta_3/\alpha$., $a_5=\beta_4/\alpha$.

There are different theories that can explain causal links between growth and the factors specified in equation 3.

Localization and urbanization economies

The concentration of economic activity in a region helps firms save on costs for the transport of goods, people and ideas. In particular, when information cannot be easily represented in a formal way and it is disseminated across many economic agents, proximity reduces costs for transmitting ideas. Repeated face-to-face interactions allow firms to learn quickly from others. Hence, a new idea arising in a specific firm is quickly disseminated among neighbouring firms, thus generating knowledge spillovers within the local economy. In turn, these externalities may have important effects on the growth of a region, since they facilitate the accumulation of human capital and increase the rate of innovation (Romer, 1986 and Lucas, 1988).

Glaeser *et al*. (1992) distinguish between two types of knowledge spillovers. On one hand, the exchange of ideas and learning processes can take place between firms or workers belonging to the same sector. These are defined as localization or Marshall-Arrow-Romer (MAR) externalities. On the other hand, the accumulation of new ideas can spread from interactions among firms working in different sectors. These are called Jacobs (1969) or urbanization externalities.

Despite their intuitive meaning, knowledge spillovers are not the only explanation for the role of diversity and specialization. In fact, there can be alternative forms of externalities operating through markets and the price system, producing effects similar to those of knowledge spillovers. In particular, the New economic geography (NEG) assumes the existence of increasing returns to scale at firm level, imperfect competition and transport costs. These three assumptions create an incentive for firms to locate near large input or output markets. Combes (2000) offers many examples of models with these features that can explain the existence of a correlation between growth, diversity or specialization. For instance, specialization can improve labour matching in the labour market. If there is uncertainty about the potential uses of a given innovation, a more diversified local environment can speed up its introduction and increase its effectiveness.

Competition on local markets

In an environment with many externalities it is important that firms introducing an innovation should be able to reap the benefits of their investment decision. If a local market is highly competitive or there are many neighbours, the innovator has to share the returns on innovative activity with many other firms. This in turn may lower its propensity to invest. From this point of view, competition can be detrimental to innovative activity and growth. An alternative view stresses the importance of competition as an incentive mechanism for innovation. In highly competitive local markets, firms are pushed towards continuous improvements in their technologies and towards a rapid imitation of ideas introduced by their competitors. In this view, this positive effect compensates the lower ability of the innovator to appropriate the benefits of innovation typical of highly competitive local markets. Hence it is expected that local competition will have a positive effect on growth.

A priori the effect of local competition on growth will be ambiguous, more competition at local level can stimulate or diminish local growth.

Size of local markets

Glaeser *et al*. (1992) introduce the level of own-sector employment at the beginning of the period among the controls in the growth equation, but they do not offer a clear explanation of its role. Combes (1999) shows that the introduction of own-sector employment and specialization in the same regression biases the coefficient of the latter variable upwards. To avoid this bias, one has to control for total employment in the region instead of own sector employment in a regression with the specialization rate among the regressors.

Overall employment in a region can be considered a proxy for the size of local input and output markets. In turn, the extent of local markets can have an influence on TFP growth in many ways. In models based on knowledge spillovers we can expect that the value of geographical proximity and face-to-face interactions will be increased in the case of large markets with a huge number of economic agents. A similar conclusion can be achieved by using NEG models. Large input and output markets will attract location decisions by firms and workers due to the existence of backward and forward linkages. These new arrivals will make that market even larger and will induce further migration of firms and workers to that region. Similar positive effects linked to the size of local markets can be produced when there are shared inputs or local public goods.

This mechanism of circular causation in which agglomeration fosters growth and this in turn increases agglomeration can be arrested and even reversed by congestion costs. These arise when some production factors are not mobile across regions. As local markets get larger, land rates, commuting costs and pollution increase and this may have a negative impact on future growth.

Last, the initial level of employment can negatively affect future growth, due to a conditional convergence process triggered by decreasing marginal productivity, as in neo-classical growth models. It is obvious that the theoretical underpinnings of the neo-classical school are incompatible with those of urban economics or NEG. The same effect would be produced by the presence of measurement errors causing mean reversion.

In Glaeser *et al.*'s model, growth is measured on employment because of the lack of data on capital stock and output at local level. This is equivalent to assuming that output and TFP will always move with employment levels.

Combes (2003) has recently made explicit all the assumptions needed for this result to hold. Specifically, a positive shock on TFP will increase employment at local level provided that: a) demand for the good is sufficiently elastic with respect to price and b) labour supply at local level is also sufficiently elastic to match the increase in demand. In the absence of the first condition and in a model with capital stock, a positive shock on TFP would decrease employment at local level due to its labour-saving effects. The second assumption is needed to guarantee that an increase in the demand for labour will be made possible by the availability of workers in the region.

About the role of labour supply, Cingano and Schivardi (in this volume) have recently criticized Glaeser *et al.*'s model for using employment-based regressions to get insights into the effects of local productive structures on TFP growth.[3] The authors use data on output and capital of a sample of Italian manufacturing firms to get a correct measure of TFP at local and sectoral level. They then show that in a regression analysis sectoral specialization and the size of a local economy have a positive effect on TFP growth but a negative impact on future employment levels. The authors interpret these conflicting results in the light of an identification problem affecting employment-based regressions. In particular, the degree of specialization and the size of a local economy can also influence labour supply. For instance, highly agglomerated regions may suffer from congestion costs inducing workers to move towards less dense regions. Consequently, the negative effects of local productive structures on future employment levels will be driven by an upward shift in the labour supply curve. This identification problem does not affect TFP-based regressions and hence their results can be correctly interpreted as dynamic externalities.

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[3] See Henderson (1999) and Dekle (2002).

This contribution certainly represents a strong warning against the possibility of interpreting results from the regressions on employment data in terms of dynamic effects on TFP growth. However, it is not fully convincing when it argues that supply factors may have had a large role in determining employment dynamics in the context of the Italian labour market. We will come back to this issue in the section commenting on econometric results.

In any case, previous remarks make it clear that specification in (3) is not equivalent to a full local growth model derived from basic assumptions regarding technology and consumer preferences. Rather, it represents a partial equilibrium analysis where it is assumed that employment dynamics are driven by labour demand and hence by the dynamics of productivity. In the section on econometric results, we will discuss some of the identification problems that this circumstance may generate.

Despite these limits, Glaeser *et al.*'s model is still useful in studying employment dynamics at local and sectoral level, particularly because the dynamics are conditioned on a set of variables featuring important aspects of an industrial structure at local level.

Interregional spillovers

Paradoxically enough, the local growth models shown above do not consider the possibility that different locations may influence each other. In equation (3) it is assumed that all the externalities, either in the form of knowledge spillovers or of backward and forward linkages, arise and produce their effects within the same location. This assumption is extremely restrictive. It is likely that spillovers extend their influence across different regions, maybe with weaker effects on more distant locations. The range of the influence of knowledge spillovers can be limited to a few kilometres, but other forms of market-based externalities do not suffer from the same limitation.

As an example of models with spatial dependence between location growth rates consider the following case. Normally, innovative activity tends to be clustered in a few regions. If the adoption of the new technology is hampered by distance, regions which are closer to the place of origin of the innovative activity will display higher adoption rates. Accordingly, fast-growing regions will be clustered in space.

NEG literature offers additional examples of models with interregional spatial effects. For instance, a firm that is located in a region with a good access (i.e. low transport costs) to a fast-growing market will also have good opportunities for growth. Obviously, this positive effect will fade away as firms located in more distant regions are considered.

But an increasing concentration of economic activity can also generate negative spatial spillovers. If a region is affected by a sort of snowball effect in which agglomeration and growth mutually reinforce each other, this may attract resources from nearby regions, thus reducing their future growth. In this circumstance, being close to a fast growing region will imply a negative effect on growth, or in other words growth rates of neighbouring regions will be negatively correlated.

Because of their relevance, we extend equation (3) to include interregional spatial effects in the form of a spatially lagged variable of employment growth rates. In other words, we show that the employment growth rate in a specific location and sector depends on a weighted average of employment growth rates in the other locations, with weights varying inversely with the distance between regions. Details about the way these weights are defined will be given in the next section.

To derive spatial effects we extend the previous model by Glaeser *et al*. (1992) by assuming that TFP can be decomposed into two parts: *AxB*, where *A* is, as before, a function of variables capturing spillovers within a specific region, whereas *B* depends on variables representing across-region spillovers or interaction between different regions. In particular, we introduce the following modified Cobb-Douglas production function:

$$y_{ijt} = A_{ijt}(\cdot) \cdot B_{ijt}(\cdot) \cdot l_{ijt}^{1-\alpha} = A_{ijt}(\cdot) \cdot \left(\prod_{\substack{k \\ k \neq j}} l_{ikt}^{\gamma\omega_k(d_{jk})} \right) \cdot l_{ijt}^{1-\alpha} \tag{4}$$

where the term in parenthesis denotes the externality effect depending on a weighted average of employment levels in the other provinces. In particular, d_{jk} is the geographical distance between provinces j and k, $\omega_k(d_{jk})$ is a weight related to employment level in k, varying inversely with distance and constrained in the interval between 0 and 1 for each *k.* We also assume that the sum of these weights has to be equal 1: $\sum_{\substack{k \\ k \neq j}} \omega_k(d_{jk}) = 1$. Finally, γ measures the intensity of the overall externality effect and is assumed to vary between –1 and 1. Following the same procedure adopted to derive (3) but using the production function in (4) we obtain:

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\log\left(\frac{l_{ijt+1}}{l_{ijt}}\right) = -a_1 \cdot \log\left(\frac{w_{ijt+1}}{w_{ijt}}\right) + a_2 \cdot \sum_{\substack{k \\ k \neq j}} \omega_k(d_{jk}) \cdot \log\left(\frac{l_{ikt+1}}{l_{ikt}}\right) + a_3 \log(spec_{ijt}) + \\ + a_4 \log(div_{ijt}) + +a_5 \log(com_{ijt}) + a_6 \log(l_{ijt}) + \varepsilon_{ijt} \qquad (5)
$$

with a_1=1/α, a_2=γ, a_3=β_1/α, a_4=β_2/α, a_5=β_3/α., a_6=β_4/α.

Before moving to the econometric analysis we discuss two aspects of the specification in equation (5).

First, with equation (5) it is not possible to identify the sources of spatial externalities that can be based alternatively on market mechanisms or knowledge spillovers.

Second, Glaeser *et al.* (1992) find for the US that urbanization economies foster employment growth, whereas specialization has a negative effect. Henderson *et al*. (1995) make an important qualification to this result by showing that urbanization economies are important for the growth of innovative sectors while localization economies do matter in more traditional or mature sectors. In more general terms, diversity and specialization can play different roles in different stages of product life cycles. Duranton and Puga (2000), in particular, show that new-born firms can benefit from a diversified urban environment because of the advantages in terms of learning. Once the learning process is complete, the same firms may decide to move toward specialized cities to benefit from localization economies.

All these results emphasize the need to look at the behaviour of the model across different time periods and for different groups of sectors. Because of the lack of data, many empirical contributions have neglected the importance of looking at the way in which the influence of localization and urbanization economies may change in different time periods. The dataset used in this paper together with the choice of an appropriate estimation technique allows this analysis to be carried out.

3. The source of the data and the main econometric specification

The data come from the Italian National Institute for Statistics (Istat).[4] In particular they are obtained from different censuses, reporting the number of employees and establishments in Italy broken down by sector (about 40 sectors) and geographical unit (about 8,000 municipalities) in the years 1961, 1971, 1981 and 1991. Criteria with which census data are collected have changed over decades. An advantage of the present database is that Istat has harmonized data to make them comparable over time.

We restrict our investigation to manufacturing activities classified into 24 sectors, although data are also available for services and the building sector.

Geographical units are defined by the 95 Italian provinces existing in 1992. Italian provinces are administrative units, including at least one urban location which is usually the main provincial town. Their definition has no economic content.

Given the availability of data at municipal level, we could also have opted for a much more detailed classification based on the 784 local labour systems (LLS) defined by Istat in 1991. These are self-contained clusters of municipalities, whose boundaries are defined on the basis of daily commuting patterns so that most of the workers living in the area have also their workplace there. They seem to offer an ideal geographical classification to study spillover effects, given that these are usually generated thorough interaction between workers in the labour market.

However, we have decided to use a classification based on provinces instead of LLS in our main specification. This choice is motivated by the circumstance that, since LLS are identified according to meaningful economic criteria, their definition in the final year of our sample period can

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4 See Istat (1998).

influence previous dynamics, thereby causing a problem of endogeneity. This difficulty can be avoided by using an exogenous geographical classification based on the 95 Italian provinces in 1992. In this case we can obviously introduce some border effects, but we can control for them by using the spatially lagged dependent variable that allows externalities originating at a particular location to spill over onto other regions. In any case, to check the robustness of our results we have also run different regressions for the 784 LLS and for the 20 Italian regions.

Our specification for the rate of employment growth in sector *i* *(i*=1*,….,S)* and province *j (j*=1*,…,R)* is the following:

$$\begin{aligned} g_{ij1} &= a_1 + b_1(D \cdot g_1)_{ij} + c_1.spec_{ij} + d_1 div_{ij} + e_1 com_{ij} + f_1 den_j + \sum \phi_i s_i + \sum \lambda_a r_a + \varepsilon_{ij1} \\ g_{ij2} &= a_2 + b_2(D \cdot g_2)_{ij} + c_2.spec_{ij} + d_2 div_{ij} + e_2 com_{ij} + f_2 den_j + \sum \phi_i s_i + \sum \lambda_a r_a + \varepsilon_{ij2} \\ g_{ij3} &= a_3 + b_3(D \cdot g_3)_{ij} + c_3.spec_{ij} + d_3 div_{ij} + e_3 com_{ij} + f_3 den_j + \sum \phi_i s_i + \sum \lambda_a r_a + \varepsilon_{ij3} \end{aligned} \quad (6)$$

Define:

$l_{jt} = \sum_i l_{ijt}, l_{it} = \sum_j l_{ijt}, l_t = \sum_i \sum_j l_{ijt}$ as total employment in region *j*, total employment in sector *i* at national level and total employment for all sectors and regions, all in year *t*.

Hence:

$g_{ij1} = log(l_{ijt+1} / l_{ijt}) - log(l_{it+1} / l_{it})$ is the employment growth rate in sector *i* and region *j* net of the employment growth rate in sector *i* at national level.

t and *t*+1 denote, respectively, the initial and final year of each decade. Decades 1961-71,1971-81,1981-91 are indicated with 1, 2 and 3. The choice of a decade as the time interval to study growth rate is partially due to the availilabily of census data. However, in a recent paper Lamorgese (2002) shows that the time pattern of externality effects on growth can be represented as a bell-shaped curve, reaching its maximum around a ten-year lag. Hence our choice of a ten-year interval seems to find some justification in the data.

The term $(D \cdot g_1)_{ij}$ is an element of a *SRx*1 vector $D \cdot g_1$ obtained as follows:

$$D = \begin{bmatrix} W & & & 0 \\ & \cdot & & \\ & & W & \\ & & & \cdot \\ 0 & & & W \end{bmatrix}$$ is a *SRxSR* block diagonal matrix.

Each submatrix *W* is defined as an *RxR* symmetric matrix as follows:

$$W = \begin{bmatrix} \cdot & & \\ & & \\ & w_{kl} & \\ & & \cdot \end{bmatrix}$$

A generic element of this matrix is defined according to:

$$w_{kl} = \frac{1/d_{kl}}{\sum_l 1/d_{kl}} \quad for \quad k \neq l \; and \quad w_{kl} = 0 \; for \quad k = l$$

where d_{kl} is the physical distance in kilometres between two generic provinces *k* and *l* measured with the method of the great circle. Distance between two provinces is measured with respect to the location of the provincial capital town.

g_1 is a *RSx*1 vector with generic element g_{ij1}.

$spec_i$ = log $[(l_{ijt} / l_{jt}) / (l_{it} / l_t)]$ is the log of specialization rate at the beginning of the period.

$$div_{ij} = \log\left[\frac{1/(\sum_{\substack{i'=1\\ i'\neq i}}^{S}(l_{i'jt}/(l_{jt}-l_{ijt}))^2}{1/(\sum_{\substack{i'=1\\ i'\neq i}}^{S}(l_{i't}/(l_{t}-l_{it}))^2}\right]$$ is the log of diversity index

normalized with respect to the national average.

com_{ij}=log[(N_{ijt} /l_{itj})/(N_{it}/l_{it})] measures the number of establishments per employee normalized with respect to the national average. This corresponds to the inverse of the average size of the establishments measured in terms of employees.

$den_{jt}=log(l_{jt}/Surf_j)$ where $Surf_j$ represents the area covered by province *j* measured in square kilometres.

Last, we introduce sectoral and geographical fixed effects, s_i and r_a. In particular, we have 20 dummy variables corresponding to Italian regions (a=1,…, 20) and 24 sectoral dummy variables one for each sector. Notice that Italian regions consist of clusters of provinces sharing a common border and covering the entire national territory. The number of provinces belonging to a region may vary.

Specification (6) is very similar to that of Combes (2000) and requires some comments.

Wages are not included in the specification because of lack of data. Given the way wages are determined in the Italian labour market, this should hardly be a problem for our specification. Italian wages are usually set on the basis of a national agreement with relatively modest differences across regions. Hence the introduction of sectoral and geographical fixed effects should at least in part account for the influence of the wage rate, thereby mitigating the omitted variables problem.

Employment growth in a specific sector and province is normalized with respect to the growth rate of the sector at national level. Hence the dependent variable is not employment growth per se but the difference for a specific province with respect to the national average. Consequently all the regressors (apart from density) are normalized with respect to their national average. With this normalization we can rule out effects on growth linked to a specific sector but that are common across all regions. $D{\cdot}g$ excluded, all the other regressors are taken at their initial value of the estimation period to avoid problems of endogeneity.

The term $D{\cdot}g$ represents the spatially lagged dependent variable. This means that employment growth in a sector and province is regressed against a weighted average of employment growth rates in the other provinces for the same sector. Weights vary inversely with distance between provinces so that more distant provinces have weaker effects on the growth of a specific area. As discussed in the previous section, this assumption is consistent with many economic models in which the strength of external effects tends to decay with distance.

We have already analyzed the economic meaning of variables like specialization and diversity. Note that these two regressors are not necessarily negatively correlated: a province can be very specialized in a specific sector and still have lot of variety in terms of the presence of the other sectors.

Competition on local markets can be better represented by concentration indexes instead of average plant size. The trouble is that we do not have data on individual firms' output and hence we cannot compute such indexes. It is evident that plant size can also pick up the effect of scale economies on growth. Our dataset does not allow us to disentangle these two effects as done in other contributions.[5]

The value of the density indicator at the beginning of the period requires some comments too. The choice of dividing the level of employment by the size of the area of a province is due to the fact that in this way we can simultaneously control for differences among province surface areas. Hence, the dependent variable in (6) can be reinterpreted in terms of employment density growth rate, given that the province surface are constant and then cancel out in the formula for growth rates. Note also that in the regression we use total employment in a province instead of local sectoral employment (see Combes, 1999).

As anticipated, we also introduce into the regression sectoral and geographical dummy variables. These regressors play an important role in our specification since they control for the potential influence of omitted

5 See Henderson (1999) and Combes (2000) .

variables that can be correlated with the error term across space or sectors. As an alternative to spatial controls based on the 20 regional dummies, we could have used dummy variables for the 95 provinces. We have ruled out this possibility to avoid problems with collinearity. Moreover, spatial dummies based on clusters of provinces with a common border have the further advantage of controlling for potential unobserved common factors influencing nearby provinces.

Finally, note that we have specified equation (6) for three different decades since we want to analyze the evolution of the model across different time periods. This also explains why we do not pool the data in order to get a panel data model.

4. Econometric issues and estimation strategy

The estimation of equations in (6) raises many econometric issues. The presence of the spatially lagged dependent variable among the regressors causes correlation between the error term and the right hand side variable. Accordingly, in this spatial model the OLS estimator will be biased and inconsistent irrespective of the properties of the error term (Anselin, 1988). Thus, we have to adopt instrumental variables (IV) or maximum likelihood (ML) techniques. Our choice has fallen on IV methodology since it is easier to implement than ML. As usual the search for good instruments can be a problem, but in spatial econometrics it is customary to choose spatially lagged exogenous regressors as instruments. A problem with IV is that the value of the coefficients for the spatially lagged dependent variables can be greater than 1 in absolute value. Under these circumstances, the spatial process would become explosive. This problem does not arise for ML since this coefficient is constrained to lie in the interval between –1 and 1. As we will see, most of our estimation results do not suffer from this problem.

Thus we estimate (6) using IV, the set of instruments include the spatially lagged values of the exogenous regressors, obtained by premultiplying the set of exogenous explanatory variables with the spatial weights matrix D defined in the previous section. Specifically, define Z as the set of exogenous regressors in (6) including diversity, specialization, competitiveness, density and dummy variables. The set of additional instruments used in the regression will be given by DZ.

We estimate (6) for three periods: 1961-71, 1971-81 and 1981-91. Parameters are free to vary across decades, but we assume that error terms can be correlated across equations. This implies that we have to estimate (6) as a simultaneous equations system using three-stage least squares (3SLS). A system perspective has many advantages with respect to estimating each equation separately. It improves efficiency and provides a way of capturing omitted variables that may be common across equations (Fingleton, 2001). Furthermore, it is possible to test for the difference of parameters across time.

For certain sectors and provinces there are very few plants and employees and hence growth rates can become extremely large. To prevent these extreme values from having too much influence on the estimates, we use weighted regressions with weights given by the size of a province in 1961 as measured by its population.

5. A discussion of the econometric evidence

5.1 *Comments on main results*

Table 1 presents the main results for the two specifications with and without sectoral and geographical fixed effects. The following comments are mainly directed to the former specification. To check the robustness of estimations reported in Table 1, we have rerun the regression dropping extreme values. More precisely, we have dropped all those observations whose values were lower or greater than the first and 99^{th} percentile of the distribution of the variables in the dataset. All the results (not reported in the text) are unchanged. So we are quite confident that our findings are not driven by extreme values of the variables used in the regression.

A striking result of our regression analysis is the strong positive influence of the spatially lagged dependent variable on g. The coefficient of this regressor is statistically different from zero in all the estimations and decades and it is also positive and always less than 1. Hence faster growing provinces tend to be geographically clustered, that is to say, proximity does matter for employment growth. Similar results have been obtained by Moreno and Trehan (1997) in a cross-country growth analysis and by Fingleton (2001) for the European regions.

Table 1

Econometric results: dependent variable employment growth rate in a sector and province

(t statistics in brackets)

	With no fixed effects			With sectoral and geographical fixed effects		
	1961-71	1971-81	1981-91	1961-71	1971-81	1981-91
Dg	0.505 *(9.29)*	0.6 *(16.15)*	0.475 *(7.3)*	0.37 *(3.63)*	0.43 *(4.54)*	0.51 *(3.65)*
Specializ.	-0.21 *(-11.37)*	-0.195 *(-12.7)*	-0.145 *(-10.35)*	-0.22 *(-11.11)*	-0.23 *(-13.78)*	-0.135 *(-8.98)*
Diversity	0.14 *(2.52)*	0.095 *(2.18)*	0.08 *(2.08)*	0.14 *(2.28)*	0.125 *(2.61)*	0.055 *(1.23)*
Density	-0.075 *(-5.56)*	-0.075 *(-7.25)*	-0.07 *(-8.06)*	-0.115 *(-5.88)*	-0.095 *(-6.63)*	-0.08 *(-6.07)*
Compet.	-0.03 *(-1.31)*	0.04 *(2.18)*	0.04 *(2.21)*	0.005 *(0.26)*	0.025 *(1.08)*	0.07 *(3.52)*
No. obs.	1972			1972		

As shown by Attfield *et al.* (2000), this evidence may not reflect the influence of proximity per se but the circumstance that groups of neighbouring provinces are affected by unobserved common factors. In particular, they show that the effects of proximity disappear once continental dummies and country dummies are introduced, respectively, in a regression analysis for a group of countries and for European regions. As shown by the last three columns of Table 1, our estimates are robust to this test. Introducing regional dummies does not modify our main finding: employment growth in a province is positively related to the growth rate of provinces nearby.

In the equation with fixed effects, the coefficient of $D{\cdot}g$ is increasing through the three decades. In the time interval 1981-1991, a one per cent point of extra employment growth in neighbouring provinces produces

0.51 per cent point of extra employment growth in a sector and province. This time pattern of spatial effects can be explained with a process of increasing integration of provincial markets, which in turn may depend on improvements of transport technologies or regulatory regime.

Obviously this evidence does not allow us to identify the sources of spatial interaction. What these results show however is the relevance of spatial spillovers across provinces in a context in which there are other regressors and regional dummy variables. In other words, these spatial spillovers are not picking up effects correlated with specialization, diversity or the size of the local economy and they do not depend on a common factor influencing groups of nearby provinces.

The two variables representing agglomerative forces, i.e. sectoral specialization and density, both have a negative and statistically significant effect on employment growth in all decades. Similar results have been already obtained by Glaeser *et al*. (1992) for the US, by Combes (2000) for France and by Cainelli and Leoncini (1999) and Usai and Paci (2001) for Italy.[6] A difference with our paper is that we have these results simultaneously controlling for spatial effects. Moreover, our estimation procedure allows an investigation into the stability properties of the model through time.

The negative influence of specialization and density on growth is puzzling and also at odds with the conclusions of the externality based theoretical models. There are many potential explanations for this evidence.

First, one could argue that agglomeration produces negative dynamic spillovers lowering the rate of growth of employment and TFP. According to this interpretation, knowledge spillovers can have a positive effect on the level of productivity, but not necessarily on its rate of growth. This static advantage would explain why specialized regions and concentration of overall economic activity are so diffuse.

As we have seen, Cingano and Schivardi (in this volume) throw doubts on this interpretation, by showing that agglomeration variables can have a positive effect on TFP growth and a negative impact on future

[6] Peri and Cuñat (2001) and Forni and Paba (2002) obtain different results by using different methodologies.

employment levels. Specifically, they argue that, due to disamenities typical of more agglomerated provinces, specialization and density may reduce local labour supply. This effect would explain the negative correlation between agglomerative forces and subsequent employment growth.

To be valid, this interpretation requires a relatively high degree of mobility of the population from less agglomerated to highly agglomerated provinces, but this circumstance seems to be at odds with a well-known feature of the Italian labour market, i.e. the low propensity of the working population towards territorial mobility. To shed some light on this issue we have ranked Italian provinces according to their degree of sectoral specialization and employment density. Hence we document ten-year changes in the distribution of population across the 95 Italian provinces ranked, respectively, by their degree of sectoral specialization and density.

As is evident from Tables 2 and 3, we observe hardly any propensity of the population to move from more specialized towards less specialized provinces. In a similar way, the weight of more densely populated provinces does not show any decline across different decades. Hence, we conclude that the disamenities typical of highly agglomerated provinces do not have a strong influence on local labour supply. Accordingly, it is doubtful that shifts in the labour supply schedule may be responsible for the negative relation between agglomerative forces and employment growth.

To explain the negative effect of specialization, Combes (2000) conjectures that it may depend on a business cycle effect. Specialization would be an advantage in growing periods and a disadvantage when sectoral employment declines at national level because of lower flexibility and worse adaptability. He also argues that this conjecture cannot be verified with his data since they cover a period in which the overwhelmingly majority of the French industrial sectors show a decline in the levels of employment at national level.

Our dataset offers the opportunity to verify this conjecture for the Italian economy by comparing the 1960s, in which employment grows at national level for most sectors, with the 1980s, which correspond to a stage of decreasing employment for many industrial activities. As is evident from Table 1, we do not find evidence of a different behaviour of the model across the three decades. In particular, the coefficient of specialization is negative and highly significant both in the 1960s and in the 1980s. Hence we do not find evidence in favour of Combes's conjecture.

Finally, the negative effect of agglomeration variables on employment growth could be explained by an orthodox neoclassical model in which resources (labour) move from regions where they are abundant to other locations where they are scarce.[7] It is hard to believe that this model can explain employment dynamics in Italy. First, we observe a strong persistence of differences in the degree of development between northern and southern regions in Italy which are difficult to reconcile with a convergence process. Second, spatial interactions between provincial economies described above increase the complexity of the convergence

Table 2

Cumulative population shares of provinces by population density

	Year			
Deciles (1)	1961	1971	1981	1991
1	24.36	29.53	29.59	26.87
2	39.67	41.94	43.97	43.86
3	50.6	52.82	53.57	53.51
4	60.82	62.87	63.63	64.05
5	67.13	69.37	69.68	69.51
6	73.66	75.89	76.73	77.15
7	81.13	82.48	82.65	82.46
8	89.16	90.79	90.98	90.94
9	95.53	95.66	95.69	96.26
10	100	100	100	100

(1) Deciles of provinces are ordered by population density from highest to lowest.

7 The inverse relation between density and employment growth can also be explained by improvements in public infrastructures as well as by innovations in transportation and communication technologies that may have favoured scarcely populated and relatively peripheral regions. Policies directed to offer incentives for certain economic activities to locate in relatively de-specialized and peripheral provinces could have produced a similar effect.

process well beyond what is assumed by an orthodox neo-classical growth model.

Table 3

Cumulative population shares of provinces by degree of specialization

	Year			
Deciles (1)	1961	1971	1981	1991
1	6.18	6.63	5.27	5.10
2	19.21	12.37	13.98	13.42
3	26.21	25.69	28.37	28.30
4	34.09	35.24	35.34	44.61
5	46.21	41.16	41.95	58.60
6	58.23	51.56	49.48	65.15
7	65.86	58.36	61.47	74.55
8	78.77	66.52	76.00	81.60
9	87.48	88.24	88.21	92.66
10	100.00	100.00	100.00	100.00

(1) Deciles are defined as follows. We order sectors in each province by their degree of specialization from the highest to the lowest. We take the five most specialized sectors in each province and we compute the average value. We then order provinces by this index (from highest to lowest).

Consider a province with a high level of density and surrounded by fast-growing provinces. According to convergence theory, this local economy should have a growth rate below the average. The proximity of fast-growing localities, however, has a positive effect on its growth rate and hence can also significantly slow down the speed of convergence to the steady state. With a similar experiment, one can conclude that the speed of convergence would increase in the case of less dense provinces surrounded by fast-growing localities. These examples show that dispersion of the speed of convergence around the mean can also depend on location effects and spatial patterns.[8]

Thus, alternative explanations for the negative effects of agglomeration on employment dynamics are not fully satisfactory. Here we advance a conjecture, although we are not able to provide evidence to test its validity. The relative concentration of a sector in a province can impose a negative externality on incumbent firms in terms of an excess of rivalry at local level, thus some firms may decide to delocalize toward despecialized provinces causing a reduction in local employment. Incidentally, if these firms have lower productivity levels than those exhibited by the remaining firms, this could explain why specialization has a positive effect on TFP growth. Similar but distinct effects may be generated in highly dense provinces. A high level of concentration of overall economic activity increases congestion costs, for instance by augmenting land rates, commuting costs and pollution, and this circumstance may induce some firms to leave that specific location in favour of less dense provinces. As before, if the firms interested by migration process are less productive than the others, their departure may increase average productive at local level. This circumstance may explain why density and TFP growth are positively correlated.

Diversity has a positive and statistically significant impact on *g* as expected, both in the specification with fixed effects and in the one without them (in 1981-91 the coefficient of this variable is only marginally significant in the model with spatial and sectoral fixed effects). This evidence could signal that a rich mix of productive activities exerts a positive influence on future employment growth as predicted by externality based theories.

Finally, we find some evidence of a positive effect of small plants on employment growth, although the impact of this regressor is statistically significant at 5 per cent only for 1981-91. The problem with this variable is that it is highly collinear with specialization (their correlation is around -0.7 for each of the three decades). Dropping *spec* from the model makes the coefficient on small plants variable significantly different from zero for all the three decades without affecting the other regressors. We have also

8 On the relation between convergence and spatial process see Baumont *et al.* (2002) and also Rey and Montouri (1999).

dropped the size variable, maintaining the specialization rate, and results do not change. So we find that a local economy with many small plants *and* with low sectoral specialization is likely to grow more in terms of employment. As already said, we cannot interpret this result as a positive effect of more competitive local markets on employment growth. The small plants variable could also pick up decreasing returns to scale at plant level or the fact that small plants tend to grow more than large ones since they are in early stages of a plant life cycle.

Summing up previous results, we find evidence of a contagion process between growth rates of neighbouring provinces; we also detect negative effects of localization factors on employment growth as opposed to a moderate positive impact of urbanization economies and of the small plant variable on future employment dynamics.

In the next section we will try to give more structure to these contagion mechanisms and we will also analyze the relation between across- and within-province spillovers.

5.2 *Changing the spatial scale*

An important robustness check for our results and an interesting topic on its own is that of a change in the spatial scale on which the analysis is carried out. Enlarging the geographical units of analysis may influence the relative importance of knowledge spillovers versus market-based externalities. The former tend to lose their relevance with increasing distance while the latter are much less dependent on it. Furthermore, the degree of mobility of production factors can also change with spatial scale. In particular, with larger geographical units some resources tend to be less mobile and this fact may in turn change the balance between agglomeration and dispersion forces to the advantage of the latter (Puga, 1999).

To investigate this issue we have rerun our regression using as geographical units the 784 LLS as previously defined and the 20 Italian regions. Results are reported in Tables 4 and 5.

The evidence for the 784 LLS is very similar to that obtained from the regression for the 95 Italian provinces. What is striking is that when one moves to LLS coefficients on *Dg* are always greater than those in Table 1 (this is not true for the last decade in which the coefficient on *Dg* has a sharp reduction with respect to the value of the parameter for 1961-71 and 1971-81).

Table 4

Econometric results: dependent variable employment growth rate in a sector and LLS

(t statistics in brackets)

	With no fixed effects			With sectoral and geographical fixed effects		
	1961-71	1971-81	1981-91	1961-71	1971-81	1981-91
Dg	0.675 *(22.99)*	0.72 *(37.11)*	0.56 *(18.32)*	0.93 *(13.32)*	0.925 *(16.84)*	0.155 *(1.79)*
Specializ.	-0.22 *(-23.19)*	-0.185 *(-24.41)*	-0.145 *(-21.28)*	-0.235 *(-23.46)*	-0.205 *(-24.91)*	-0.17 *(-22.93)*
Diversity	0.12 *(6.22)*	0.03 *(1.9)*	0.03 *(2.11)*	0.13 *(6.25)*	0.04 *(2.29)*	0.03 *(2.05)*
Density	-0.08 *(-12.76)*	-0.065 *(-13.06)*	-0.05 *(-11.62)*	-0.085 *(-10.73)*	-0.06 *(-9.93)*	-0.055 *(-9.82)*
Compet.	-0.015 *(-1.06)*	0.04 *(3.81)*	0.085 *(8.38)*	0.025 *(1.69)*	0.045 *(4.02)*	0.09 *(8.28)*
No. obs.		9832			9832	

When moving to a larger spatial scale, as in the case of the 20 Italian regions, results change again (see Table 5).[9] In particular, in the specification without fixed effects, coefficients on *Dg* are still positive and statistically significant, but smaller than those in Tables 1 and 4. This is consistent with the idea that there are short-range externalities that lose their relevance when geographical units increase in size. Results change

[9] In this regression spatial controls are given by 4 dummy variables indicating North-West, North-East, Centre Italy and South. We could not use the 20 dummy variables for the regression with Italian regions since they cause problems with collinearity. To be sure that these different spatial controls do not influence the comparison between the econometric results based on different geographical units, we have rerun our regression for the provinces and LLS using the 4 macro regions dummy variables. Results do not change.

Table 5

Econometric results: dependent variable employment growth rate in a sector and region (1)

(t statistics in brackets)

	With no fixed effects			With sectoral and geographical fixed effects		
	1961-71	1971-81	1981-91	1961-71	1971-81	1981-91
Dg	0.36	0.385	0.32	0.19	0.13	0.21
	(5.08)	*(7.18)*	*(3.95)*	*(1.21)*	*(0.94)*	*(0.88)*
Specializ.	-0.22	-0.2	-0.09	-0.245	-0.23	-0.09
	(-7.41)	*(-8)*	*(-4.08)*	*(-7.65)*	*(-8.73)*	*(-3.7)*
Diversity	0.3	0.13	-0.04	0.095	-0.29	0.05
	(2.07)	*(1.08)*	*(-0.46)*	*(0.41)*	*(-1.84)*	*(0.46)*
Density	-0.095	-0.125	-0.065	-0.03	0.025	-0.065
	(-3.15)	*(-5.94)*	*(-4.19)*	*(-0.51)*	*(0.62)*	*(-2.3)*
Compet.	0.04	0.035	0.09	0.015	0.01	0.105
	(0.96)	*(1.13)*	*(3.0)*	*(0.36)*	*(0.26)*	*(3.23)*
No. obs.		451			451	

(1) Geographical fixed effects are defined by macro regions dummies: North-West, North-East, Centre Italy and South.

even more when considering the specification with sectoral and spatial fixed effects. Apart from the variable measuring specialization, the effects of all the other regressors are not statistically different from zero.

The consequence of these results for spatial spillovers is quite evident. Employment growth rates are still spatially correlated, as is clear from the first three columns of Table 5, but it is no longer possible to interpret this correlation in terms of spillover effects. In other words, spatial correlation of employment growth rates is due to common unobservable factors influencing groups of neighbouring regions.

All in all, these findings show that econometric results are similar when considering small areas like LLS and provinces. By contrast, most of the variables in the model lose their importance in affecting employment growth when one moves to larger geographical units like Italian regions.[10] In particular, a quite clear-cut spatial pattern seems to emerge: mechanisms based on spatial spillovers or contagion are at work in small areas, but vanish when one considers geographical units of larger size.

6. Alternative specifications of the spatial effects

In specifying spatial effects, we have introduced a strong assumption on the way geographical distance affects economic variables. In particular we have assumed that employment growth in province l will influence employment growth in province k according to the weight $w_{kl} = \frac{1/d_{kl}}{\sum_l 1/d_{kl}}$. Now we want to check the robustness of previous econometric results with respect to different assumptions on w_{kl}. In particular, we try with these different specifications of the elements of the distance matrices:

$$(a)\quad w^{(a)}_{kl} = \frac{1/d^2_{kl}}{\sum_l 1/d^2_{kl}} \qquad (b)\ w^{(b)}_{kl} = \frac{(1/d_{kl}).GDP_{l1961}}{\sum_l (1/d_{kl}) \cdot GDP_{l1961}} \qquad (c)\ w^{(c)}_{kl} = \frac{(1/d^2_{kl}).GDP_{l1961}}{\sum_l (1/d^2_{kl}) \cdot GDP_{l1961}}$$

In assumption (a) we have simply squared the inverse of distance to control for non-linear effects. In the second specification we have assumed that the influence of province l on province k varies not only with the inverse of distance but also with the size of province l as measured by its GDP in 1961.[11] This expression is conceptually similar to the idea of a market potential function.[12] Finally, assumption (c) is obviously the same as (a) but with the square of the inverse of the distance weighted with provincial GDP in 1961. Results for the specification with sectoral and

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[10] Pagnini (2003) obtains similar results in a static analysis of agglomeration across sectors.

[11] We used GDP in 1961 also for other decades to avoid potential problems of endogeneity.

[12] See Fuijta *et al.* (1999).

geographical fixed effects and for each of the assumptions on the weights matrices are reported in Tables 6 and 7.[13]

Table 6

Econometric results: dependent variable employment growth rate in a sector and province (1)

(t statistics in brackets)

	Using w_{kl}			Using $w^{(a)}_{kl}$		
	1961-71	1971-81	1981-91	1961-71	1971-81	1981-91
Dg	0.37 *(3.63)*	0.43 *(4.54)*	0.51 *(3.65)*	0.185 *(4.61)*	0.25 *(6.1)*	0.155 *(2.21)*
Specializ.	-0.22 *(-11.11)*	-0.23 *(-13.78)*	-0.135 *(-8.98)*	-0.22 *(-11.37)*	-0.23 *(-13.85)*	-0.145 *(-9.7)*
Diversity	0.14 *(2.28)*	0.125 *(2.61)*	0.055 *(1.23)*	0.135 *(2.19)*	0.125 *(2.61)*	0.055 *(1.31)*
Density	-0.115 *(-5.88)*	-0.095 *(-6.63)*	-0.08 *(-6.07)*	-0.115 *(-5.93)*	-0.095 *(-6.62)*	-0.075 *(-6.00)*
Compet.	0.005 *(0.26)*	0.025 *(1.08)*	0.07 *(3.52)*	0.005 *(0.21)*	0.03 *(1.26)*	0.06 *(3.12)*
No. obs.		1972			1972	

(1) Model with geographical and sectoral fixed effects.

This evidence clearly shows that previous results are quite robust with respect to different specifications of the distance matrix. When assumption (*a*) is introduced, the time pattern of the coefficient of the spatially lagged dependent variable changes slightly with respect to that obtained with the linear specification (see Table 6). Combining distance with GDP produces more unstable results, with the non-linear specification now becoming the preferred one (see Table 7). In any case, the economic

[13] We have used the geographical classification based on the 95 provinces.

effect of the spatially lagged dependent variable is stronger when weights based on pure distances are used. All in all, these results show that the main conclusions of the model are not altered by changes in the way the weights of the distance matrices are built.

Up to now we have been assuming that spatial spillovers are conveyed through province growth rates. For instance, a change in the degree of sectoral specialization of a specific province may have an effect on neighbouring provinces' growth rates only through the impact of this change on the growth rate of the province where it is generated. This assumption on the working of the spatial process may appear overly restrictive. Knowledge spillovers, for instance, may flow from one province to another affecting directly the rate growth of the province towards which they move. Moreover, with the previous specification one loses the ability to detect what productive characteristics of the neighbouring provinces may be responsible for spatial spillovers.

Table 7

Econometric results: dependent variable employment growth rate in a sector and province (1)

(t statistics in brackets)

	Using $w^{(b)}_{kl}$			Using $w^{(c)}_{kl}$		
	1961-71	1971-81	1981-91	1961-71	1971-81	1981-91
Dg	0.14 *(3.46)*	0.02 *(0.83)*	0.055 *(1.46)*	0.11 *(5.36)*	0.04 *(2.56)*	0.03 *(1.26)*
Specializ.	-0.225 *(-11.7)*	-0.26 *(-16.47)*	-0.145 *(-9.84)*	-0.22 *(-11.25)*	-0.255 *(-16.07)*	-0.145 *(-9.88)*
Diversity	0.145 *(2.37)*	0.145 *(2.93)*	0.055 *(1.25)*	0.13 *(2.17)*	0.135 *(2.78)*	0.055 *(1.28)*
Density	-0.11 *(-5.62)*	-0.095 *(-6.58)*	-0.075 *(-5.72)*	-0.11 *(-5.57)*	-0.095 *(-6.46)*	-0.075 *(-5.78)*
Compet.	0 *(0.02)*	-0.01 *(-0.38)*	0.06 *(2.91)*	0.005 *(0.25)*	-0.005 *(-0.16)*	0.06 *(2.94)*
No. obs.		1972			1972	

(1) Model with geographical and sectoral fixed effects.

Another potential problem affecting previous estimates is related to the spatial autocorrelation exhibited by the explanatory variables. Using a Moran *I* index we find evidence of a positive spatial autocorrelation for most regressors, decades and sectors. Thus, if neighbouring provinces tend to have similar levels of sectoral specialization or of the density of economic activity, they will also show similar employment growth rates. In this circumstance, the similarities shown by neighbouring provinces in terms of growth rates cannot be attributed to a genuine contagion mechanism. In previous regressions, we control for this eventuality by introducing spatial dummies grouping nearby provinces into 20 regions, but it is still possible that these dummies do not correctly represent the clustering of provinces in terms of the explanatory variables.

To tackle the problems raised by these considerations we have modified the specification in (6) by adding to the set of the regressors their spatial lags (excluding the dummy variables). As done in the previous sections, these are obtained by premultiplying all these variables by the distance matrix *D*. Hence, we assume that a province-sector's employment growth will depend on its spatially lagged endogenous value, on a set of productive characteristics of that province-sector and finally on the spatially lagged values of this set of variables. Thus, the spatially lagged value of, say, specialization may have two different effects on growth: (a) an indirect effect which is channelled through neighbouring provinces' growth rates and (b) a direct impact which is not mediated by these growth rates. As before, we use 3SLS to estimate the model. Notice that the set of additional instruments now include spatially lagged values of the regional dummies and D^2Z, the set of exogenous regressors lagged twice.

Before commenting on the new estimates, it is worth mentioning that this new specification may suffer from multicollinearity, due to the correlation between the regressors and their spatial lags. Thus, one has to be very careful in interpreting the results from this regression. However, in the light of previous considerations, we have decided to control for the direct effects of spatial lags in the regression. The results are reported in Table 8.

As should be evident, our findings are not very different from those obtained in our previous specification (see Table 1). Some coefficients become more unstable probably because of collinearity; in particular for 1981-91 the coefficient of *Dg* is equal to 1. But apart from these aspects, we find clear evidence of positive spatial spillovers conveyed through neighbouring provinces' growth rates. Moreover, these indirect effects seem to be prevalent on direct effects represented by the coefficients of the spatial lags: most of them are not statistically different from 0.[14] The only exception to this general pattern is given by the spatial lag of the degree of sectoral specialization. This variable has a positive impact on employment growth in two out of three decades.

Table 8

Econometric results: dependent variable employment growth rate in a sector and province

(t statistics in brackets)

	With sectoral and geographical fixed effects		
	1961-71	1971-81	1981-91
Dg	0.455	0.685	1.00
	(3.86)	*(5.87)*	*(5.26)*
Specialization	-0.235	-0.245	-0.16
	(-10.45)	*(-13.68)*	*(-9.25)*
Diversity	0.155	0.14	0.045
	(2.47)	*(2.7)*	*(1.02)*
Density	-0.115	-0.09	-0.085
	(-5.55)	*(-5.99)*	*(-6.24)*
Competitiveness	0.0	0.035	0.05
	(-0.08)	*(1.4)*	*(2.34)*
Spat. Lagged Specializ.	0.12	0.19	0.25
	(1.25)	*(2.6)*	*(3.28)*
Spat. Lagged Diversity	0.07	-0.09	-0.905
	(0.14)	*(-0.16)*	*(-1.86)*
Spat. Lagged Density	0.06	0.195	-0.01
	(0.36)	*(1.34)*	*(-0.05)*
Spat. Lagged Comp.	0.02	-0.315	-0.04
	(0.13)	*(-3.23)*	*(-0.44)*
No. obs.	1972	1972	1972

[14] A similar conclusion is obtained by Baumont *et al*. (2002) in a recent paper on convergence and growth across European regions.

7. Concluding remarks

In this paper we have investigated the determinants of employment growth rates at local and sectoral level for the Italian economy. With respect to previous literature, we have introduced spatial spillover effects and we have made use of an explicit dynamic framework to analyze the evolution of the model across different time periods.

The main empirical findings can be summarized as follows. We find a strong and positive effect of the spatially lagged dependent variable on employment growth at provincial level. Being located near fast-growing provinces has a positive impact on growth. This result has been obtained by simultaneously controlling for a set of regional dummies. It is also robust with respect to different specifications of the distance matrix. Spatial spillovers however depend on the spatial scale at which geographical units are defined. Specifically, they seem to be stronger when using small geographical units like provinces or LLS. As in previous contributions, but with the additional control of spatial effects, we find that sectoral specialization and the density of overall employment negatively influence employment growth. These two negative effects are persistent across different decades, hence they do not depend on having observed sectors in a phase of declining employment levels. We find also some evidence in favour of urbanization economies: a diversified products mix positively affects employment growth. This effect is limited to sectors with an higher propensity to innovate.

The research agenda for future works is quite rich. First, it is important to explain the sources of mechanisms of contagion through space; in particular, it would be important to clarify whether spatial spillovers are generated through market-based or non-market interactions. A second issue concerns a better identification of some of the relationships commonly used in models of growth in cities. Finally, to study long-term employment dynamics at local level we need to go more deeply into the analysis of topics like location decisions by firms and plant life cycle and their differences at sectoral level.

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