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AGGLOMERATION ECONOMIES, SPATIAL DEPENDENCE AND LOCAL INDUSTRY GROWTH

Mots-clés :

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I. — INTRODUCTION (*)

Economists and geographers have recently refocused their attention on the contribution of agglomeration economies on the process of local economic growth. This phenomenon entails several issues which have been examined extensively by the economic literature from both a theoretical (Baldwin and Martin, 2004) and an empirical point of view (Rosenthal and Strange, 2004; Combes and Overman, 2004).

This paper contributes to the empirical stream of literature by assessing the role of the forces which induce firms co-localisation and may generate different growth patterns both for sectors and local areas. It is argued that such patterns have to be studied together with the process of structural change which characterises modern economies. Indeed, these transformations have insightful implications for the analysis of the spatial distribution of economic activities which, in turn, are highly affected by the process of de-verticalisation and de-localisation of mass production industries and the concurrent development

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and diffusion of service activities. These trends are modifying the economic geography of local production systems as well as the way these are linked to the global economy. Economic landscapes are increasingly being shaped by a complex mixture of forces operating simultaneously worldwide as much as at the regional level and which share a common denominator: the structural shift from manufacturing to services. The main effect of such phenomenon in space is the fact that, on the one hand, urban areas lose manufacturing capacity to become more service oriented and, on the other hand, peripheral areas become more favourable locations both for manufacturing and service.

The main aim of this paper is to analyse local economic performances, as expressed by employment dynamics, in the service and in the manufacturing sectors. As in most theoretical and empirical literature, we refer not only to the presence of traditional production factors (capital, labour and natural resources) in a given area, but also to several types of « local externalities ». We focus on the usual distinction among specialisation – Marshall externalities, diversity – Jacobs economies and competition – Porter effects. Moreover, we analyse the potential influence of firm size, population density, human and social capital.

Another goal of the paper concerns the use of spatial econometric techniques to take into account the possibility of some cross-border externalities, that is, neighbourhood factors affecting local growth. This allows us to avoid considering geographical units as isolated closed economies and therefore placing artificial bounds to agglomeration economies as sometimes occurred in previous literature, especially in the United States (Glaeser *et al.*, 1992; Henderson *et al.*, 1995).

The empirical analysis is applied to the 784 Local Labour Systems (LLS) in Italy over the period 1991-2001 and 34 manufacturing and services sectors. The present contribution builds upon our previous work on this topic (Usai and Paci, 2003; Paci and Usai, 2005), since it considers the entire market economy over a longer time period while including some important additional factors among the set of explanatory variables.

The paper is organised as follows. The next section presents the databank along with a descriptive picture of the employment dynamics at the local and sectoral level. In the third section we briefly survey the literature on local agglomeration. In the fourth section the empirical model is presented. In section five the estimation procedures are described while the main econometric results are discussed in section six. In the last section some concluding remarks are proposed.

II. — DATA AND DESCRIPTIVE ANALYSIS

The empirical analysis is applied to the 784 LLS in Italy identified in the 1991 population census by the national Statistical Office (ISTAT). LLSs are

groupings of municipalities showing a high degree of self containment of commuting workers. This fine level of geographical breakdown appears particularly fruitful for the analysis of local growth since it facilitates the identification of the agglomeration forces at the local level and of the spillover effects arising from contiguous areas. As for the sectoral breakdown, we consider 34 sectors at the 2 digit ATECO91 – ISIC3 level: 21 industrial sectors (including building) and 13 service sectors (excluding the public sector and other non-market services).

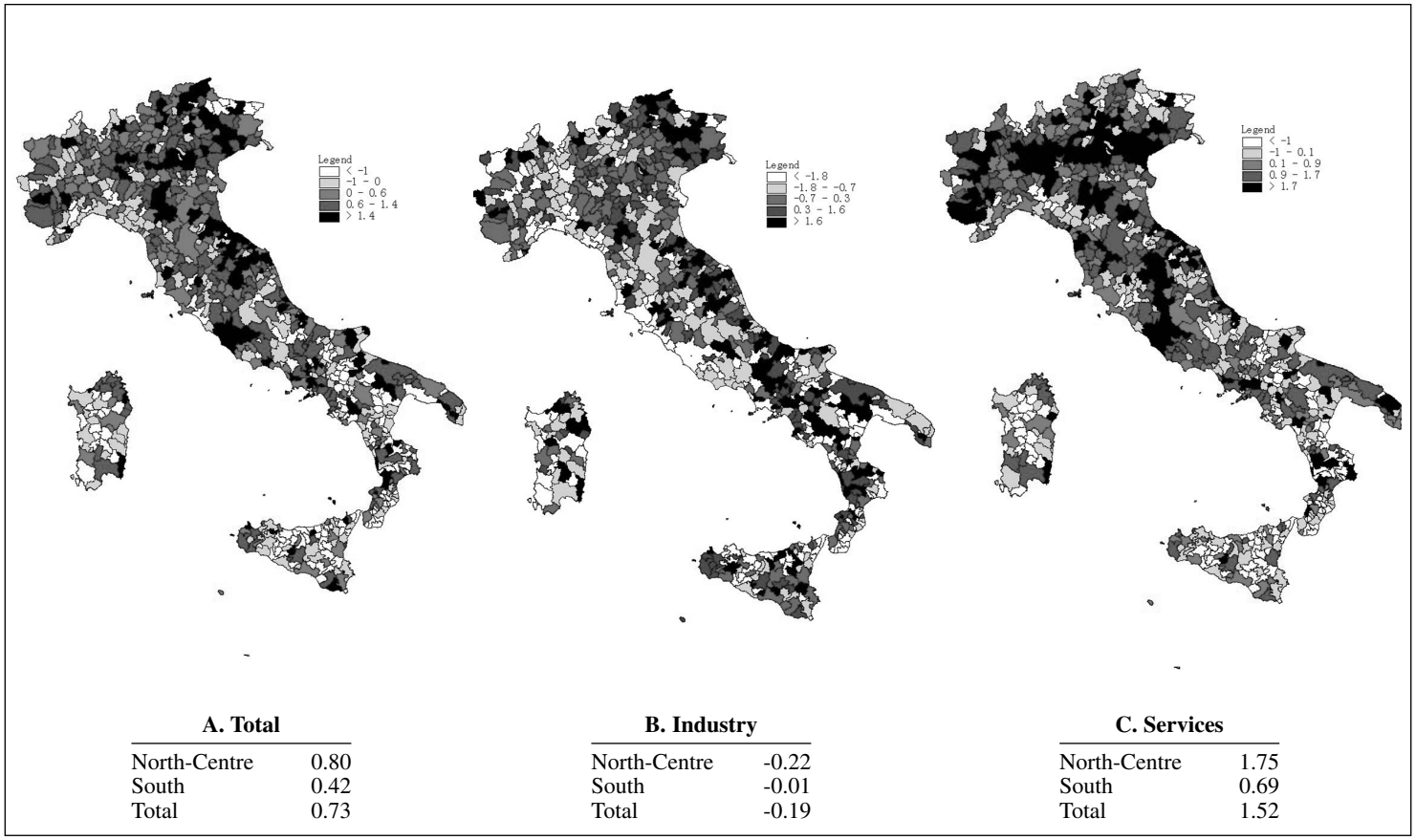
The employment dynamics in Italy in the decade from 1991 until 2001 is positive, with a gain of more than one million units of labour and an average annual increase of 0.7% (see Map 1A, next page). In the nineties, employment in Italy was characterised by a clear divide: until 1995 there was a long crisis whilst in the second period Italy experienced a long expansion which allowed the country to move along a convergence path towards European standards, especially in terms of labour participation.

The positive trend in employment for the whole country is confirmed in all geographical areas but for the Islands (Sicily and Sardinia), which report a slightly negative variation of - 0.01 % each year. The highest aggregate increase is, on the contrary, achieved in the North East and in the Centre-South, contributing to the reinforcement of the long-lasting gap between the area of North and Centre, which experiences a 0.8 % annual average growth rate, and the area of South and Islands which moves at half of that pace with a mere 0.4 % (1).

Most importantly for the scope of this paper, these aggregate trends conceal opposed patterns for the two macro-sectors (see Maps 1B and 1C, next page): industry shows an average employment fall of 0.19 % per year, whilst the service sector increases by 1.5 % per year. These divergent performances are obviously related to the process of structural change common to most OECD countries, with manufacturing employment constantly decreasing and service activities becoming the primary source of employment growth. Such a process has many explanations. One is that labour productivity growth may result from an increase in manufacturing output associated to a fall in employment. This, in turn, is the result of many factors: from the process of re-localization of manufacturing where operating costs are lower, to the practice of outsourcing, which implies that industrial firms, in order to improve their core business' productivity, move auxiliary activities to external service firms (*i.e.* cleaning,

(1) Looking at individual LLSs, one can see the presence of idiosyncratic shocks affecting specific sectors prevalent in certain areas. Therefore among the top ten best performing LLSs we find areas both in the South (mainly in Puglia and Basilicata) and in the North (especially in Veneto). For instance, the highest employment growth is recorded at Melfi, in the southern region of Basilicata, where the multinational car maker Fiat built a plant to exploit the financial and fiscal incentives available to the Objective 1 regions of the EU.

Map 1. Employment Dynamics in Local Labour Systems in Italy (% annual average growth rate, 1991-2001)



A. Total	
North-Centre	0.80
South	0.42
Total	0.73

B. Industry	
North-Centre	-0.22
South	-0.01
Total	-0.19

C. Services	
North-Centre	1.75
South	0.69
Total	1.52

accounting, engineering, marketing, security, etc.). Nonetheless, it should be noticed that relocation of service activity is accelerating too. Internationally tradable sectors, which are ICT intensive and require low levels of face-to-face interaction, are especially likely to move abroad. This affects both low and high skilled jobs, due to the fact that relocation of services occurs mostly between developed countries and is driven not only by cost but also by quality and market access reasons. Italy is not different: the employment growth process is mainly due to the increase of services, whose share of total labour is constantly expanding.

Looking at the maps we can see a clustering of growing LLSs in the North-East, both in industrial and service sectors. The North-East is a recent story of industrial and service development based on local networks of small and medium firms and plants scattered throughout the area, which follows the model of the « industrial districts ». On the contrary, the North-West, traditionally based on large heavy industries, presents over the nineties the deepest fall in industrial employment compensated by the highest growth in services. The performance of the other macro-regions is always characterised by positive dynamics for the service sector and negative ones for manufacturing. The combination of these two contrasting trends often produces a positive global performance.

When one looks at individual sectors, as in Table 1, employment dynamics shows as much variation from sector to sector as from one area to another. The best performing sectors within services are, above all, *Real estate activities* (10% annual average growth rate) and *Computer activities* (6.7%). Some services have, however, negative dynamics: *Retail trade* (which has the highest employees' share) and *Post and telecommunication*. The worst performing sectors in manufacturing are primarily *Wearing apparel* (-3.4%), the upward related sector of *Textiles* (-2.6%) and also the two transport industries. Few manufacturing sectors show a positive performance: *Rubber and plastic* (+1.9%), and *Fabricated Metal products* (+1,3%). The employment dynamics in the *Building* sector is also positive (1.4%).

Table 1, next page reports also the Moran test for spatial dependence in the employment growth rates among the 784 LLSs (2). At the global and macro-sector level we find evidence of spatial autocorrelation, already perceivable from the visual inspection of the previous maps. The Moran index for the whole country and for the industrial and service sectors indicates that employ-

(2) The Moran index is based on the notion of binary contiguity between spatial units, where the generic element of the first order spatial matrix takes value 1 if the two regions share a common border or 0 otherwise. This contiguity matrix is also used in the econometric estimation. The Moran test can be computed also for higher order contiguity matrices and for the distance matrix. In the latter case the generic element is the inverse of the geographical distance in kilometers between the centroids of regions *i* and *j*.

Table 1. Employment growth and spatial autocorrelation at the sectoral level, 1991-2001

	Sectors	Annual average % variation 1991-2001	Moran test, 1° spatial contiguity Standardized Z values	Probability level	Share on total employment, % 2001
01	Food, beverages, tobacco	-0.52	3.9	0.0	3.1
02	Textiles	-2.65	2.6	0.0	2.1
03	Wearing apparel	-3.41	4.0	0.0	2.1
04	Leather and footwear	-1.69	3.1	0.0	1.4
05	Wood products	-0.38	7.7	0.0	1.2
06	Paper	-0.58	2.0	0.0	0.6
07	Printing, publishing	-1.13	0.8	0.3	1.2
08	Coke, petroleum products	-1.48	-1.7	0.0	0.2
09	Chemicals	-1.49	-0.9	0.3	1.4
10	Rubber, plastic	1.93	0.5	0.6	1.5
11	Non metallic mineral products	-0.83	3.6	0.0	1.7
12	Basic metals	-2.01	1.4	0.1	1.0
13	Fabricated metal products	1.31	2.7	0.0	4.8
14	Machinery	1.02	1.3	0.1	4.1
15	Office, computing, electrical machinery	-0.09	2.3	0.0	1.6
16	Radio, tv, communication equipment	-2.60	1.4	0.1	0.7
17	Precision, medical instruments	0.66	0.8	0.3	0.9
18	Motor vehicles	-2.17	-0.3	0.7	1.2
19	Other transport equipment	-2.88	0.3	0.6	0.7
20	Furniture, recycling and other	0.00	2.9	0.0	2.2
21	Building	1.38	12.6	0.0	10.5
	Industry (subtotal)	**-0.19**	**7.2**	**0.0**	**44.3**
22	Motor vehicles trade, repair	-0.70	0.7	0.4	3.2
23	Wholesale trade	1.24	3.8	0.0	7.0
24	Retail trade	-1.32	7.1	0.0	11.6
25	Hotel, restaurant	1.57	9.3	0.0	5.9
26	Transport services	-0.10	3.0	0.0	4.0
27	Auxiliary transport, travel agencies	5.45	0.3	0.7	2.2
28	Post and telecommunication	-1.82	1.8	0.0	2.0
29	Financial intermediation, insurance	0.34	4.3	0.0	4.1
30	Real Estate activities	10.36	7.6	0.0	1.6
31	Renting of machinery, personal goods	4.05	-0.0	0.9	0.2
32	Computer and related activities	6.74	2.1	0.0	2.4
33	Research and development	2.46	0.9	0.3	0.4
34	Other professional services	6.04	7.6	0.0	11.1
	Services (subtotal)	**1.53**	**16.6**	**0.0**	**55.7**
	Total	**0.73**	**10.9**	**0.0**	**100.00**

ment dynamics in an LLS is influenced by the performance of nearby areas. At the same time, when employment growth is disaggregated by sector, the occurrence of spatial dependence also shows sectoral differences. As an example, one can see in Map 2, next page the contrasting patterns of *Wearing apparel* where employment dynamics clearly show a tendency to cluster in contiguous areas; and those of *Chemicals* which are more scattered over space. Spatial association is, therefore, found only in the former case, while in the latter the index is not significant. More generally, a positive and significant spatial dependence is found in 21 sectors out of 34 (12/21 in industry and 9/13 in services). In one sector, *Coke and petroleum products*, a negative significant spatial dependence is detected, due to the extremely dispersed and polarised structure of this industry.

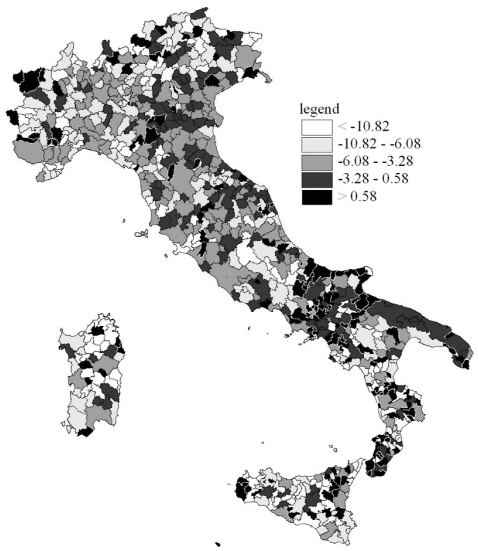
In conclusion, two main findings emerge from the descriptive analysis of employment dynamics. Firstly, a highly differentiated pattern among sectors; secondly, the presence of spatial association among contiguous areas in the employment growth rates. In the econometric estimation these stylised facts are directly taken into account.

III. — LITERATURE BACKGROUND

In the last decade, the influence of agglomeration and other forms of local externalities on economic growth has been under recurrent investigation. Glaeser *et al.* (1992) wrote the first contribution to focus on employment growth as a proxy for local economic performance and to study its dynamics at both the city and the sectoral level. Their empirical analysis is based on the distinction between static externalities, associated with cost efficiencies, and dynamic externalities, related to knowledge spillovers. Both types of externalities are potentially related to Marshall-Arrow-Romer (MAR) localisation economies which encourage growth via industrial specialisation (Marshall, 1890; Arrow, 1962; Romer, 1986). In fact, Glaeser *et al.* (1992) included also Porter's (1990) and Jacobs's (1969) hypotheses that competition and industrial diversity, respectively, enhance local growth. Since then, the debate about dynamic externalities has mainly focused on three competing theories which have different predictions on the relationship between agglomeration phenomena and economic growth.

The main difference between these theories concerns the effects of industrial specialisation (the degree to which a location specializes in one industry), diversity (the variety of sectors in a location) and competition (the local market structure) (see Van Oort, 2004). The MAR framework maintains that most spillovers occur among firms within the same industry; specialized locations with high levels of industry concentration should, therefore, experience more innovation and faster growth. In contrast, Jacobs suggests that positive externalities arise across different industries and predicts that industries innovate more and grow faster in locations with greater diversity and competition. Porter accepts the idea of localisation economies but, in accordance with

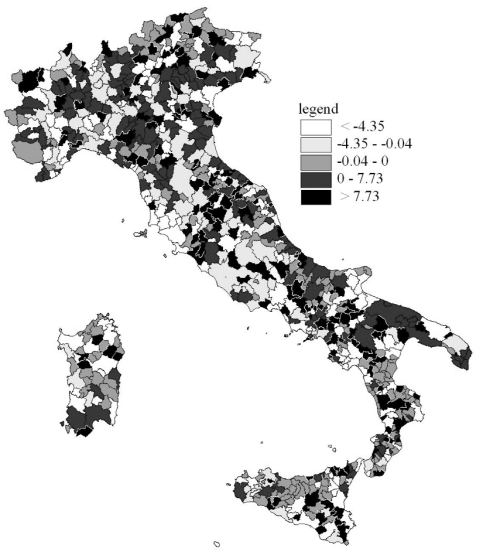
Map 2. Employment growth rate and spatial association in selected sectors (% annual average, 1991-2001)



A. Wearing apparel

Moran test, 1° contiguity

Stand. value	Probability
4	0.0



B. Chemicals

Moran test, 1° contiguity

Stand. value	Probability
-0.9	0.3

Jacobs, asserts that local competition induces more innovation and hence local economic growth.

Empirical tests addressing this debate have produced conflicting results depending on the proxy of economic growth used as the dependent variable (employment, labour productivity, TFP, wages), on the level of geographical aggregation (firms data, local systems, metropolitan areas, regions) and on the sectoral level (2- or 3- digit, employment, services). Glaeser *et al.* (1992) find that both competition and diversity foster industry growth measured by employment dynamics, while specialization discourages it. As for Porter effects, the indicator of local market structure (the firm dimension) is unsatisfactory. The evidence collected for other countries, mainly in the European Union, seems to support these findings. For example in the case of Italy, Usai and Paci (2003) find a positive effect on growth played by diversity and a negative one by specialization at the local labour system level. In the Netherlands, Van Soest *et al.* (2006) find similar results at the city level.

These results conflict with those of Henderson *et al.* (1995) who reported positive effects for both diversity and specialization externalities for high tech industries while finding only MAR spillovers for mature industries. The importance of taking into account all relevant differences across sectors is raised also by Forni and Paba (2002), who find that in Italy specialization and variety matter for growth in most manufacturing sectors, even though they show that each industry needs its own variety in terms of input-output relations (3).

Along this research path, Maggioni (2002), concentrates on high tech sectors in four countries (US, UK, France and Italy), and finds that geographical specialisation may prove crucial together with a competitive environment. In this vein Combes (2000b) for France, Paci and Usai (2005) for Italy and Blien and Suedekum (2005) for Germany have tried to improve the analysis by examining both the manufacturing and the service sector. Although a positive effect is generally associated with diversity and a negative one with specialization, such a choice is insightful given that these externalities prove to be rather different across sectors. As far as the Porter effect is concerned, this is correctly measured by Combes (2000b) who finds a negative effect on growth in industry and no significant effect in services.

The contributions of Dekle (2002) and Cingano and Schivardi (2004) are particularly important because they remark that employment growth cannot be used as a valid proxy of productivity growth unless four conditions hold. These conditions concern the constancy of local capital stock, the demand

(3) These outcomes (as the one in Glaeser *et al.*, 1992) is subject to Combes' critique (2000a), according to which the simultaneous inclusion of a specialisation index and total employment among the regressors introduces a positive bias on the specialisation coefficient. The positive effect of specialisation is therefore questioned.

elasticity, the effects of agglomeration on labour supply and the degree of substitutability among factors. In the light of such considerations, Cingano and Schivardi (2004) for Italy, and more recently Almeida (2005) for Portugal, show that within the same sample, results are different when employment growth is substituted as dependent variable by other more correct proxies for economic growth (TFP and wages). In fact, specialization effects became positive. Similar results are found by De Lucio *et al.* (2002), who report no effect of diversity on labour productivity growth and an interesting U-shaped curve for specialisation effects. Finally, Henderson (2003), through the estimation of plant level production functions in a panel context, finds that MAR externalities have strong productivity effects in high-tech but not in machinery industries. He also finds no evidence of urbanization economies from the diversity of local economic activity outside the industry under analysis and limited evidence of urbanization economies (4) altogether.

The use, as the dependent variable, of either TFP or labour productivity is an obvious notable improvement by these studies because this allows to measure in a more accurate way the economic performance of firms and areas. For instance, a highly specialised industrial district may follow a reorganization process based on the reduction of employment which may end up with an increase of the economic performances. However, the choice of productivity measures often implies some inconvenience in terms of data availability. In particular, Dekle (2002) and De Lucio *et al.* (2002) have to move to a more aggregated geographical level (*i.e.*, administrative regions) where the effects of local externalities are difficult to assess. On the contrary, Henderson (2003) and Cingano and Schivardi (2004) are able to keep a very disaggregated spatial level of analysis at the cost of relying on samples of plant data for the calculation of the productivity measures which bring about serious problems of selection bias.

Another interesting issue raised in the literature is whether the role of externalities varies with some concurrent economic phenomena. Glaeser *et al.* (1992), for instance, suggested that there might be an industry life cycle in which externalities are only important in the early development stages. Similarly, Krugman (1991) indicates that as an industry develops, it might become less dependent on pooled labor, specialized inputs and knowledge spillovers. Moreover, externalities that foster the initial development of a location might not be the same that affect its subsequent growth (Duranton and Puga, 2001). In other words, the nature of externalities is not independent from product cycle: experimental activities are initially found in large diverse urban areas (Jacobs externalities) with a large number of small economic enterprises (Porter externalities). Conversely, traditional productions, which are more standardized, can

(4) He also studies the spatial range of externalities and finds that they are quite localized within the same county, so that there are no external benefits from plants in other counties in the MSA.

be more decentralized in smaller specialized urban areas with lower costs (Marshall externalities) where large plants can operate more efficiently.

Most importantly for the purposes of this paper, the role of externalities may vary across industries and, most of all, between the two macro-sectors: manufacturing and service. The reason is, as argued by Krugman and Venables (1995), that goods which are essentially non-tradable (such as services) have to be produced close to customers, leading activities to remain spread out. On the contrary, tradable goods, such as manufacturing, can enjoy agglomeration economies by locating where it is more convenient and therefore more concentrated in space. This view, according to Desmet and Fafchamps (2003), may have interesting dynamic implications. As transport costs fall, goods became tradable, allowing production to take advantage of agglomeration economies in the first place. Later, however, if transport costs continue to drop, those agglomeration economies may go beyond a threshold where activities start spreading back out to less congested areas.

Finally, the dynamics of the service sectors is linked to the evolution of the manufacturing sector through two connections. First, an inverse relationship between the two macro-sectors, resulting from the fact that manufacturing firms increasingly outsource part of their activities to service firms. Second, a positive relationship because the manufacturing sector is a buyer of services and the two macro-sectors are thus complementary. However, one should bear in mind that service sectors are extremely heterogeneous: for example business services may follow an altogether different localisation process with respect to personal services. Business services are, on average, agglomerated close to the firms to which they sell their products. This is usually explained by referring to intangible aspects of localised knowledge which needs daily and face to face contacts to facilitate exchanges of essential information. Conversely, personal services are usually more spread out in the territory. The complexity of the nature of the two macro-sectors and of their relationship is bound to be reflected in our results, especially those devoted to single sector analysis.

IV. — THE EMPIRICAL MODEL

Factors affecting employment dynamics of a certain industry in a given area can be decomposed into three major groups: 1.) local and industry specific level, 2.) local specific level, 3.) industry specific level. We will now discuss in some details the various phenomena which have a potential effect on the performance of local sectoral employment (see next page, the Appendix for the variables' description and sources).

Local and industry specific level

The first group of determinants are those which are considered idiosyncratic for both area and industry. They include the three types of externalities (spe-

Appendix. Variables description and sources

Variables	Index	Level of aggregation area	Level of aggregation sector	Sources
Dependent variable				
– *Local industry growth (gL)*	annual average growth rate of employment	LLS	2-digit ateco91	1991-2001 Industrial Census
Local and industry specific variables				
– *Specialisation externalities (SE)*	index of relative sectoral specialisation of employment	LLS	2-digit ateco91	1991 Industrial Census
– *Diversity externalities (DE)*	inverse of Herfindhal index computed on sectoral employment	LLS	2-digit ateco91	1991 Industrial Census
– *Market power (MP)*	Herfindhal index computed on employees distribution over plants	LLS	2-digit ateco91	1991 Industrial Census
– *Firm Size (FS)*	average number of employees over number of plants	LLS	2-digit ateco91	1991 Industrial Census
Local specific variables				
– *Small firms (SF)*	quota of workers in firms with less than 50 employees	LLS	-	1991 Industrial Census
– *Population density (PD)*	number of resident population (100000)/km^2	LLS	-	1991 Population Census
– *Human capital (HK)*	population with university education/pop age > 24	LLS	-	1991 Population Census
– *Social capital (SK)*	quota of firms with inter-firms agreements	NUTS 3	-	Industrial Census Long Form
– *Labour supply (LS)*	labour forces over population age 15-65	LLS	-	1991 Population Census
All independent variables has been standardised with respect to the national index				

cialisation, diversity, market power) previously discussed in the survey of the literature.

Specialisation externalities (SE), measured by an index of relative production specialisation (the widely used comparative advantage index), should capture the consequences of producing in an area crowded with firms which belong to the same sector. This variable covers both static and dynamic externalities. The former include pecuniary and localisation externalities such as the availability of suitable supplies of labour force, primary and intermediate goods (Ellison and Glaeser, 1999), the provision of specific goods and services (Bartelsman *et al.*, 1994) and the availability of specific infrastructures and networks. The latter take into account dynamic spillovers coming from the intra-industry flows of localised knowledge which occur among similar firms located in the same area (Henderson *et al.*, 1995; see Audretsch and Feldman, 2004 for an up to date survey).

Diversity externalities (DE) are measured by the inverse of the Herfindhal index applied to employment in all sectors except the one considered. Such externalities 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 profitable inter-industries interactions and cross fertilisation. Furthermore, diversity can be seen as a portfolio strategy which protects the regional economy, and especially local employment, from sector specific shocks (Frenken *et al.*, 2007).

The degree of market power (*MP*) is assessed by means of an Herfindhal index based on employees distribution over plants following Lafourcade and Mion's (200) methodology. The predicted effect is uncertain, since we may have a positive effect on employment dynamics coming from a higher incentive to innovate for firms with some market power but also a negative one coming from demand pressures on inputs and intermediate goods.

Finally, we consider firm size (*FS*) measured in number of employees, which may affect labour dynamics either because of internal economies of scale or because of different dynamics towards optimal size by firms of different dimensions (O'hUallachàin and Satterthwaite, 1992). This way we are able to distinguish between the two effects – competition and scale economies – defining two different indicators and including both of them in the estimated equation.

Local specific level

Employment changes at the local industry level may be due to some features which characterise the whole local labour system. Local factors may refer to a large set of socio-economic phenomena which influence firms' performance in the area.

The first variable focuses on the supply side by taking into account the presence of small firms (*SF*) within the local economy. The idea is that a larger share of small plants may induce firms to find their optimal production scale through cooperation and integration with other firms at the local level while stimulating the creation of local network externalities (Brusco, 1982). The opposite happens with large firms which are more vertically integrated and therefore are less involved in local networks.

The second variable takes into account the influence of the size of the local economic system, measured by the population density (*PD*) in each LLS where a firm is located. A positive effect on local growth is expected when a larger population density implies, among others, a higher and differentiated local demand as well as the availability of a wider supply of local public services (Ciccone and Hall, 1996). Proximity to buyers may have both a static and a dynamic effect, the latter being related to the fact that this may facilitate early perception of market needs. At the same time, increases in the size of the local economy may imply congestion effects giving rise to pollution and other local diseconomies.

The role of human capital (*HK*) in facilitating innovation activities, information spillovers and therefore growth is considered by looking at the presence of labour forces with high levels of education in the local area, measured by the share of population with a university education. The hypothesis is that a higher availability of well educated labour forces represents an advantage for the localization of firms, thus fostering local growth (Rauch, 1993; Moretti, 2004).

Another important local element which may encourage innovation activities and smooth the process of knowledge diffusion is social capital (*SK*). It is not an easy task to find the proper indicators for such a complex and intangible phenomenon (Helliwell and Putnam, 1995). In this paper we are interested to measure the degree of trust in the local society which may favour firms productivity. Thus 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 the industrial census at the provincial level. The assumption 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.

Finally, we follow the idea that externalities may affect labour supply (Cingano and Schivardi, 2004) and therefore we try to include this potential effect by inserting an indicator of the labour force size (*LS*) computed as the share of labour forces over population age 15-65.

Industry specific level

The growth rate of employment in a local industry may also be affected by factors which are peculiar to each production sector but common to all geographical areas. These factors can capture, for instance, different levels of

technological opportunities within each industry at the national level or sectoral demand shocks. They are proxied by the 34 sectoral fixed effects (*FE*) in the regressions, where the two dimensions (geographical and sectoral) are considered together in a panel framework, while they are, obviously, redundant in the sectoral estimates.

V. — THE ESTIMATION PROCEDURE

We attempt to consider simultaneously different factors which potentially affect local employment dynamics. The same general specification is applied to sub samples to establish if there is any difference in the value, sign and significance of the estimated coefficients and thus in the role of the explanatory factors. The econometric analysis is based on a simple reduced form where the employment growth rate (gL_{ij}), which refers to the local labour system i and the industry j, is affected by the three sets of phenomena described in the previous section:

$$(1)\ gL_{ijt+1} = \beta_1 SE_{ijt} + \beta_2 DE_{ijt} + \beta_3 MP_{ijt} + \beta_4 FS_{ijt} + \delta_1 SF_{it} + \delta_2 PD_{it} + \delta_3 HK_{it} + \delta_4 SK_{it} + \delta_5 LS_{it} + \Sigma\gamma_j FE_j + \varepsilon_{ij}$$

It is important to remark that all our regressors are exogenous to the local industry employment growth rate (1991-2001) since they refer to the beginning of the period considered (1991). We have excluded local industry observations with zero employee in the initial year (4,373 cases) due to the impossibility of calculating the growth rates and also the observations with zero employee in the final year (939 cases) because this gives rise to extreme growth rate values with typical outlier characteristics (5).

Spatial analysis

As we have remarked before, one interesting feature in the analysis at the local level is that employment growth in a region may be influenced by factors which are outside the region. In other words, the economic environment in the nearby areas may influence employment dynamics in a given region and this introduces a possible bias in the regression analysis if we do not control for this element. In order to deal with the problem of spatial association in the sectoral regressions (6) we apply the following estimation procedures.

(5) Consequently, from the total number of 26,656 potential observations (given by 784 LLSs x 34 sectors) we have excluded 5,312 observations in various sectors ending up with a total number of 21,344 cases used in the econometric analysis.

(6) In the estimations for the whole economy with both the geographical and sectoral dimensions it is not feasible to deal with the problem of spatial association due to technical limits imposed by both Spacestat and Matlab for such large datasets with an unbalanced panel due to the presence of several missing values.

i. OLS estimation to assess the presence of first order spatial autocorrelation based on the Kelejan and Robinson test which, in contrast to the Moran's I and Lagrange Multiplier tests, does not require normality of the error term (a problem which is pervasive in our regressions).

ii. If there is no autocorrelation, then the least squares estimates are efficient and consistent. In such a case, equation 1 is estimated by the OLS White-robust estimation which allows to take into account potential heteroskedasticity, which is found in several cases.

iii. If spatial dependence is detected, we draw on LM tests, despite they can be problematic with a-normal errors, in order to assess its possible form: substantive or nuisance (7). In both cases the Maximum Likelihood (ML) estimation is usually suggested instead of OLS. However, this is not appropriate in this case, given that this method is sensitive to deviations from normality and homoscedasticity. Consequently, we apply General Method of Moments (GMM) in the nuisance case with spatial errors and Instrumental Variables (IV) in the substantive case with spatial lags.

iv. In the substantive case, a spatial lag of the dependent variable is included up the contiguity level necessary to correct for the presence of spatial autocorrelation.

v. In the nuisance model, spatial association is accounted for by estimating the spatial autoregressive coefficient λ for the error lag.

VI. — ECONOMETRIC RESULTS

Table 2, next page reports the aggregate estimations based on a dataset with two-dimensions (geographical and sectoral) and with cross section weights and fixed effects to control for sectoral differences, while the results of sectoral regressions are reported in Table 3, next page. Let us now discuss the main results for each explanatory variable.

Specialisation externalities. The first important result is the absence of positive specialisation externalities: the coefficient of *SE* is negative and significant in all panel estimations and in all service sectors. This outcome confirms previous studies for the US (Glaeser *et al.*, 1992), France (Combes, 2000b) and Italy (Cunat and Peri, 2001, Forni and Paba, 2000; Usai and Paci, 2003).

(7) In the former case, which is the most relevant, spatial dependence implies the presence of an interactive process among spatial units, whereas in the latter case, dependence is probably a by-product of measurement errors for observations in contiguous spatial units. In the case of spatial error autocorrelation, OLS coefficients estimates are unbiased but inefficient; while in the presence of spatial lag dependence, OLS parameters become biased and inconsistent (Anselin and Florax, 1995).

Table 2. Econometric results for whole economy and macro-sectors

Dependent variable : employment growth in the local industry, annual average 1991-2001.
Estimation method : GLS with cross section weights and White robust standard errors.
Panel estimation by LLS and sectors and with 34 industry Fixed Effects.
Level of significance : *** = 1 % ; ** = 5 %, * = 10 %.

Variables			**Italy whole economy**	**Italy industrial sectors**	**Italy services sectors**
Local and industry specific variables	SE	Specialisation Externalities	-0.45***	-0.9***	-0.81***
	DE	Diversity Externalities	1.89***	2.70***	1.36***
	MP	Market Power	0.20***	0.50***	0.07**
	FS	Firm Size	-0.76***	-0.95***	-0.89***
Local specific variables	SF	Small Firms	0.37 ***	0.40*	0.42***
	PD	Population Density	0.05**	0.00	0.07***
	HK	Human Capital	0.46***	-0.08	0.79***
	SK	Social Capital	0.14***	0.08	0.15***
	LS	Labour Supply	0.70***	0.49***	0.73***
		n. observation	21344	12052	9292
		Adj. R^2	0.10	0.06	0.13
		S.E. of regression	6.89	7.84	5.28

Note : we have excluded local industry with zero employee in 1991 or 2001

One possible explanation for the negative effect of specialisation in services is the fact that probably these sectors are becoming more and more diffused across space closer to consumers. At the same time it is possible that services, thanks to technological change which is labour saving, is substituting capital for labour implying a reduction of employment and a potential increase in productivity. Specialisation has no effect in most manufacturing sectors, since coefficients are often not significantly different from zero, whilst it has a positive effect in two of the most traditional sectors, *Wearing apparel* and *Leather and footwear*. These two sectors are among those which are losing more employees and it seems that this global dynamics is stronger in those areas where specialisation was relatively weak, whereas local specialised districts manage to preserve some of the past strength in terms of work force.

Diversity externalities. We find robust evidence for the positive and significant role played by diversity externalities (*DE*) both for the panel estimates and in most sectors especially in the services activities (9 out 13). This may be due to several externalities at work. On the one hand, pecuniary externalities due to the fact that firms benefit from the presence of a wide ranging local availability of supply and demand linkages. On the other hand, externalities may be due to knowledge spillovers which move across sectors. Moreover, additional indicators should be computed for this variable in order to disentangle those effects which are truly cross-fertilisation spillovers (and therefore more dynamic in nature) from those which are due to input-output relation-

Dependent variable : employment growth in the local industy. Annual average 1991-2001 - Cross-section estimation by LLS - Level of significance : *** = 1 % ; ** = 5 % ; * = 10 %
Estimation Method : OLS-W : Ordinary Least Squares Estimation-White robust Standard Error, GM-error : General method of moments, IV-lag : Instrumental Variables ; constant is included

Cod Sector	Estimation method	Obs.	- SE - Specialisation externalities	- DE - Diversity externalities	- MP -- Market Power	- FS - Firm size	- SF - Small firms	- PD - Population density	- HK - Human capital	- SK - Social capital	- LS - Labour supply	Spatial lag/error Ist order
01 Food, beverages, tobacco	GM-error	783	-0,84***	-0,04	0,26**	-0,47	0,23	0,01	-0,20	-0,01	-0,48	0,09**
02 Textiles	IV-lag	644	-0,07	3,60	1,26***	-0,94***	0,32	0,29	-1,02	-0,10	1,07	0,54**
03 Wearing apparel	IV-lag	731	1,14***	4,67**	1,79***	-2,73***	1,82	0,34	1,10	-0,10	1,17	0,37*
04 Leather and footwear	OLS-W	472	0,33***	-6,25**	1,12	-2,99***	1,05	0,15	0,95	0,07	-2,92**	
05 Wood products	GM-error	783	-0,07	2,00**	0,01	0,28	-1,30***	-0,93	-0,60	0,13	0,84*	0,22***
06 Paper	GM-error	391	-0,05	1,02	1,74**	-0,70***	1,13	0,06	1,07	-0,24	5,07*	0,13*
07 Printing, publishing	OLS-W	683	-0,52	5,20***	1,37***	-1,52*	1,19	-0,06	0,42	0,23	-0,87	
08 Coke, petroleum products	IV-lag	196	-0,11	-7,57	5,49**	-0,16	-7,79*	0,22	3,44	-0,13	12,89**	-0,96**
09 Chemicals	GM-error	455	-0,75	4,83*	2,12***	-1,20***	-0,98	-0,27	-1,56	0,09	-0,24	-0,27***
10 Rubber, plastic	GM-error	529	-0,18	7,37***	1,54***	-1,67***	2,89*	0,41	-1,50	0,11	3,54***	-0,01
11 Non metallic mineral products	OLS-W	768	-0,07	5,06***	0,81***	-1,83***	1,59*	-0,27	-0,34	0,13	1,10	
12 Basic metals	OLS-W	332	-0,41	-1,96	2,65*	-0,15	3,16	-1,25***	0,14	1,00*	8,83*	
13 Fabricated metal products	OLS-W	784	-0,64**	4,27***	0,34***	-0,74***	-0,58	-0,11	-0,86	-0,07	0,77	
14 Machinery	GM-error	652	-0,50	3,47	0,10	-1,21**	2,18*	-0,02	-1,33	0,12	0,96	0,13**
15 Office, computing, electrical machiner	OLS-W	563	-1,20*	7,12**	0,59	-2,44***	-2,35	-0,04	-1,50	-0,39	-1,17	
16 Radio, tv, communication equipment	OLS-W	550	-0,84	3,05	3,95***	-0,88	1,34	0,11	4,71***	0,12	-0,59	
17 Precision, medical instruments	GM-error	646	0,18	10,70***	2,57***	-1,01***	3,58***	0,01	0,66	-0,06	1,07	0,11
18 Motor vehicles	OLS-W	242	-0,01	5,64	4,30***	-1,05	0,34	-0,59	2,36	0,43	-0,82	
19 Other transport equipment	OLS-W	337	-0,45	-0,45	2,57**	-1,30***	5,00*	0,00	3,24	0,13	-2,86	
20 Furniture, recyling and other	IV-lag	727	0,28	6,49***	1,64***	-2,19***	2,07*	-0,10	1,86*	-0,04	0,32	0,33**
21 Building	GM-error	784	-2,84***	-0,01	0,05	-0,95***	0,56	0,04	-0,26	0,11	-0,17	0,27***
22 Motor vehicles trade, repair	OLS-W	784	-0,84***	0,23	-0,22***	-0,54	0,66**	-0,09	0,53*	0,02	0,49**	
23 Wholesale trade	OLS-W	783	-4,01***	3,59***	0,22**	-0,23	1,44***	0,33***	0,94*	0,13	0,58	
24 Retail trade	GM-error	784	-0,90***	0,73**	-0,06	1,70***	0,85***	-0,02	0,62***	-0,02	0,49**	0,13***
25 Hotel, restaurant	IV-lag	784	-0,14*	1,10*	-0,15*	-0,51	0,53*	0,03	1,26***	-0,05	0,56**	0,76***
26 Transport services	OLS-W	784	-3,86***	0,04	-0,09	0,15	1,09	0,31	0,29	0,10	0,21	
27 Auxiliary transport, travel agencies	OLS-W	668	-1,96***	8,44***	1,30***	-2,44**	1,77	0,16	4,23***	0,78**	1,49	
28 Post and telecommunication	GM-error	784	-1,15***	-0,26	0,22**	0,08	-0,02	0,16**	0,21	0,15**	-0,21	0,10**
29 Financial intermediation, insurance	GM-error	782	-4,41***	1,84***	0,04	0,07	-0,63*	0,03	1,47***	0,22**	0,54*	0,06
30 Real Estate activities	IV-lag	639	-2,29***	5,74***	0,60**	-5,86***	-0,73	-0,01	2,87***	0,78***	2,64***	0,36***
31 Renting of machinery, personal goods	GM-error	588	-0,47*	7,03***	2,43***	-4,19***	2,89**	0,15	3,97***	0,76***	2,19**	-0,16**
32 Computer and related activities	OLS-W	711	-7,49***	6,38***	1,24***	-3,20***	0,85	0,19	6,40***	0,50**	0,98	
33 Research and development	GM-error	417	-0,74***	-0,06	4,66***	-0,66*	0,93	0,20	7,31***	0,30	-1,80	0,20***
34 Other professional services	GM-error	784	-5,92***	2,46***	-0,02	0,63	0,17	-0,01	4,25***	0,12	0,19	0,18***

Note : we have excluded local industry with zero employee in 1991 or 2001

ships (and therefore with more static consequences). Finally, it would also be interesting to investigate further the role of diversity as a portfolio strategy which defends local areas from sudden demand and supply shocks which hit only some sectors.

Market power. The market power index (*MP*) is mostly positive and significant (except for two service sectors) signalling that a competitive environment discourages growth of the local industry and that Porter's idea does not apply to employment dynamics in Italy. This effect is present both in manufacturing sectors (16 out of 20) and in the service sectors (7 out of 13). Market power, that is low competitive environment, may have positive effects on firms' ability to grow, thanks to extra-profits which can be invested in innovation (as in the MAR view). Moreover, under the hypothesis of local and segmented markets for immobile inputs (such as land but also skilled labour in Italy) market power can decrease local price competition on inputs favouring employment growth.

Firms size. As far as the average firm size (*FS*) is concerned, results show that there is a negative influence of economies of scale both in the global regression and in most sectors. We should remember that this negative influence is not to be interpreted necessarily as the absence of internal economies of scale since we are not measuring effects on productivity but on employment. One way to interpret this result is suggested by Combes (2000b) who finds the same result for France. Since average size is referred to the initial period one may think that the presence of small firms is bound to increase employment growth given that these firms grow faster than big firms which are closer to their optimal dimension. Moreover, knowledge spillovers and flexibility may be higher in small firms, which are therefore better able to adapt to difficult periods, such as the nineties. Interestingly, a positive and statistically significant role is found only *in Retail trade*, where the last decade has been characterised by a large increase of the plant size.

Local specific variables. Turning to local specific determinants of employment growth we find a positive influence of the presence of small firms (*SF*) in the global regressions and in some sectors. These results are in accordance with the Italian production structure characterised by systems of small and medium sized firms with a higher degree of flexibility and ability to respond to the economic cycle.

The size of the local system, measured by population density (*PD*), is statistically significant in the aggregate sample and in the service macro-sector, where local demand and urbanisation economies are more important. On the contrary, the estimated coefficients are not significant in the manufacturing macro-sector and in almost all sectoral estimates.

The indicators referring to the different qualities of capital (human, social) show interesting and composite results. First, university education (*HK*) emerges as a relevant and positive determinant of local growth (Lodde, 2000)

for the whole country, for the service macro-sector and for most service sectors (11 out of 13), but not for manufacturing. On the contrary, several coefficients are not statistically significant or show negative signs in the manufacturing sectors, indicating a less strategic role played by well educated labour forces in the Italian industry, mainly specialised in traditional productions.

Similarly, social capital, represented by the variable which measures cooperation among firms (*SK*), is positive and statistically significant, as expected, in the whole country and in the service sectors on the whole but it is not statistically significant in manufacturing. At the sectoral level the effect of social capital is in general not statistically significant in manufacturing while positive and significant values are detected in six service sectors.

Finally, the presence of a large labour supply (*LS*) exerts a positive influence on employment dynamics in all aggregate regressions and also in some sectoral estimates.

Spatial association. The last but not less important result to remark is that, on the basis of the Kelejan and Robinson test, spatial autocorrelation is detected in 20 out of 34 sectors using a first order spatial contiguity matrix (8). Therefore either a IV or a GMM estimation is performed according to the indication of the LM tests. More precisely, we implement a lag dependence model (estimated with IV) in six sectors and an error model (estimated with GMM) in 14 sectors (9). Thanks to this procedure, spatial autocorrelation has been controlled in all sectors at the first order contiguity. The spatial lagged variables and the spatial autoregressive coefficients have proved positive and significant in 14 sectors, which implies that some form of positive spatial dependence among contiguous areas in employment dynamics is present. In three further sectors (*Chemicals*, *Coke* and *Renting of machinery*), as expected from the Moran analysis, the spatial coefficients are negative and significant, implying that production districts of this type are very polarised. As for the comparison of manufacturing and service sector, we find that spatial association is equally distributed across sectors.

VII. — CONCLUDING REMARKS

This paper tries to put the issue of local economic performance in the scenario of ongoing structural change which is transforming modern economies from manufacturing to service ones. It is argued that such a process has insightful implications for the analysis of the geography of economic activities. The main contribution of this paper is, therefore, the analysis of local eco-

(8) We have also used the distance matrix and main results are maintained.

(9) Actually, since the indication of the LM test may be contradictory with anormal errors every model is estimated with both methods (IV and GMM). Most results are maintained.

nomic performance, as expressed by employment dynamics, both in the service and in the manufacturing sectors. Thanks to a large set of variables and data we attempt to explain some of the differences in the economic performance of industries by assessing the role of several potential determinants of local economic dynamics.

Results confirm the existence of a multifaceted picture when it comes to agglomeration forces operating at local geographical level. Overall, we find that specialisation has negative effects on employment growth, possibly due to a process of reorganization which substitute labour with capital and other factors but also due to the diffusion process of services across space. This suggests that local employment, especially in industrialised countries, can benefit from a local production system characterised by a diversified network of small flexible firms willing to cooperate and employing well educated labour forces. Moreover, the presence of some market power seems to imply either less competition for inputs or more resources (due to extra-profits) for investments and therefore positive effects on firm growth. Finally, the presence of spatial association indicates that the growth process in a specific area benefits from the positive performance of the surrounding regions.

Further, we find evidence of remarkable differences in the influence of local specific externalities between manufacturing and services. As a result of the structural changes, we observe a decline in manufacturing and an increase in services and these opposed dynamics appear to be led by different factors. In the former case, a process of delocalisation is undergoing and this implies the transfer of manufacturing activities out of industrial districts with a reduction of employment. The analysis shows that such industrial districts do not seem to be able any more to exploit the standard set of externalities typical of their success: a collection of specialized small firms based on social networks and human capital. In the latter case of service activities, specialisation externalities have a negative impact since these sectors are becoming more pervasive across space. In spite of that, they remain mainly located in urban areas, where intangible factors (human and social capital) are more relevant to enhance growth within a production environment characterised by a diversified mixture of activities. All these results can have interesting policy implications.

Finally, it is worth noting that these results somewhat contrast with those obtained by Paci and Usai (2000) for Italy and Moreno *et al.* (2005) for Europe, whose work investigates on the impact of agglomeration economies on local innovative performances. They find that specialisation rather than diversification externalities are important in the localisation of innovative activity. Our interpretation is that in the developed world specialisation economies, providing they are related to pecuniary externalities, no longer reinforce local industrial districts but only local technological enclaves, as long as such enclaves are mainly due to pure technological spillovers. In other words, factor costs appear to be the main determinant of localisation strategies by firms,

as they affect productive structures, while knowledge spillovers are pivotal in innovative performances.

Differentiated local production systems, together with specialised scientific and technological areas, appear to be the best way to support both employment dynamics and innovative performance in the new century.

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