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E C O N O M I C S B U L L E T I N

Testing economic geography: Italy, 1951−1991

Alberto Brugnoli
Università di Bergamo, Dipartimento di Scienze Economiche

Stefano Fachin
Università di Roma

Abstract

A rural country in the 1950's, Italy is now a large industrial economy. In this paper we show through a joint analysis of spatial autocorrelation and concentration of employment that this development has not been driven by centre−periphery mechanisms.

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1.Introduction[1]

In the 1950's Italy was still a rural country; in the following decades a fast growth led it to became one of leading industrial economies of the world. The aim of this paper is to examine the localization processes underlying the making of Italy as an industrial country exploiting a recently released data base covering the economic censuses 1951-1991. In section 2 we will discuss in more detail the motivation, methodology and data used, and in section 3 present the main results and draw some conclusions.

2. The geography of industrial employment in Italy, 1951-1991

2.1 *A stylised fact and an open question*

As it can be appreciated from the data reported in Table 1, the post-WWII growth of industrial employment in Italy has been very fast in some parts of the country, North-East and Centre[2], and rather slow in other parts. Especially noteworthy is the very limited growth in the traditional industrial regions of the North-West. If we look at the maps of employment in 1951 and 1991 (Figs. 1 and 2 below) the impression is indeed that the distribution in 1991 was more uniform than forty years before.

Table 1
Manufacturing employment in Italy 1951-1991 (thousands)

	1951		1991		1991/1951
North-West	1851	*53%*	2250	*39%*	+22%
North-East	613	*18%*	1505	*26%*	+146%
Centre	482	*14%*	1031	*18%*	+114%
South	553	*16%*	998	*17%*	+80%
Italy	3498	*100%*	5785	*100%*	+65%

Source: Istat, *I censimenti delle attività produttive dal 1951 al 1991*

In a way, this evidence is simply suggesting a process of convergence in the economic structure of the different regions, and thus presumably of average productivity and income, and therefore it is not particularly surprising. However, it is interesting to note that such a convergence process is at odds with the centre-perifery hypothesis put forth by Krugman (1991): a careful empirical analysis of the dominant localization patterns testing the data compatibility of the centre-periphery hypothesis is thus called for. An interesting point arises here.

[1] Financial support by MURST and CNR is gratefully acknowledged. E-mail: brugnoli@unibg.it, s.fachin@caspur.it; homepage: http://www.uniroma1.it/dcnaps/fachin/. We would like to thank A. Serpente for making available the program Winmap (www.dmqte.unich.it/users/serpente/winmap) used to produce the maps and the participants to the Bonn 2000 ESPE Conference for helpful comments and criticism.

[2] Italy is divided into 20 Eurostat NUTS level 2 areas called *regioni*, hereafter regions, which are often grouped into four standard Divisions: *North-West* (Piemonte, Val d'Aosta, Lombardia, Liguria); *North-East* (Veneto, Friuli-Venezia Giulia, Trentino-Alto Adige, Emilia-Romagna); *Centre* (Toscana, Umbria, Marche, Lazio); *South and Isles*, here simply *South* (Abruzzo, Molise, Campania, Puglia, Calabria Sicilia, Sardegna). Higher disaggregation levels are those into *province* (provinces; NUTS 3) and *comuni* (communes; NUTS 4), which in 1991 were respectively 95 and 8100.

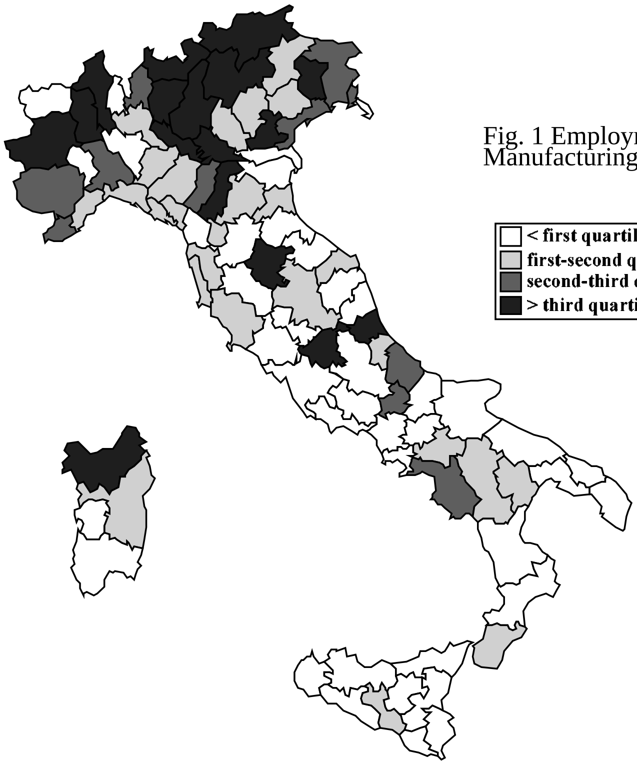

Fig. 1 Employment in Manufacturing - 1951

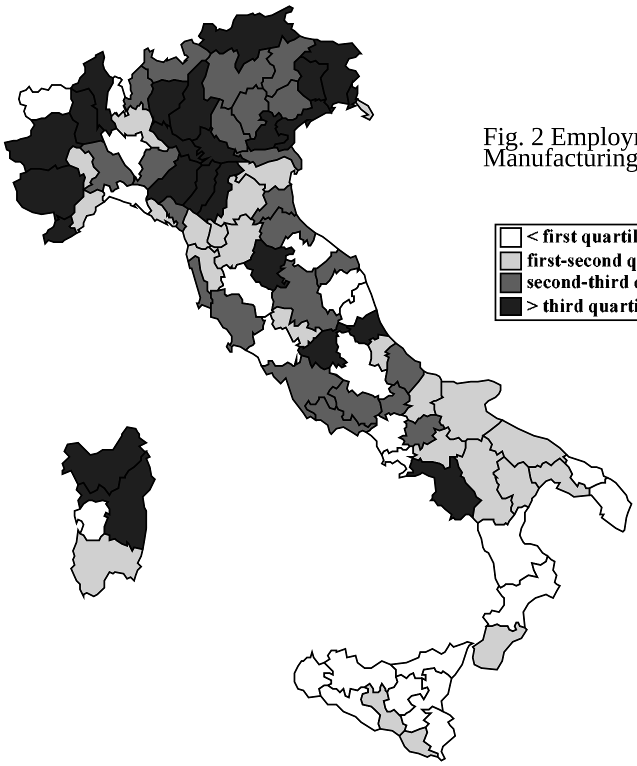

Fig. 2 Employment in Manufacturing - 1991

The statistical tool used by Krugman (1991) is the analysis of concentration; however, all concentration measures (including the model-based index proposed by Ellison and Glaeser, 1997, and the agglomeration measures put forth by Devereux, Griffith and Simpson, 1999) do not take into account the spatial structure of the data, and as a result the same degree of concentration is compatible with very different localization schemes. For instance, in 1991 the provincial distrbutions of employment in the Rubber and Paper industries were almost equally concentrated, with Lorenz's *R* respectively equal to 0.67 and 0.65. However, a closer look at the data reveals that in the case of the Rubber industry five of the six largest provinces, accounting for over 40% of national employment, are in the same region (Lombardia), whereas in the case of the Paper industry they are all in different regions. In order to discriminate between cases of these types we need to examine the *spatial autocorrelation* as well as concentration of the distributions. In other terms, we need to ask the question "do high employment areas tend to be close to each other?" as well as the question "how much is employment concentrated?".

The answers to these questions are particularly interesting from the dynamic point of view. Assuming for instance an initial geographical distribution with non-zero concentration it is indeed immediately seen that a centre-periphery mechanism with constant employment (in other terms, the growth of the centre is completely fuelled by geographical labour mobility) generates a SW-NE path in a concentration-autocorrelation plan: as over time employment concentrates in the centre the periphery areas become more and more similar to each other, so that both concentration and autocorrelation grow. The opposite case of spill-over effects from the centre to the periphery generates a NE-NW path, as concentration falls with autocorrelation approximately constant: the periphery areas, initially similar at low employment levels, are still similar at higher employment levels. Unfortunately, any autocorrelation measure is conditional on the proximity structure of the data, so that a general proof of this statements cannot be given. However, a simple numerical example will be given below.

2.2 Data and methodology

As far as the data are concerned, both the employment measure and the geographical disaggregation to be used require careful choices. Let us discuss them in turn.

(i) Employment measure: given that we are interested in long-run localization trends at first sight the natural choice seems to be employment in units. However, provinces vary greatly in size and population, and this may cause a spurious negative bias in the spatial autocorrelation if there is a significant number of small provinces sharing a boundary with large provinces. We thus decided to replicate the analysis with employment measured both in units and normalized by the resident population, taken as an indicator of size (in principle surface might have been used as well, but this option was discarded in view of the many mountain areas not suitable for urbanization). We will obviously find less concentration in the case of normalized data. However, this is not particularly important as we are interested in the change between the start and the end of the period, rather than in an absolute measure of the degree of concentration.

(ii) Geographical disaggregation: this is a delicate point, as all statistical analysis carried out on geographical data are conditional on the aggregation scale and may be entirely change with it (Arbia, 1989)[3]. We decided to use the provincial level, as the 95 provinces are arguably a reasonable compromise between the 20 regions and the over 8100 communes.

[3] A simple example is as follows. Consider a distribution equally divided between two provinces, but entirely

From the methodological point of view, Lorenz's R and Moran's I ($I = k(\mathbf{x'x})^{-1}\mathbf{x'Wx}$, where k is a scale factor, $\mathbf{x}$ a n×1vector of observations and $\mathbf{W}$ a spatial proximity matrix between the n areas; see, e.g.,Cliff e Ord, 1981), are natural candidates respectively as measures of concentration and autocorrelation. However, in order to compute Moran's index we have to tackle a number of empirical problems related to the design of the spatial proximity matrix. Having excluded *a priori* the simple dicotomic first-order proximity matrix (all elements zero except for first order neighbours, i.e. areas sharing a boundary) in favour of obviously superior proximity matrices based on the distances between areas, the first problem is the choice of the measure of distance between two areas. Requiring the choice of a centre for any area, here we have two alternatives:
(a) the main urbane centre;
(b) the economic centre of gravity.

The two options present opposite advantages and disadvantages. The former would allow use of real world (road or rail) distances at the cost of a possibly inaccurate simplification of the spatial structure of the area; the opposite happens in the latter case, which will necessarily lead to the use of the euclidean distance between the centres of gravity. Given that the emphasis of this analysis is precisely on economic space we decided to follow the second option, computing the centres of gravity as weighted averages of the coordinates of the communes included in each province, with weights given by employment shares.

Once defined the distances we have to specify the shape of the function delivering spatial proximity coefficients as a function of distance. A common assumption is that spatial interaction decays exponentially with distance, leading to the choice of the exponential function $c(r,s) = e^{-b d(r,s)}$, where $c(r,s)$ is the measure of proximity between areas r and s, $d(r,s)$ the euclidean distance between their centers of gravity, and b the parameter governing the speed of decay of the interaction. Clearly, the key point here is the choice of b. Unfortunately, there is an obvious circularity problem: in order to fix b we need to know the pattern of spatial interaction, which can be measured only if b is known. The only way out is to repeat the analysis with different values of the decay parameter, thus performing a robust analysis. In previous work we found that with distances measured in kilometres a reasonable interval to consider is [0.01,0.03]: with b=0.03 areas farther away more than 75 km are assumed to have virtually no interaction, while with b=0.01 the interaction between areas 200 km away is still taken into account in the computation of the spatial correlation.

Having solved these problems we are able to provide a numerical example of the representation in a concentration-autocorrelation plan of a centre-periphery process. A random provincial distribution of employment obtained by sampling from a Multinormal distribution (asymptotically equivalent to the Multinomial used as baseline case by Ellison and Glaeser, 1997) with diagonal covariance matrix and constant variance yields R=0.61 and I=0.47. Keeping nation-wide employment fixed but assuming it is entirely concentrated in the North-West (with a uniform distribution within that area), we find that both R and I increase markedly, to respectively 0.80 and 0.92, thus confirming the point made above.

A last problem to be tackled is how to carry out inference on the autocorrelation measures. Given that the available asymptotic approximations are not entirely reliable when the spatial proximity matrix is sparse (Haining, 1990) we computed the significance levels by Monte Carlo simulations, assuming a Multinormal data generating process.

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concentrated in a single commune within each of them: concentration is zero with provincial data, but almost maximum with commune data.

Obviously, in principle the problem of inference applies to the concentration measure as well. However, as we will see below, the results will turn out to be so clear-cut that the point will be irrelevant in practice.

3. Results and conclusions

The results are reported in Tables 2 below. Given that Moran's index depends on the values of the weights, and thus its numerical value has no interest, the tables include only the estimate of its *p*-value under the hypothesis that the data are *NIID* over space.

The first point of interest is that the results appear qualitatevely robust with respect to the choice of both the decay parameter (except one case, Food industry with normalized data) and the measure of employment. The normalized data behave as expected, appearing always less concentrated and more autocorrelated; however, significant differences in autocorrelation are found only in four cases.

Going into some detail, it can be immediately appreciated that in most cases concentration has generally fallen (but recall the point made above: this result will not necessarily extemd to data at different geographical aggregation levels), thus suggesting straight rejection of the centre-periphery hypothesis. The only exception are the Clothing and Timber industries, where it has grown markedly. However, in these industries we do not find any significant increase in autocorrelation[4] (although for opposite reasons: in the latter case the distribution is always extremely autocorrelated, whereas in the former the distribution was indeed more autocorrelated in 1951-61 than afterwards). Interestingly, in two cases (Machinery and Rubber and Plastic) there is some evidence in support of the opposite hypothesis of spill-over effects, as concentration has been declining steadily with constant or possibly growing autocorrelation.

The overall conclusion is thus that the centre-periphery mechanism does not appear to have driven the localization processes underlying industrial growth in post-WWII Italy. Does this mean that regional differences were less marked in the 1990's than in the 1950's? Not necessarily. As far as welfare is concerned income (that is, value added) matters, rather than employment, so that geographically uniform employment growth is compatible with increasing geographical divergence if initially low-employment areas specialise in the creation of low-value added jobs, and viceversa. Indeed, falling employment is fully compatible with increasing income if low-value added jobs are replaced by a smaller number of high-value added jobs. Of course, these points are the subject of the enormous literature on convergence. Studying sectoral productivity convergence across Italian regions Brugnoli and Fachin (2000) found that over the period 1980-95 regional productivity differentials in Italy did not decrease, and in some cases did increase, thus suggesting that in some sense a centre-periphery dynamics was in action.

[4] Further, average plant and firm size in these industries are both very small: increasing returns are irrelevant.

Table 2

Concentration and spatial autocorrelation of employment, 1951-91

Industry	Normalization	Decay parameter	Autocorrelation					Concentration				
			1951	*1961*	*1971*	*1981*	*1991*	*1951*	*1961*	*1971*	*1981*	*1991*
Clothing	*No*	0.03	**0.2**	15.6	20.2	40.0	27.9	0.44	0.81	0.79	0.79	**0.78**
		0.01	7.6	9.0	15.8	34.8	26.3					
	Population	0.03	**0.0**	**1.9**	13.6	21.2	27.2	0.23	0.71	0.74	0.75	**0.75**
		0.01	**0.1**	**2.6**	12.7	17.4	20.0					
Food, Beverages and Tobacco	*No*	0.03	42.1	31.3	34.8	34.2	29.8	0.74	0.77	0.77	0.71	0.67
		0.01	65.6	57.9	57.9	61.1	59.0					
	Population	0.03	**0.7**	**0.8**	16.9	12.9	**2.7**	0.43	0.46	0.53	0.43	0.36
		0.01	10.1	15.4	58.3	52.6	36.7					
Paper, Printing and Publishing	*No*	0.03	**0.9**	**0.1**	**0.3**	**0.7**	**1.0**	0.74	0.72	0.69	0.66	0.64
		0.01	**1.3**	**1.1**	**0.7**	**0.9**	**1.5**					
	Population	0.03	**0.9**	**0.0**	**0.0**	**0.3**	**0.4**	0.68	0.62	0.59	0.57	0.55
		0.01	**1.0**	**0.0**	**0.2**	**0.7**	**0.2**					
Chemicals	*No*	0.03	-	22.2	19.5	8.2	10.3	-	0.77	0.73	0.68	0.69
		0.01	-	17.7	26.8	23.7	25.3					
	Population	0.03	-	**2.8**	6.9	26.9	**2.9**	-	0.66	0.60	0.54	0.51
		0.01	-	**1.2**	**4.0**	18.7	**4.8**					
Rubber and Plastic	*No*	0.03	13.5	6.0	**1.7**	**0.3**	**0.0**	0.94	0.86	0.76	0.67	0.65
		0.01	20.4	10.1	**3.0**	**1.2**	**0.3**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.84	0.69	0.57	0.49	0.48
		0.01	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**					
Timber	*No*	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.43	0.46	0.51	0.52	**0.54**
		0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.23	0.29	0.40	0.42	**0.44**
		0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**					

NB

(a) *Geographical units*: 95 provinces, 1991 boundaries.

(b) *Population*: resident population in 1997. Source: Istat, unpublished data.

(c) *Autocorrelation*: Monte Carlo estimate (1000 replications) of $prob(z>I)$ with z MNIID, I Moran's index with spatial proximity coefficient $c(r,s) = e^{-bd(r,s)}$, $d(r,s)$ the euclidean distance between the centers of gravity of provinces r and s, and decay parameter b. The covariance matrix of the Multinormal distribution is diagonal with variances fixed at their empirical values. Percent values, cases under 5% in bold type.

(d) *Concentration*: Lorenz R; in bold type 1991 values greater than 1951 values.

Table 2 (continued)

Concentration and spatial autocorrelation of employment, 1951-91

Industry	Normalization	Decay parameter	Autocorrelation					Concentration				
			1951	*1961*	*1971*	*1981*	*1991*	*1951*	*1961*	*1971*	*1981*	*1991*
Machinery	*No*	0.03	5.9	5.3	8.4	5.4	**1.8**	0.72	0.80	0.75	0.66	0.62
		0.01	**4.2**	**3.7**	**4.8**	5.1	**2.4**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.52	0.64	0.56	0.45	0.41
		0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**					
Fabricated Metal	*No*	0.03	25.8	46.6	21.2	24.5	12.5	0.92	0.91	0.88	0.88	0.85
		0.01	51.6	74.3	59.9	65.0	48.2					
	Population	0.03	32.9	33.3	18.6	39.8	24.2	0.89	0.86	0.81	0.76	0.71
		0.01	48.7	53.3	47.2	66.8	55.4					
Stone	*No*	0.03	**0.8**	**1.5**	**0.4**	**0.2**	**0.2**	0.51	0.48	0.48	0.47	0.45
		0.01	**0.3**	**1.0**	**0.6**	**0.6**	**0.6**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.42	0.39	0.39	0.38	0.37
		0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**					
Textiles	*No*	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.82	0.79	0.74	0.74	0.73
		0.01	**0.0**	**0.0**	**0.0**	**0.2**	**0.1**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.10**	0.75	0.71	0.65	0.66	0.66
		0.01	**0.0**	**0.0**	**0.0**	**0.2**	**0.3**					
All industries	*No*	0.03	**0.1**	**0.0**	**0.5**	**0.2**	**0.3**	0.59	0.64	0.62	0.57	0.55
		0.01	**0.2**	**0.6**	**1.8**	**1.8**	**1.2**					
	Population	0.03	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.39	0.45	0.40	0.35	0.34
		0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**					

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