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REGIONAL SYSTEMS OF INNOVATION. EVIDENCE FROM ITALIAN DATA

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ABSTRACT

The paper investigates the features of regional innovation systems in Italy, looking not only at factors directly related to technology and codified knowledge but also to uncodified knowledge that is usually embedded in virtuous entrepreneurial environments. To this end, two principle components, representing respectively regional innovative and entrepreneurial environments, have been obtained from a large set of variables. By clustering regions in homogeneous groups, at least four different geographical systems of innovation can be observed. The paper concludes looking at the difference of economic performance between groups.

1 INTRODUCTION

The literature on local externalities in favouring geographical concentration of economic and innovative activities has its origin in the pioneering and seminal contribution of Marshall (Marshall, 1890). The idea of Marshall is that skills, know-how and knowledge accumulated within spatially bounded environments are able to create an "industrial atmosphere" favourable to foster economic growth and innovative activities. In more recent years, the definition of National Systems of Innovation (NSIs) based on systematic interactions between many and different actors (for example firms, technical agency, R&D public infrastructures, education and training system) has been provided in literature (Lundvall, 1992; Nelson, 1993). Applications of this idea to a regional level have been soon proposed (Breschi, 1995; Cooke *et al.*, 1997). However, these attempts of defining Regional Systems of Innovation (RSIs) appear to face at least two main problems (Cooke, 2001; Evangelista et al. 2002; Iammarino, 2005). The first one has theoretical nature and arises from the fact that the NSIs literature ignores the presence of a multi-level governance (national and sub-national) in the systems of innovation. Hence, a rethinking of the network of systematic interactions and of the relevant actors is necessary, and in a multi-level perspective the degree of complexity is of course significantly higher. The second problem concerns the availability of data at regional level on the characteristics and behaviours not only of firms but also of the multitude of actors and institutions whose interactions determine the innovative performance of the region.

Notwithstanding all these constrains that can affect the possibility of exploring the existence of regional systems of innovation, our paper attempts to carry out this kind of empirical analysis on the case of Italy. To this end, a recent regional data-set on the innovative activities of Italian firms is used and this is matched with other data sources in order to define two different (but both favourable to innovative performance) dimensions of the regional context. The first dimension is labelled "innovative environment" and concerns the technological features and the transmission of codified knowledge in the region. The second one, defined as "entrepreneurial environment", is related to factors that indirectly affect regional system of innovations by transmission of uncodified knowledge.

The paper is organised as follows. Section 2 provides a descriptive statistical analysis on the innovative activities in Italian regions. Section 3 introduces the data-set and the methodology employed in order to investigate on regional systems of innovation in Italy, and discusses the empirical results. Section 4 points out the economic performance of each innovative cluster identified in the previous section. Section 5 presents the conclusions.

2 TECHNOLOGICAL GAPS IN ITALIAN REGIONS. PRELIMINARY EVIDENCE FROM A REGIONAL VERSION OF CIS4

Italian Statistical Institute (Istat) has recently provided data at regional level on innovative activities of Italian firms with at least 10 workers in manufacturing and services sectors in the period 2002-2004 (Istat, 2007). These data are conformed to the definitions of the *Community Innovation Survey 2002-2004* (CIS4)[1]. In order to have a more representative sample of the regional productive systems, regional units (RUs) have been taken instead of firms[2].

The total number of RUs that have innovated in the period 2002-2004 and the relative breakdown by type of innovation (product, process and product-process) are shown in Table 2. The technological gap between the Northern areas and the rest of Italy is then evident. The innovators located in the North-West and in the North-East are respectively 36.8% and 30.6%, while they are 18.2% in the Centre and only 14.5% in the South. The gap is slightly less evident for the innovation of product-process but this last evidence is not able to confute the conclusion that the technological divide between North and South exists independently of the type of innovation. Moreover the gap between North-West (46.2%) and South (12.2%) becomes more marked if the expenditure in innovative activities is observed (Table 3).

As regards the distribution of innovators by size of unit, it is interesting to note that 91.7% of innovative RUs are small-medium size (SMEs), i.e. with 10-99 workers, and only 8.3% are large size (LSEs), i.e. with at least 100 workers (Table 4). This result is confirmed looking also at each macro-area, even if the share of innovative LSEs (10.1%) is bigger in the North-West and smaller in the South (6.8%). This evidence is coherent with the features of industrial system in Italy that is predominantly based on small and medium enterprises. However, innovative SMEs are predominant only in terms of frequency but not of intensity. Indeed, there is a balance between SMEs and LSEs (respectively 52.2% and 47.8%) looking at their expenditure in innovative activities (Table 7). It is worth noting the different distribution of expenditure between SMEs and LSEs in the four macro-areas. In particular, the innovative system in the North-East seems to be strongly based on SMEs (64.8%) and, even if less evidently, this characterises also the South (58.1%). On the contrary, LSEs appear to be predominant in the North-West (55.2%). From Table 6, it is possible to note that innovative LSEs are mostly located in the North-West (44.6%) and, independently of the macro-area, this kind of firms prefers to innovate jointly product and process rather than only product or only process. On the other hand, the strategy of SMEs favours the innovation of process, always independently of the macro-area (Table 5).

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[1] Community Innovation Survey (CIS) is based on a European standardised questionnaire, with which each National Statistical Institute must conform. The Italian CIS4 includes, at present, only data at national level and a first attempt to obtain regional data has been recently made by Istat in collaboration with the Italian Ministry of Development. At the moment, Istat has provided regional data only for two variables of CIS4, i.e. number of innovators and expenditure for innovative activities (Istat, 2007).

[2] Regional unit is a single productive unit of a multi-plant firm.

For a deeper investigation, the following indexes have been computed: 1) index of innovation (IIN)= (innovators / all the units); 2) index of product innovation (IPD)= (product innovators / all the units); 3) index of process innovation (IPC)= (process innovators / all the units); 4) index of product-process innovation (IPP) = (product-process innovators / all the units); 5) share of product innovation (IPD1)= (product innovators / all the innovators); 6) share of process innovation (IPC1)= (process innovators / all the innovators); 7) share of product-process innovation (IPP1)= (product-process innovators / all the innovators). Tables 8 shows the regional values of the indexes above listed and some descriptive statistics. Only seven regions (Trentino A.A., Lombardia, Veneto, Emilia R., Piemonte, Friuli V.G. and Marche) record then values of IIN above the national value (0.31) and, except Marche that belongs to the Centre, all these regions are located in the North. On the other hand, the South is entirely placed in the group of regions with IIN below the national value and, in particular, most of the Southern regions fill the lowest part of ranking (Sardegna, Puglia, Calabria, Campania, Sicilia and Molise). It is also interesting to look at the shares of specific innovation (IPD1, IPC1 and IPP1) of the two groups. Unsurprisingly, the group of the most innovative regions manifests higher average values of IPD1 and IPC1 (i.e. 0.17 and 0.51 in comparison with 0.15 and 0.48 of the second group) but it is unexpected the higher value of IPP1 recorded in the least innovative regions (i.e. 0.37 compared with 0.31). In other words, many Southern regions seem to address their strategy towards the innovation of products-processes. In particular, scores significantly higher than national value (0.33) are recorded in Basilicata (0.45), Puglia (0.47) and Molise (0.44). This result appears quite unreasonable, since the innovation of product-process is typical in high-tech sectors and the productive system of the South is prevalently based on traditional manufacturing sectors. In Figure 1, the gap between Northern and Southern regions with respect to both the general (IIN) and the specific indexes of innovation (IPD and IPC) is well evident. Notwithstanding the gap is less marked, it exists also looking at IPP. From Tables 9 and 10, it is possible to note that the distribution of regions changes within groups only when units with 1-99 workers and with at least 100 workers are taken separately, but the regions below and above the national value do not change. An exception is Valle d'Aosta that would represent the most innovative region when units with at least 100 workers are taken and one of the least innovative regions when units with 1-99 workers are taken. This region is frequently omitted in this kind of studies for its modest size in absolute terms and in order to avoid problems of outliers. Also our analysis will follow this line in the next section.

3 LOOKING FOR REGIONAL SYSTEMS OF INNOVATION (RSIs)

3.1. Data and methodology

In order to investigate the variety of regional systems of innovation (RSIs) in Italy, a set of 12 indicators has been selected (Table 11). The first 3 indicators (IIN, EXPEND and SIZE) have been obtained by using data shown in the previous section. In particular, IIN is a measure of *frequency* of innovation, EXPEND is the average expenditure in innovative activities and then gives information on the *intensity* of innovation, SIZE measures the weight of LSEs with respect to SMEs in the regional system of innovation. HIGHTECH is a measure of regional specialization in technological sectors[3] and is obtained from the *Regional Accounts* (Istat, 2008b). Finally, the other 8 indicators are directly built by Istat and are available in *Regional Indicators for Monitoring the Community Support Framework* (Istat, 2008a)[4]. These last indicators are related to factors that directly affect RSIs (such as RD_PRIVATE, RD_PUBLIC, RD_WORKER, and INTERNET), factors that indirectly affect RSIs by transmission of codified knowledge (SCIENTIFIC and FDI), and factors that indirectly affect RSIs by transmission of uncodified knowledge (DISTRICT and TURNOVER). All the indicators are expressed as average values for the period 2002-2004.

A principal components analysis (PCA) has been carried out in order to obtain new summary-variables that facilitate the interpretation of a larger set of variables, without losing the multidimensionality of data. The new variables, i.e. the principal components, are uncorrelated and each of them is a particular linear combination of the ones in the original data. The coefficients of the first components are derived so that the variance is as large as possible. The other components are defined similarly in decreasing order with respect to their variance and by requiring that they are uncorrelated with all previous components. The next step has been the identification of groups of regions, applying cluster analysis (CA) to the first three components obtained from PCA (Everitt, 2000). Finally, Tukey's Honestly Significant Difference (HSD) test has allowed to check to what extent our clusters differ with respect to the innovative performance[5].

3.2. Empirical results

The results of PCA on the set of indicators listed in Table 11 are reported in Table 12. Three components have been extracted, explaining altogether almost 75% of the total variance of the original 12 variables. In particular, the first component explains 44.09% of the variance (eigenvalue = 5.29) and, looking at the eigenvectors[6], it is possible to conclude that this component is related to features of technology (IIN, EXPEND, SIZE, RD_PRIVATE,

[3] In particular, the sectors of mechanical, electrical and optical equipments, machineries and transport are taken into account.

[4] Istat has produced these indicators in collaboration with the Department for Development and Cohesion Policies (DPS) of the Italian Ministry of Economic Development. The dataset can be downloaded from http://www.istat.it/ambiente/contesto/infoterr/azioneB.html.

[5] A similar approach has been applied to socio-economic features of Italian Southern provinces by Guerrieri *et al.* (2006), and to Italian data from the first *Community Innovation Survey* by Camagni *et al.* (1999), Piacentino (2002) and Evangelista *et al*. (2002).

[6] The eigenvector is the vector of coefficients of the linear combination that defines the component.

RD_WORKER, HIGHTECH and INTERNET) and codified knowledge (SCIENTIFIC and FDI). This dimension can be labelled as "innovative environment". The second component explains 17.97% of the variance (eigenvalue = 2.15) and is related to the "entrepreneurial environment", namely factors that indirectly affect RSIs by transmission of uncodified knowledge (DISTRICT and TURNOVER). Finally, the third component explains 12.74% (eigenvalue = 1.52) and is prevalently represented by the public R&D (RD_PUBLIC) and is here used as factor of control[7].

Figure 2 displays the regional scores of PCA with respect to the first two components. The regions located in the lower-left corner of the graph are those with the poorest innovative and entrepreneurial environments. On the contrary, the regions in the upper-right corner are characterised by the best innovative and entrepreneurial environments. It is worth noting that few regions have an unbalance endowment of the two environments. The most evident case is that of Lazio, where a high innovative environment contrast with a very low entrepreneurial environments. It is interesting, moreover, to note the positions of Marche and Veneto that manifest the highest presence of entrepreneurial environment and middle levels of innovative environment.

The cluster analysis[8] performed on the three components described above has allowed the identification, at least, of four groups of regions (Figure 3). As a matter of fact, the stopping rule based on the index of Duda and Hart suggests to take eight groups (Duda and Hart, 1973). Therefore, our analysis will proceed considering two possible groupings, i.e. the first in four and the second in eight groups.

Table 13 shows the grouping in four groups and the percentage values of some indicators for each group. The first group includes almost all the Southern regions (Puglia, Basilicata, Sardegna, Calabria, Molise, Sicilia and Campania). This group manifests the lowest value of IIN (21%) and is characterised by the highest percentage share of innovation in product and process (IPP1). The group 1 shows also the lowest percentage values of the share of innovative LSEs on all the innovative regional units (LSEs), of the share of expenditure for innovative activities in LSEs on the total expenditure in innovative activities (EXPLSEs), and of the index of specialization in technological sectors (HIGHTECH)[9]. The group 2 is constituted by a Southern region (Abruzzo), three Central regions (Marche, Umbria and Toscana) and two North-eastern regions (Veneto and Trentino A.A.). This group manifests a high value of INN (31%) and is characterised by a system based on innovation of process, a low weight of LSEs (both in terms of frequency and intensity) and a low specialization in technological sectors. The group 3 is the most innovative group (IIN = 33%) with the best

[7] This component allows to control for those regions where the system of innovation is prevalently public. Of course, this is the case of Lazio where most public Institutions are located.

[8] To measure the distance among regions we have used the squared Euclidean distance, while the method of Ward has been employed for the cluster analysis. The application of other agglomerative hierarchical methods has not led to different results.

[9] See Table 11 for the description of this last indicator.

diversification among different types of innovation and a relevant weight of LSE and of technological industry in the system of innovation. In this group, there are the North-western regions (Lombardia, Piemonte and Liguria) and two North-eastern regions (Emilia Romagna and Friuli V.G.). Finally, the group 4 includes only Lazio that manifest a system of innovation strongly based on large size firms with low specialization in technological sectors. This region, however, can be considered an outlier for the predominant role of the public sector in its industrial and innovative system. Looking at the results of the one-way ANOVA on the variable IIN (Table 14), we can conclude that the difference in the performance of innovation, here measured by the frequency of innovation, between groups is statistically significant. Moreover, the test of Tukey shows that only the differences between the group 1 and the groups 2 and 3, and that between the group 3 and the group 4 are statistically significant (Table 15). In other words, taking into account a multidimensional view of the phenomena, the technological gap between the South and the rest of Italy seems significantly marked. Moreover, it is possible to identify two different systems of innovation within the most innovative area of Italy, one characterised by a significant presence of technological LSEs with diversification among different types of innovation (group 3) and the other on the presence of innovative SMEs specialised in less technological sectors and with a preference for innovations of process.

A sub-grouping in eight groups can be obtained from the cluster analysis (Table 16). Each group belongs, of course, to one of the previous grouping. In particular, the previous group 1 can be split into two groups: the group 1 that includes Puglia, Basilicata, Sardegna, Calabria and Molise, and the group 2 composed of Sicilia and Campania. This last group differs from the former one for the presence of a higher level of innovative environment but also for a lower level of entrepreneurial environment. Moreover, the group 2 is characterised by relatively higher shares of innovative LSEs (only in terms of intensity of innovation, i.e. in terms of EXP_LSEs) and of regional specialization in technological sectors. Notwithstanding this, the group 1 is more innovative (IIN = 21.24%) than the group 2 (IIN = 20.86%), supporting the hypothesis of the role of entrepreneurial environments in order to foster innovation processes. The previous group 2 can also be divided into two groups: the group 3 (Trentino A.A., Umbria, Toscana and Abruzzo) and the group 4 (Marche and Veneto). The two groups are very similar in relation to the level of innovative environment and both of them show modest shares of innovative LSEs and low specialization in technological sectors, but the group 4 manifests a higher level of entrepreneurial environment that could represent the cause of its better innovative performance (its IIN is almost 2.5% more than that of group 3). The group 3 of the previous grouping is the one with the greatest dispersion and can be divided into three different sub-groups: the group 5 (Friuli V.G. and Liguria), the group 6 (Emilia Romagna and Lombardia) and the group 7 (Piemonte). The three groups are similar with respect to the shares of the different types of innovation (IPD1, IPC1 and IPP1), while

the main difference concerns the share of innovative LSEs that is bigger in the group 6 and 7 (LSEs and EXPLSEs are respectively 9.87% and 52.55% in group 6 and 9.75% and 35.14% in group 7) than in the group 5 (LSEs is 7.80% and EXPLSEs 49.80%). Moreover, it is worth noting that the three groups differ also for the levels of innovative environment but especially for those of entrepreneurial environment. Only group 6 shows positive levels of both the environments and is also the most innovative group (IIN is almost 35%). The groups 5 and 7 seem to manifest a scarcity of entrepreneurial environment, probably due to an industrial system excessively based on few big firms or on small-medium firms not organised in district, and this may have affected their innovative performance negatively. Finally, the group 8 includes only Lazio, like the previous group 4. From Table 17, it is possible to note that innovative performance, measured by IIN, statistically differs also between the eight groups. However, the test of Tukey suggests that the statistically significant differences can be restricted to those between the group 1 and the groups 6 and 7 and between the group 2 and the groups 6 and 7 (Table 18).

Notwithstanding the differences of economic performance result statistically significant only between the most and the least innovative clusters, it is possible to conclude that at least four systems of innovation exist in Italy. Moreover, a sub-grouping allows to identify even eight groups that are homogeneous with respect to the regional innovative and entrepreneurial environment.

4 ECONOMIC PERFORMANCE OF RSIs

Tables 13 and 16 display for each group the economic performance, measured by the average growth rate of value added in the period 2004-2006 . The growth rate of value added (VA) can be expressed as sum of the growth rates of labour (LAB) and of labour productivity (PROD), allowing then to look at their relative contribution to economic growth (Sylos Labini, 1992).

From Table 13, it is possible to note that the most innovative groups (3 and 2) manifest the highest growth rate of VA (respectively, 1.13% and 1.39%). The lowest growth rate of VA (0.69%) is recorded in the group 4, i.e. in the region of Lazio. The contribution of LAB to the growth of VA is the most relevant in each of the four groups. On the contrary, the contribution of PROD is quite low and is even negative in the group 2 (-0.13%).

Table 16 points out some important differences of economic performance also among the most innovative groups. Indeed, the group 7 manifests a growth rate of VA (0.71%) similar to that of the least innovative groups (i.e. the groups 8, 1 and 2), notwithstanding its IIN is very high. This bad economic performance of Piemonte seems to be mainly due to the negative growth of labour productivity (PROD = -0.29%). Moreover, it is interesting to note the higher growth rates of VA in those groups where the share of innovative LSEs is not so relevant (the

growth rate of VA is respectively 1.50%, 1.28% and 1.54% in the groups 4, 3 an 5). Finally, it is worth noting that the group 1, similarly to the group 8, records a negative growth rate of labour productivity (PROD = -0.08%), while the group 2 shows at the same time the highest growth rate of PROD (0.57%) and the lowest of LAB (0.22%).

5 CONCLUSIONS

The paper has investigated on the presence of regional systems of innovation in Italy in the period 2002-2004. The theoretical definition of Regional System of Innovation (RSI) is complex and an increasing body of literature is focused on this topic. In addition to problems of conceptual nature in defining RSI, the unavailability of regional data constrains the possibility of empirical investigations. Within such a context, our analysis attempts to cluster the Italian regions with respect not only to technological features but also transmission factors of codified and uncodified knowledge. After summarizing a large set of variables into few principal components, we are able to define two dimensions of the innovative phenomena that we label as “innovative environment” and “entrepreneurial environment”. The first environment is related to factors that more directly affect RSIs, while the second one concerns transmission factors of uncodified knowledge that usually have an indirect effect on the regional systems of innovation. Then, we are able to identify at least four different RSIs in Italy. In this grouping, a significant technological (or more in general innovative) divide between the Centre-North and the South is pointed out. Moreover, two different systems of innovation can be found within the Centre-North. The most innovative system that includes all the North-western and some North-eastern regions, seems to be characterised by a relevant share of innovative LSEs, a high specialization in technological sectors and a better diversification among different types of innovation. The other innovative system contains almost all the Central and some Nort-eastern regions, and is prevalently based on innovative SMEs, low specialization in technological sectors and innovation of process. These two systems manifest the best economic performances in the period 2004-2006. Finally, the analysis is able to provide also a grouping in eight different systems of innovation and to compare their economic performances.

APPENDIX

Table 1 – Italian regions

macro-area	region	code
North-West	Piemonte	PIE
	Valle d'Aosta	VAO
	Lombardia	LOM
	Liguria	LIG
North-East	Trentino Alto Adige	TAA
	Friuli Venezia Giulia	FVG
	Veneto	VEN
	Emilia Romagna	EMI
Centre	Toscana	TOS
	Umbria	UMB
	Marche	MAR
	Lazio	LAZ
South	Abruzzo	ABR
	Molise	MOL
	Campania	CAM
	Puglia	PUG
	Basilicata	BAS
	Calabria	CAL
	Sicilia	SIC
	Sardegna	SAR

Table 2 - Innovative regional units (2002-2004)[*]

	Product	Process	Prod/Proc	Total
North-West	4346.0	12463.0	8100.0	24909.0
	(38.1)	(36.3)	(36.8)	(36.8)
	(17.4)	(50.0)	(32.5)	(100.0)
North-East	3670.0	10776.0	6268.0	20714.0
	(32.2)	(31.4)	(28.5)	(30.6)
	(17.7)	(52.0)	(30.3)	(100.0)
Centre	1924.0	6445.0	3953.0	12322.0
	(16.9)	(18.8)	(18.0)	(18.2)
	(15.6)	(52.3)	(32.1)	(100.0)
South	1461.0	4645.0	3699.0	9805.0
	(12.8)	(13.5)	(16.8)	(14.5)
	(14.9)	(47.4)	(37.7)	(100.0)
Italy	11401.0	34329.0	22020.0	67750.0
	(100.0)	(100.0)	(100.0)	(100.0)
	(16.8)	(50.7)	(32.5)	(100.0)

[*] *% values in brackets*

Table 3 – Expenditure in innovative activities (thousands of euro, 2002-2004)[*]

	Expend
North-West	13352452.0
	(46.2)
North-East	6689749.0
	(23.1)
Centre	5345763.0
	(18.5)
South	3531273.0
	(12.2)
Italy	28919237.0
	(100.0)

[*] *% values in brackets*

Table 4 - Innovative regional units by size of unit (2002-2004)[*]

	SMEs	**LSEs**	**Total**
North-West	22397.0	2512.0	24909.0
	(89.9)	(10.1)	(100.0)
North-East	19101.0	1613.0	20714.0
	(92.2)	(7.8)	(100.0)
Centre	11483.0	839.0	12322.0
	(93.2)	(6.8)	(100.0)
South	9135.0	670.0	9805.0
	(93.2)	(6.8)	(100.0)
Italy	62116.0	5634.0	67750.0
	(91.7)	(8.3)	(100.0)

[*] *% values in brackets; SMEs are units with 10-99 workers and LSEs are units with at least 100 workers.*

Table 5 – Innovative regional units with 1-99 workers (2002-2004)[*]

	Product	**Process**	**Prod/Proc**	**Total**
North-West	4001.0	11579.0	6817.0	22397.0
	(38.1)	(35.7)	(35.6)	(36.1)
	(17.9)	(51.7)	(30.4)	(100.0)
North-East	3353.0	10293.0	5455.0	19101.0
	(31.9)	(31.7)	(28.5)	(30.8)
	(17.6)	(53.9)	(28.6)	(100.0)
Centre	1794.0	6163.0	3526.0	11483.0
	(17.1)	(19.0)	(18.4)	(18.5)
	(15.6)	(53.7)	(30.7)	(100.0)
South	1363.0	4420.0	3352.0	9135.0
	(13.0)	(13.6)	(17.5)	(14.7)
	(14.9)	(48.4)	(36.7)	(100.0)
Italy	10511	32455	19150	62116
	(100.0)	(100.0)	(100.0)	(100.0)
	(16.9)	(52.2)	(30.8)	(100.0)

[*] *% values in brackets*

Table 6 – Innovative regional units with at least 100 workers (2002-2004)[*]

	Product	**Process**	**Prod/Proc**	**Total**
North-West	345.0	884.0	1283.0	2512.0
	(38.8)	(47.2)	(44.7)	(44.6)
	(13.7)	(35.2)	(51.1)	(100.0)
North-East	317.0	483.0	813.0)	1613.0
	(35.6)	(25.8)	(28.3)	(28.6)
	(19.7)	(29.9)	(50.4)	(100.0)
Centre	130.0	282.0	427.0	839.0
	(14.6)	(15.0)	(14.9)	(14.9)
	(15.5)	(33.6)	(50.9)	(100.0)
South	98.0	225.0	347.0	670.0
	(11.0)	(12.0)	(12.1)	(11.9)
	(14.6)	(33.6)	(51.8)	(100.0)
Italy	890.0	1874.0	2870.0	5634.0
	(100.0)	(100.0)	(100.0)	(100.0)
	(15.8)	(33.3)	(50.9)	(100.0)

[*] *% values in brackets*

Table 7 – Expenditure in innovative activities by size of unit (thousands of euro, 2002-2004)[*]

	SMEs	**LSEs**	**Total**
North-West	5982785.0	7369667.0	13352452.0
	(44.8)	(55.2)	(100.0)
North-East	4333909.0	2355840.0	6689749.0
	(64.8)	(35.2)	(100.0)
Centre	2730687.0	2615076.0	5345763.0
	(51.1)	(48.9)	(100.0)
South	2052648.0	1478625.0	3531273.0
	(58.1)	(41.9)	(100.0)
Italy	15100029.0	13819208.0	28919237.0
	(52.2)	(47.8)	(100.0)

[*] *% values in brackets; SMEs are units with 10-99 workers and LSEs are units with at least 100 workers.*

Table 8 - Indexes of innovation (2002-2004)

macro-area	Region	IIN	IPD1	IPC1	IPP1	IPD	IPC	IPP
	Regions with IIN above the national value							
North-East	Trentino Alto Adige	0.36	0.18	0.53	0.29	0.07	0.19	0.11
North-West	Lombardia	0.35	0.17	0.51	0.32	0.06	0.18	0.11
North-East	Veneto	0.35	0.16	0.54	0.30	0.06	0.19	0.10
North-East	Emilia Romagna	0.34	0.20	0.50	0.30	0.07	0.17	0.10
North-West	Piemonte	0.33	0.17	0.48	0.35	0.06	0.16	0.12
North-East	Friuli Venezia Giulia	0.33	0.18	0.48	0.34	0.06	0.16	0.11
Centre	Marche	0.31	0.14	0.56	0.30	0.04	0.17	0.09
	Mean	*0.34*	*0.17*	*0.51*	*0.31*	*0.06*	*0.18*	*0.11*
	St. dev.	*0.02*	*0.02*	*0.03*	*0.02*	*0.01*	*0.01*	*0.01*
	Regions with IIN below the national value							
South	Abruzzo	0.30	0.15	0.57	0.28	0.04	0.17	0.08
Centre	Toscana	0.29	0.16	0.55	0.29	0.05	0.16	0.08
Centre	Umbria	0.27	0.13	0.57	0.30	0.04	0.16	0.08
North-West	Liguria	0.27	0.21	0.45	0.33	0.06	0.12	0.09
Centre	Lazio	0.24	0.17	0.45	0.38	0.04	0.11	0.09
South	Basilicata	0.24	0.24	0.31	0.45	0.06	0.07	0.11
North-West	Valle d'Aosta	0.23	0.13	0.47	0.40	0.03	0.11	0.09
South	Sardegna	0.23	0.10	0.52	0.38	0.02	0.12	0.08
South	Puglia	0.22	0.16	0.37	0.47	0.04	0.08	0.10
South	Calabria	0.22	0.17	0.46	0.37	0.04	0.10	0.08
South	Campania	0.21	0.14	0.51	0.35	0.03	0.11	0.07
South	Sicilia	0.21	0.16	0.47	0.37	0.03	0.10	0.08
South	Molise	0.17	0.05	0.51	0.44	0.01	0.08	0.07
	Mean	*0.24*	*0.15*	*0.48*	*0.37*	*0.04*	*0.11*	*0.09*
	St. dev.	*0.04*	*0.05*	*0.07*	*0.06*	*0.01*	*0.03*	*0.01*
	National value	0.31	0.17	0.51	0.33	0.05	0.16	0.10

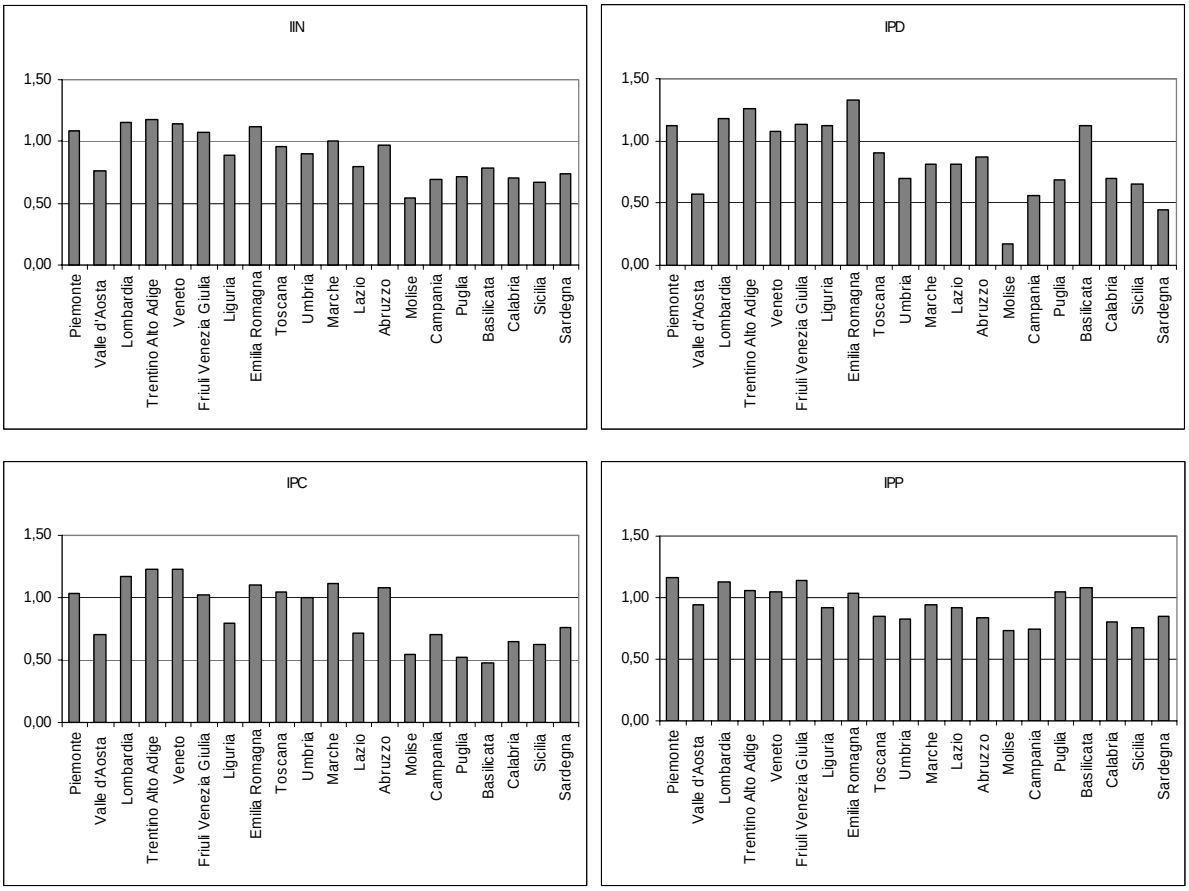
Table 9 – Indexes of innovation for units with 1-99 workers (2002-2004)

macro-area	Region	IIN	IPD1	IPC1	IPP1	IPD	IPC	IPP
	Regions with IIN above the national value							
North-East	Trentino Alto Adige	0.35	0.18	0.54	0.28	0.06	0.19	0.10
North-East	Veneto	0.34	0.16	0.56	0.28	0.05	0.19	0.10
North-West	Lombardia	0.34	0.18	0.53	0.30	0.06	0.18	0.10
North-East	Emilia Romagna	0.33	0.20	0.52	0.28	0.07	0.17	0.09
North-West	Piemonte	0.32	0.18	0.50	0.32	0.06	0.16	0.10
North-East	Friuli Venezia Giulia	0.32	0.18	0.49	0.33	0.06	0.16	0.11
Centre	Marche	0.30	0.13	0.58	0.29	0.04	0.17	0.09
	Mean	*0.329*	*0.171*	*0.531*	*0.298*	*0.056*	*0.175*	*0.098*
	St. dev.	*0.017*	*0.022*	*0.031*	*0.021*	*0.009*	*0.013*	*0.006*
	Regions with IIN below the national value							
Centre	Toscana	0.29	0.16	0.56	0.28	0.05	0.16	0.08
South	Abruzzo	0.29	0.15	0.58	0.27	0.04	0.17	0.08
Centre	Umbria	0.27	0.13	0.58	0.29	0.04	0.16	0.08
North-West	Liguria	0.27	0.21	0.46	0.32	0.06	0.12	0.09
South	Basilicata	0.24	0.26	0.31	0.43	0.06	0.08	0.10
Centre	Lazio	0.24	0.18	0.46	0.36	0.04	0.11	0.09
Southt	Puglia	0.22	0.17	0.37	0.46	0.04	0.08	0.10
South	Sardegna	0.21	0.10	0.52	0.37	0.02	0.11	0.08
South	Calabria	0.21	0.16	0.48	0.36	0.03	0.10	0.08
North-West	Valle d'Aosta	0.21	0.10	0.48	0.42	0.02	0.10	0.09
South	Campania	0.20	0.13	0.54	0.33	0.03	0.11	0.07
South	Sicilia	0.20	0.17	0.48	0.36	0.03	0.10	0.07
South	Molise	0.16	0.06	0.53	0.41	0.01	0.08	0.06
	Mean	*0.232*	*0.151*	*0.489*	*0.359*	*0.036*	*0.114*	*0.082*
	St. dev.	*0.038*	*0.050*	*0.079*	*0.061*	*0.015*	*0.031*	*0.012*
	National value	*0.30*	*0.17*	*0.52*	*0.31*	*0.05*	*0.15*	*0.09*

Table 10 – Indexes of innovation for units with at least 100 workers (2002-2004)

Macro-area	Region	IIN	IPD1	IPC1	IPP1	IPD	IPC	IPP
	Regions with IIN above the national value							
North-East	Valle d'Aosta	0.76	0.32	0.42	0.26	0.24	0.32	0.20
North-West	Trentino Alto Adige	0.64	0.16	0.36	0.48	0.10	0.23	0.31
North-West	Lombardia	0.61	0.14	0.37	0.50	0.08	0.22	0.30
North-East	Emilia Romagna	0.54	0.21	0.29	0.50	0.11	0.16	0.27
South	Piemonte	0.52	0.12	0.31	0.57	0.06	0.16	0.30
North-East	Veneto	0.52	0.19	0.28	0.52	0.10	0.15	0.27
Centre	Friuli Venezia Giulia	0.51	0.19	0.34	0.47	0.10	0.18	0.24
Centre	Marche	0.50	0.24	0.32	0.44	0.12	0.16	0.22
	Mean	*0.577*	*0.196*	*0.337*	*0.468*	*0.115*	*0.197*	*0.264*
	St. dev.	*0.089*	*0.063*	*0.046*	*0.092*	*0.054*	*0.059*	*0.040*
	Regions with IIN below the national value							
South	Sardegna	0.44	0.10	0.49	0.41	0.04	0.22	0.18
South	Abruzzo	0.44	0.18	0.41	0.41	0.08	0.18	0.18
Centre	Toscana	0.43	0.14	0.32	0.53	0.06	0.14	0.23
North-West	Liguria	0.42	0.19	0.34	0.47	0.08	0.14	0.19
South	Campania	0.41	0.21	0.25	0.54	0.09	0.10	0.23
Centre	Lazio	0.39	0.12	0.36	0.51	0.05	0.14	0.20
Centre	Umbria	0.38	0.16	0.25	0.59	0.06	0.09	0.22
South	Molise	0.37	0.00	0.29	0.71	0.00	0.11	0.26
South	Puglia	0.33	0.05	0.34	0.61	0.02	0.11	0.20
South	Calabria	0.32	0.33	0.17	0.50	0.11	0.05	0.16
South	Sicilia	0.28	0.11	0.37	0.52	0.03	0.10	0.14
South	Basilicata	0.22	0.00	0.26	0.74	0.00	0.06	0.16
	Mean	*0.369*	*0.134*	*0.321*	*0.545*	*0.051*	*0.121*	*0.197*
	St. dev.	*0.069*	*0.094*	*0.086*	*0.104*	*0.034*	*0.047*	*0.034*
	National value	0.50	0.16	0.33	0.51	0.08	0.17	0.26

Figure 1 - Indexes of innovation in Italian regions (Italy = 1.00)*



* *Regions are geographically sorted from north to south.*

*Table 11 - List of variables used in the factor analysis**

IIN	Innovative regional units / Total regional units
EXPEND	Expenditure in innovation / Innovative regional units
SIZE	Innovative regional units with at least 100 workers / Innovative regional units with 1-99 workers
RD_PRIVATE	Private expenditure in R&D/ GDP
RD_PUBLIC	Public expenditure in R&D/ GDP
RD_WORKER	Number of workers in R&D activities / Population
SCIENTIFIC	Number of graduates in scientific subjects / Population 20-29
FDI	Foreign direct investments / GDP
INTERNET	Index of broadband diffusion in firms
HIGHTECH	Value added in high-tech sectors / Value added in manufacturing sector
DISTRICT	Workers in SMEs of local labour systems / Total number of workers
TURNOVER	Difference between birth-rate and death-rate of firms

*All the variables are expressed as average values in the period 2002-2004. Sources: ISTAT (various publications, various years).

Table 12 – Results of the principal component analysis

	Component 1	Component 2	Component 3
Eigenvalue	5.29063	2.15599	1.52926
% of variance	44.09	17.97	12.74
Eigenvectors			
IIN	0.2964	0.4373	0.0476
EXPEND	0.3220	-0.2967	0.0805
SIZE	0.3057	-0.0925	-0.2401
RD_PRIVATE	0.3871	0.0356	-0.2868
RD_PUBLIC	0.1237	-0.4774	0.4694
RD_WORKER	0.3924	-0.1657	0.1988
SCIENTIFIC	0.3497	0.0913	0.1445
FDI	0.2586	0.0158	0.1957
INTERNET	0.3574	-0.0025	0.0884
HIGHTECH	0.2541	0.0208	-0.5348
DISTRICT	0.1196	0.5615	0.1293
TURNOVER	-0.0084	0.3622	0.4709

Figure 2 – Principal components analysis

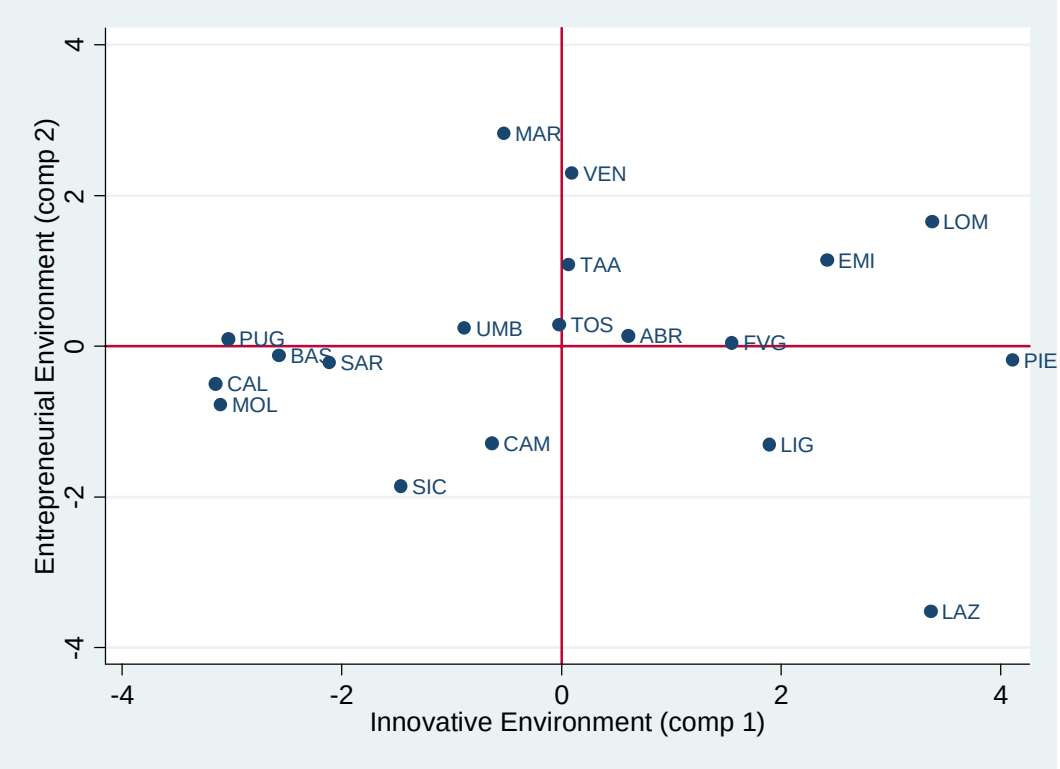


Figure 3 – Cluster analysis on components 1 and 2 (Ward's algorithm)

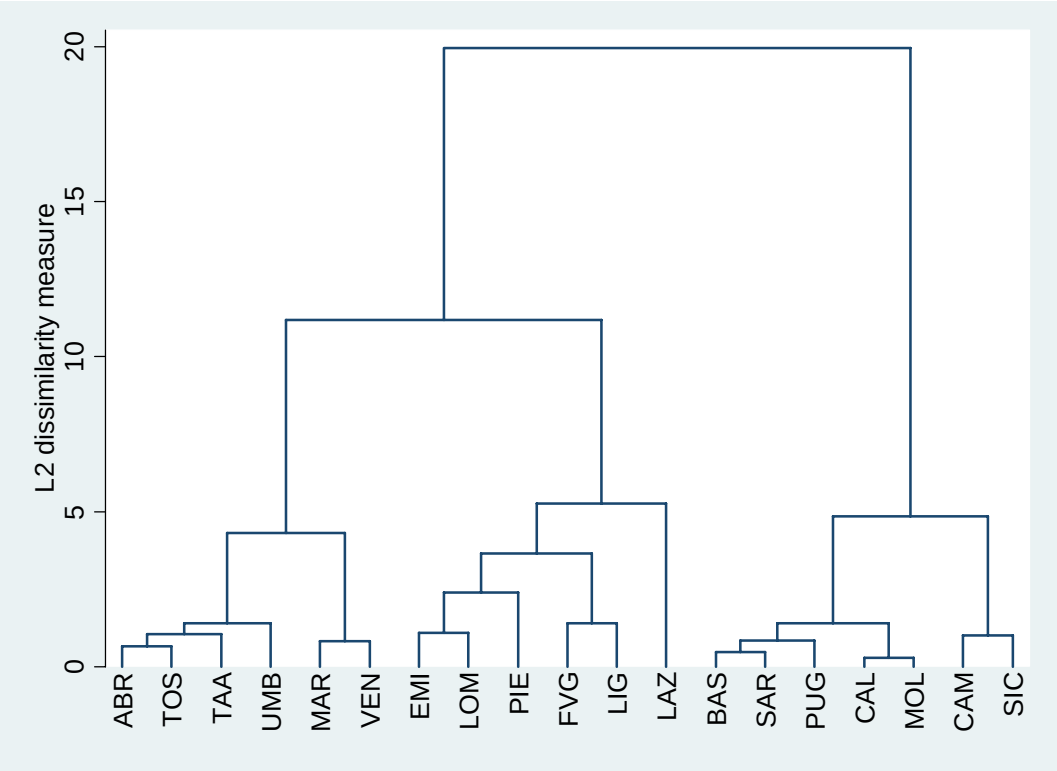


Table 13 – Clustering in 4 groups (% values)

Group	Code	IIN	IPD1	IPC1	IPP1	LSEs	EXP LSEs	HIGH TECH	VA*	LAB*	PROD*
3	EMI - LOM - PIE - FVG - LIG	32.74	18.67	48.50	32.82	9.64	54.32	31.26	1.13	1.07	0.06
2	MAR - VEN - TAA - UMB - TOS - ABR	31.42	15.30	55.24	29.46	6.53	42.30	24.51	1.39	1.09	0.29
4	LAZ	24.46	17.10	45.22	37.68	9.71	56.65	23.76	0.69	0.81	-0.13
1	PUG - BAS - SAR - CAL - MOL - SIC - CAM	21.20	14.61	45.11	40.28	6.66	37.47	22.60	0.79	0.51	0.27

* Average growth rate in the period 2004-2006

Table 14 – One-way ANOVA on 4 groups (variable: IIN)

	Sum of squares	df	Mean square	F	Prob>F
Between groups	0.051066528	3	0.017022176	19.39	0.0000
Within groups	0.013165314	15	0.000877688		
Total	0.064231842	18	0.003568436		

Table 15 – Tukey's HSD test on 4 groups (variable: IIN)

grp vs grp	group means		mean diff.	HSD-test
1 vs 2	0.2126	0.3142	0.1016	5.5807*
1 vs 3	0.2126	0.3274	0.1148	6.3077*
1 vs 4	0.2126	0.2446	0.0320	1.7574
2 vs 3	0.3142	0.3274	0.0132	0.7270
2 vs 4	0.3142	0.2446	0.0696	3.8234
3 vs 4	0.3274	0.2446	0.0828	4.5504*

* The mean difference is significant at the 0.05 level.

Table 16 – Clustering in 8 groups (% values)

Group	Code	IIN	IPD1	IPC1	IPP1	LSEs	EXP LSEs	HIGH TECH	VA*	LAB*	PROD*
6	EMI - LOM	34.94	18.57	50.57	30.86	9.87	52.55	30.15	1.17	1.03	0.14
7	PIE	33.45	17.27	48.07	34.66	9.75	64.14	35.14	0.71	1.00	-0.29
4	MAR – VEN	32.95	14.72	55.23	30.05	6.89	42.25	25.92	1.50	1.03	0.47
3	TAA - UMB - TOS - ABR	30.65	15.59	55.24	29.17	6.08	42.37	22.56	1.28	1.16	0.12
5	FVG - LIG	30.18	19.47	46.67	33.86	7.80	49.80	32.57	1.54	1.39	0.15
8	LAZ	24.46	17.10	45.22	37.68	9.71	56.65	23.76	0.69	0.81	-0.13
1	PUG - BAS - SAR - CAL - MOL	21.42	14.48	43.44	42.08	6.43	28.45	19.74	0.78	0.86	-0.08
2	SIC – CAM	20.86	14.92	49.30	35.78	6.89	42.62	25.20	0.80	0.22	0.57

* Average growth rate in the period 2004-2006

Table 17 – One-way ANOVA on 8 groups (variable: IIN)

	Sum of squares	df	Mean square	F	Prob>F
Between groups	0..054142273	7	0. 00773461	8.43	0.0011
Within groups	0.010089569	11	0.000917234		
Total	0.064231842	18	0.003568436		

Table 18 – Tukey's HSD test on 8 groups (variable: IIN)

grp vs grp	group means		mean diff	HSD-test
1 vs 2	0.2142	0.2086	0.0057	0.2510
1 vs 3	0.2142	0.3065	0.0923	4.0859
1 vs 4	0.2142	0.3295	0.1153	5.1026
1 vs 5	0.2142	0.3019	0.0876	3.8789
1 vs 6	0.2142	0.3494	0.1352	5.9853*
1 vs 7	0.2142	0.3345	0.1203	5.3245*
1 vs 8	0.2142	0.2446	0.0304	1.3442
2 vs 3	0.2086	0.3065	0.0980	4.3369
2 vs 4	0.2086	0.3295	0.1209	5.3535*
2 vs 5	0.2086	0.3019	0.0933	4.1298
2 vs 6	0.2086	0.3494	0.1409	6.2363*
2 vs 7	0.2086	0.3345	0.1259	5.5755*
2 vs 8	0.2086	0.2446	0.0360	1.5952
3 vs 4	0.3065	0.3295	0.0230	1.0166
3 vs 5	0.3065	0.3019	0.0047	0.2071
3 vs 6	0.3065	0.3494	0.0429	1.8994
3 vs 7	0.3065	0.3345	0.0280	1.2386
3 vs 8	0.3065	0.2446	0.0619	2.7417
4 vs 5	0.3295	0.3019	0.0276	1.2237
4 vs 6	0.3295	0.3494	0.0199	0.8828
4 vs 7	0.3295	0.3345	0.0050	0.2220
4 vs 8	0.3295	0.2446	0.0849	3.7583
5 vs 6	0.3019	0.3494	0.0476	2.1065
5 vs 7	0.3019	0.3345	0.0327	1.4456
5 vs 8	0.3019	0.2446	0.0573	2.5346
6 vs 7	0.3494	0.3345	0.0149	0.6608
6 vs 8	0.3494	0.2446	0.1048	4.6411
7 vs 8	0.3345	0.2446	0.0899	3.9803

* The mean difference is significant at the 0.05 level.

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