INNOVATION AND PERFORMANCE OF SMEs IN ITALY: THE RELEVANCE OF SPATIAL ASPECTS

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Abstract

Since the years 1970's, the role of small and medium firms in economic development has widely come to the fore in regional economic theory. Especially in Italy, during that period the good performance of regions with a high share of small firms was in contrast with the poor and decreasing rate of growth of the traditional large firms areas of the North-Western part of the Country. This paper provides a picture of the Italian regional industrial structure, in terms of performance and innovative behaviours, and some new elements for reflections have emerged. One of these elements is the capacity of small firms to innovate only in certain spatial contexts, where dynamic spatial elements support this process: the collective learning are one of these elements and play a crucial role, by providing innovation assets to small firms.

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INNOVATION AND PERFORMANCE OF SMEs IN ITALY: THE RELEVANCE OF SPATIAL ASPECTS

1. Introduction

Since the 1970s, the role of small and medium-sized firms in economic development has widely come to the fore in regional economic theory. Especially in Italy, during that period the good performance of regions with a high share of small firms was in contrast with the poor and decreasing rate of growth of the traditional large firm areas of the North-Western part of the country. The so called "Third Italy phenomenon" received widespread attention, with the above-average economic performance of North-Eastern and Central (NEC) regions[1]. A long wave of economic success accompanied the "Third Italy" regions, a success which was explained by the high flexibility of small firms with respect to market volatility, their innovativeness in terms of customised production, and the existence of district economies accompanying territorial specialisation.

The tripartite model of an old-industrial North-Western part of the country, of an efficient and dynamic Third Italy, mainly driven by small and medium firm agglomeration, and a peripheral lagging South still influences the economic debate on regional development: small firms tend to be regarded as the most dynamic type of industrial organisation, and for this reason, regions with a high presence of small firms tend to be interpreted as the most successful in terms of industrial growth.

Parallel to these reflections in regional economic theory, in industrial economics some new approaches have also recently been put forward, which emphasise the role of small firms in the innovative process. According to some authors (Acs and Audretsch, 1993; Loveman and Sengenberger, 1991; Sylos-Labini, 1986), the developed economies have not only experienced a process of

deconcentration and deindustrialisation rather than one of concentration and centralisation over the past two decades, but a wave of empirical studies have recently emerged identifying small firms as the engines of technological change and innovative activity, at least in certain industries (Audretsch and Vivarelli, 1994; Pavitt et al., 1987; Rothwell, 1989). This statement and these empirical findings contrast with the well known observation that, since R&D expenditure is concentrated in large firms, and that innovative output strongly depends on R&D inputs (Scherer, 1991), large firms are expected to drive the technological process.

A general reflection is therefore needed on the role that small and medium firms play in the innovation process and in regional development. The aim of this paper is to present the Italian reality on the basis of some recent data on regional growth and innovation patterns. In particular, our aim is to give an answer to the following questions:

a) is it true that regions with a high share of small firms have a better performance than the others? In other words, is it true that the North-Eastern and Central regions have still an outstanding economic performance?

b) is it true that small firm regions innovate more than large firm regions?

c) if small firms innovate more than large firms, where do they obtain the innovation assets?

Our paper tries to reply to these questions; a double theoretical conjecture has driven our analysis:

- the first relates to firm size: small firm size is not sufficient to achieve competitiveness and greater economic and innovative performance; the traditional spatial aspects, underlined by the

"local districts" model, are extremely relevant to determine the efficiency of the local area. What Marshall called the "industrial atmosphere", such as physical and cultural proximity, easy information interchange, frequency of interpersonal contacts and cooperation, and high factor mobility within the limits of the local area, all play a crucial factor in economic development;

- the second relates to the difference between a static and a dynamic approach: the previously mentioned spatial elements are the result of a typically static approach, where locational efficiency turns into market efficiency through the reduction of transaction costs and the presence of external economies. This approach is not sufficient to explain economic dynamics of local systems. This statement refers to the "milieu innovateur theory"[2] put forward by the GREMI group since the middle 1980s. This theory clearly defines the "milieu innovateur" as a set, or complex network, of mainly informal social relationships within a limited geographical area, which enhance the local innovative capability through synergetics and collective learning processes (Camagni, 1991, pp. 3). According to this definition, the distinction between local districts and innovative milieux resides specifically in the existence in the milieu of dynamic local elements, namely regarded as collective learning processes that enhance local creativity, and the reduction of the dynamic uncertainty elements which are intrinsic in technological development and innovative processes: these dynamic local elements guarantee the innovation process in local areas, and thus their long term economic survival.

The results of the analysis will help in confirming our conjectures. The structure of the paper is as follows: Section 2 describes the structure and the performance of firms in the different Italian regions, in order to inquire whether small is (always) beautiful. Section 3

describes the spatial patterns of innovation and measures whether the innovative paths follow a clear spatial trajectory; Section 4 defines the profiles of regional innovative trajectories; Section 5 highlights the determinants of small firm innovativeness and inquires under which circumstances "small may still be beautiful"; Section 6 provides some empirical evidence on the role played by two complementary and strategic elements which enhance local creativity: the milieu and the cooperation network. Section 7 provides some concluding remarks and highlights some future research directions.

2. Regional Development Patterns and Firm Size: Small is not Always Beautiful

2.1. The regional industrial structure

Since the end of the 1970s, the dichotomic model of an advanced Northern part of the country and a lagging Southern part has been replaced by the well-known tripartite model, which differentiates among:

- the North-Western regions (Piemonte, Valle d'Aosta, Lombardia, Liguria), regarded as the old industrial triangle, where development has traditionally been driven by large industrial firms;
- the North-Eastern and Central regions (Emilia-Romagna, Veneto and Trentino first, followed by Toscana and the regions along the Adriatic Coast), which has been called the "Third Italy" (or NEC regions), which during the seventies showed astonishing performance in industry, and which were characterised by a high presence of small and medium-sized firms;
- a historically lagging Southern part of the country, characterised by the presence of branch plants, mainly as the result of the development strategies of the 1960s and 1970s.

This part of the analysis investigates whether the industrial structure of the Italian regions has undergone major changes since the 1970s. The analysis is conducted on the basis of Industrial Census data (1991) on the number of firms by size and region. Large metropolitan areas[3] (provinces) are distinguished separately from the rest of the respective regional economies; this was done partly for the sake of homogeneity, as evidence (and theory) suggests that their economic structure differs from that of their hinterlands, being mainly characterised by large headquarter units or urban handicraft production; secondly, for the aim of inspecting in their case also the relevance of specific spatial elements in shaping their particular performance.

Figure 1 shows the share of small industrial firms by region: in 1991 the regional industrial structure of the country seems to depart heavily from the tripartite model of the North-West, NEC and South. Two opposite elements in fact emerge:

- a tendency for old industrial areas, like the non-metropolitan Lombardy region, to reorganise their industrial activities around small firms, as a result of an industrial restructuring process mainly based on the reinforcement of the diversified industrial milieux, historically present in this region;

- a tendency for some NEC regions to adjust around a more diversified industrial structure in terms of firm size: Emilia-Romagna is unexpectedly characterised by a relatively low presence of small firms (Figure 1).

A diversified industrial structure also emerges at the metropolitan level. Bari, Venezia and Bologna, characterised by a high share of small firms may be labelled as the "Urban Third Italy" provinces, showing an industrial fabric which maintains strong resemblances with the surrounding areas; in the case of Bari, these small firms are often sub-contracting units of the local districts in the North.

In contrast, a group of provinces exist (Turin, Genova, Roma, Napoli, Palermo and Cagliari) which mainly shows a metropolitan structure; a share of large firms above the national level reflects the presence of industrial headquarters. Milan inevitably shows its profile of a mixed economy: it has both the profile of an industrial district type of area, with the presence in its province of a high share of small firms, especially belonging to high-technology industries, and that of a metropolitan area where the headquarters of large national and international enterprises are located. These results are reinforced by Figure 2, which also shows the share of medium and large firms. Bari is a real district area, with a dominating share of small firms, while large enterprises are mainly present in provinces like Turin, Genova, Roma, Napoli, Palermo and Cagliari. As expected, Milan clearly demonstrates its nature of a mixed and balanced economy.

The regional level results show in Figure 2 also reinforce what has already been said: non metropolitan Lombardy records a profile similar to the Third Italy regions, showing a share of SMEs greater than that of large firms, like Emilia-Romagna, Veneto, Trentino and Friuli.

This Figure provides an additional important message, since it shows that a clear-cut distinction emerges in the profiles of the "Third Italy" regions, which tend to split into two different groups: a first, more advanced, group where medium sized firms tend to emerge in comparison to small ones (it is the case of Emilia-Romagna, Friuli, Veneto) and a second, more traditional group, where the traditional structure of small firms is confirmed.

The main result emerging from this part of the analysis is that something is changing in the structure of Italian regions, departing from the traditional tripartite model.

2.2. Regional industrial development patterns

Industrial productivity levels in 1986 and 1991, measured in terms of industrial value added relative to industrial employment, are given in Figure 3, for all regions and metropolitan areas. As far as these latter are concerned, the competitive profile differs very much according to the industrial structure of the metropolitan areas: the metropolitan provinces, like Turin, Milan, Genova and Rome, register high levels of the indicator, thanks to the presence of headquarters of large firms and to the positive externalities stemming from their modern and dynamic tertiary activities, while the "districts" provinces of Bari and Venezia show a productivity level below the national average.

As far as the regions are concerned, we can see that the main unexpected result regards the NEC regions; as was the case for the industrial structure, also in the case of competitiveness, NEC areas split into two, and show a more competitive North-Eastern part, with regions like Emilia Romagna, Veneto, Trentino, Friuli, and a less competitive Central area, like Marche, Toscana, Umbria and Abruzzo-Molise, which all have an industrial productivity below the national level. This difference was already present in 1986, although it does not seem to increase in the period 1986-1991.

From the analysis of industrial productivity growth, a positive result emerges for all areas representing the Third Italy model: they all witness a period of relatively high industrial productivity growth. But a more in-depth analysis is needed in this respect, as a good productivity performance may be achieved through quite different processes: it may take place through a restructuring process, when a higher productivity growth is reached through severe employment cuts, leading nevertheless to good output performance; or it may be the result of a real "virtuous cycle", where higher than average productivity growth generates good performance also in both employment and output.

For this reason, particular regional development "patterns" have to be identified according to the trend of two indicators: employment growth (and in particular relative employment growth) and productivity growth, the former representing a social problem and the latter explaining its causes and the future prospects of the local economy. Analysing jointly the two indicators, different situations emerge, which have different economic explanations: decreasing employment growth may be associated either with increasing or decreasing productivity growth. In the former case, signs of a possible revitalisation process may be envisaged, in the latter, a clear situation of deindustrialisation emerges. For the same reason, increasing productivity growth may be associated either with increasing employment growth ("virtuous cycle"), or with a decreasing one ("restructuring process").

The framework of analysis becomes much clearer if we examine the problem from an analytical perspective (Camagni, 1991b). In analytical terms, it is possible to chart the economic performance of each region on a cartesian graph, where on the X axis we plot the relative employment growth (REG) of region r, namely (Figure 4):

$$REG_r = \frac{E_r^1 / E_r^0}{E_n^1 / E_n^0}$$

and on the Y axis we plot the relative productivity growth (RPG) of the same region (value added per employee), namely:

$$RPG_r = \frac{P_r^1 / P_r^0}{P_n^1 / P_n^0}$$

where n denotes the nation, and E and P are the employment and productivity and 0 and 1 the initial and final year.

On the same figure we may therefore record two indicators for each region, and chart their relative performance in a specific period; the different possible patterns of regional growth that emerge may be designated as:

1. '*virtuous cycle*', when a higher than the average productivity growth generates good performance in both employment and output;

2. '*restructuring*' when a higher productivity growth is reached through severe employment cuts, leading nevertheless to good output performance;

3. '*deindustrialisation*', defined as a vicious cycle in which employment cuts are unable to restore competitiveness, a condition that perpetuates job losses and low output growth;

4. '*industrial take-off*', where regions grow in employment terms, thanks to some "shelters", notwithstanding low productivity performance.

Figure 4 presents the results of this methodology for the period 1986-1991, for all regions and metropolitan provinces. The main emerging result is that all NEC regions perform well, although reflecting very different paths towards better performance levels: most of them show a good performance accompanied with a good relative employment growth, but others, like Toscana and Marche, achieve a good performance through severe cuts in employment. The same ambiguous growth pattern is followed by the district provinces: Venezia seems to register a virtuous cycle, while Bari seems to suffer in terms of employment growth. The economic crisis of the Central regions, and in particular of Toscana, Marche and Umbria, has already been emphasised by other empirical analysis: one striking element is the financial and economic crisis of Prato, one of the most

well known local districts in Toscana, which now receives subsidies from the EC as part of the group of "Objective 2" regions[4].

The difference between North-Eastern and Central regions has already been emphasised in previous work of the present authors (Camagni and Capello, 1990): a locational advantage, calculated as the difference between relative productivity and wage levels, was present in NEC regions during the seventies, especially in the Central regions. In these regions, this advantage had already turned into locational disadvantages at the beginning of the eighties.

Differentiated growth patterns characterise also the other two macro regions: the old "Industrial Triangle" regions of Piemonte and Liguria witness a restructuring process underway, while Lombardia, together with Lazio (which although located in the Centre has always differed from the traditional Central regional industrial structure) seem to be in a situation of new industrial take-off, probably achieved through the exploitation of the positive externalities generated by the modern and dynamic tertiary economies of their metropolitan areas, respectively Milan and Rome.

From this analysis of regional development patterns, an important general result emerges: the regions with a greater share of small firms are no longer uniformly characterised by better performance and employment growth, as happened during the seventies. The traditional efficiency of small firms, widely underlined in regional economics, seems to take place only under certain circumstances. In this perspective, our aim is now to study the innovative patterns of these regions, in order to see whether the most dynamic regions in terms of both industrial employment and productivity growth are also the ones which innovate more.

3. Innovation and Small Firms: Spatial Patterns in Italy

The spatial pattern of industrial innovation in Italy has been analysed on the basis of an inquiry carried out by the National Statistics Office (ISTAT), in collaboration with the National Research Council (CNR), in the period 1990-1992 (Iammarino et al., 1995)[5]. Unfortunately, this source provides regional data as the most disaggregated level of territorial unit[6]; analysis of the metropolitan areas is no longer possible.

Spatial variations in innovation rates are presented in Figure 5, through the share of industrial firms reporting only product innovation, only process innovation or both together by region in 1992. At a first glance, a clear-cut distinction between the North-Western and North-Eastern regions, on the one hand, and the Central and Southern regions on the other, emerges; while the difference between the North and the South was predictable, a more astonishing result is the split between different NEC areas. Figure 5 clearly shows that the North-Eastern areas record an innovation rate which is above the national average, while the Central regions are much more similar to the levels shown in the South. Lazio is the most innovative region in the Centre and, as expected, it is not far from the national average.

Again, this result underlines that not only do the "Third Italy" regions no longer follow the same economic development patterns, they do not even show a similar innovative behaviour.

A different regional innovative behaviour emerges once the data on product and process innovations is analysed: the greater innovation capacity of the North is witnessed by the fact that in these regions the number of firms which have developed product innovations alone or at least both product and process innovations in the period 1990-1992 is greater than in Central and Southern regions, where the

innovations reported are more likely to be process innovations (Figure 6).

The next diagram (Figure 7) shows the variance of innovative firms by size. Very interestingly, this reveals a striking homogeneity *within* each region and a wide differentiation *among* regions. This result seems to give no clear answer to the traditional debate carried out in industrial economics since Schumpeter on which industrial structure is more appropriate to stimulate an innovative behaviour. On the other hand, the same result seems to be much in accordance with the view of spatial economic theory which stresses the importance of horizontal, "industrial atmosphere" elements: the environment in which firms operate, despite their size, plays a crucial role in providing both the cumulative learning processes on which a technological paradigm feeds itself and grows, and the mechanisms for reducing uncertainties associated with the technological progress (e.g. stimulating imitating behaviours on success adoption stories).

Formal innovation, measured in terms of patent intensity[7], has a very high regional variation (Figure 8). As expected, patent intensity is greater in the North than in the Centre and South of the country, and reaches very high levels in those regions with a high presence of large firms, like Lombardia, Friuli and Lazio; the last of these records a very different picture from that presented by the other regions in the Centre. An interesting result is the high patent intensity in Friuli, Emilia-Romagna and Veneto; their values are higher than the national level, a situation common only to other advanced regions, like Piemonte, Valle d'Aosta, Lombardia and Lazio.

Patent intensity is linked not only to the presence of large firms, but also to the presence of high-technology industry in the regions: as Figure 9 shows, the share of firms belonging to this sector as a proportion of the total number of firms present in the region is

extremely high in Piemonte, Lombardia, Friuli and Lazio, and, with the exception of Lombardy, this share has increased in these regions between 1981 and 1991. A share of high-technology firms above the national average is also typical of regions like Veneto and Emilia-Romagna, while the level in the South and in the Centre, although increasing, is still below the national level.

If the interest lies in the identification of innovative regions characterised by a high share of small firms, Figure 10 helps in this respect: four areas may be identified in this figure:

1. the "*milieux innovateurs*" area, characterised by a high innovation rate and a high share of small firms relative to the national level;

2. the *"traditional local districts"* area, where a greater than (national) average share of small firms is accompanied by a lower than average innovation rate;

3. the *"lagging large firms areas"*, characterised by both a share of small firms and an innovation rate lower than the national level;

4. the *"innovative large firms areas"*, where even if the level of small firms is lower than the national level, the rate of innovation is greater than the national one, indicating that an innovative process is underway, driven by large enterprises.

The results are quite interesting (Figure 10)[8]. In the "lagging large firms area" group all Southern regions are present, as expected. Their economy is in fact characterised: a) by large, mainly public, firms, created in traditional and, by definition, less innovative industries, like iron, steel and petrochemicals, as a result of a "growth poles" strategy, à la Perroux-Boudeville, in the 1960s and 1970s, and b) by branch plants of large private firms of the North, which develop their

research and development activities in core regions. More innovative large firms areas are in fact Piemonte-Valle d'Aosta, Liguria and Trentino, all Northern regions.

However, what is even more striking in this Figure is the distinction between "traditional local districts regions" and "milieux innovateurs regions". In the group of "milieux innovateurs" areas we find regions belonging to the North-Eastern part of the Country, like Emilia-Romagna, Friuli and Veneto, once again indicating that these are the leading areas of the "Third Italy" model. The remaining regions of the old NEC model however fall into the "traditional local districts area" group. They retain their historic structural characteristics of an economy mainly based on small firms, where the model of local systems, highly specialised, highly efficient in terms of information exchange and frequencies of interpersonal contacts and cooperation seems however not to be sufficient to stimulate an innovation process. Once again, a marked dichotomy between the old NEC regions emerges quite clearly.

4. Contrasting Regional Patterns of Innovative Behaviour

4.1. The methodology and the database

In this part of the analysis the aim is to investigate whether differentiated patterns of innovative behaviour exist and which regions may be grouped in each of them. For such a purpose, a methodology such as cluster analysis is quite useful. This statistical method allows us to aggregate regions on the basis of the statistical similarities of some specific variables, and to discriminate among those which are statistically rather different. The results obtained are groups of regions with rather similar behaviour in terms of the characteristics analysed.

The variables used are the following:

- industrial productivity, measured as the industrial value added industrial employment in 1991;
- patent intensity, measured as the number of patents obtained in the period 1986-1991 relative to industrial employment;
- high-technology firm concentration, measured as the number of high-technology firms relative to total industrial firms;
- the industrial structure of the region, measured as the number of industrial small, medium-sized and large firms present in the region relative to the total number of industrial enterprises;
- the share of innovative small firms as a proportion of the total number of innovative firms;
- R&D expenditure in each region relative to the total technological investments made;
- the innovation rate, measured as the number of innovative firms as a proportion of the total number of industrial firms;
- the ratio of innovative small firms to innovative large firms;
- the product innovation ratio, measured as the number of firms which developed only product innovations as a proportion of the total number of innovative firms;
- the process innovation ratio, measured as the number of firms which developed only process innovations as a proportion of the total number of innovative firms;
- the information channels regarded by firms as important in the innovative process;
- the major obstacles encountered by firms in the innovative process.

The sources of these variables are: a) the CNR/ISTAT inquiry on innovation published in 1992, for data concerning the innovative variables; b) the Industrial Census data for the industrial structure variables; c) the EPO-CESPRI database, for the patent intensity variable; d) the European Innovation Monitoring System on NTBFs (new technology based firms) for the high-technology data.

For the variable concerning information channels, we grouped different possible sources of information for innovation into three main groups:

- *public information*, mainly conferences and fairs;
- *club information*, mainly obtained by suppliers, customers or firms in some way related with the interviewed firm;
- *private information*, mainly obtained by other firms belonging to the same group or by other functions within the same firm.

As far as the obstacles to innovation are concerned, four main groups were chosen:

- *economic obstacles*, mainly dealing with financial and resource limits of the firm;
- *information obstacles*, mainly related to the lack of information on technology and markets;
- *organisational obstacles*, dealing with the lack of qualified staff, of new organisational structures more suitable to the innovation; in the words of Nelson and Winter, these are all obstacles related to a change in the "organisational routines" necessary for a break with the old "technological paradigm";
- *cooperative obstacles*, in terms of lack of service suppliers and cooperative opportunities with other firms and institutions.

Unfortunately, the database is constructed in such a way that it presents the rate of the *non-relevance* of these factors, rather than the relevance; however, this only imposes a certain care in interpreting the results of the analysis, which are all provided in the Annex.

4.2. The results

The cluster analysis has been run on these variables, and the results are presented in Figure 11. Four main clusters have emerged, with the exception of a macro region, Calabria-Basilicata, which behaves as an outlier.

The results are quite stimulating, since they reveal very different innovation profiles of the Italian regions, and contrasting innovative patterns.

The first cluster is what we label the *Innovative High-Technology Area*. In this cluster we find four main regions, Piemonte-Valle d'Aosta, Lombardia, Friuli V.G., and Lazio. The industrial structure reveals the presence of large and medium-sized firms, a very high presence of high-technology sectors, and an industrial productivity rather above the national level. The innovative structure manifests a higher than the national average innovation rate, and a high propensity of both large and small firms to innovate. R&D expenditure is extremely high, reflecting the presence of large firms and of advanced industries, like high-technology sectors. These reasons may also explain the very high level of patent intensity: formal innovation is mainly used either by large firms, or when technological progress is underway. In this area, the product innovation rate is above the national average, while process innovation shows very low levels, as expected. Private information is the most important channel by which firms obtain information on innovation, in line with the dominant presence of large firms in this cluster carrying out innovation. Obstacles to innovation in general

are in this cluster not very relevant, witnessed by the high innovation rate, and the concentration here of high-technology industry.

In other words, the profile of these regions seems to be that of an extremely advanced economy, characterised by modern and innovative industries, with a decisive orientation towards innovation, mainly driven by large firms through formal innovation and R&D activities.

A second cluster is labelled the *Innovative Traditional Firms Area*; regions belonging to this cluster are Trentino, Veneto, Emilia-Romagna and Liguria (Figure 11). The industrial structure of these regions is rather different from the previous cluster: the dominating firm size is the medium-sized firm, with a share of such firms significantly above the national average and above the level of all other clusters (see Table in Annex 1). The share of small firms is nearly at the national average, whereas large firms are markedly underrepresented. However, the interesting aspect is that these economies have the highest industrial productivity level with respect to all other clusters: this high level of productivity is accompanied by a very high innovation rate (the highest in comparison with all clusters), and by the highest product innovation rate. Since the share of high-technology firms is below the national level, innovative firms in this area tend to belong to traditional sectors. The very low proportion of large firms present in these regions is rather innovative, but the ratio between innovative small firms relative to innovative large firms is in favour of small innovative firms. Patent intensity is near the national average, which is explained by the high rate of product innovation. Club information is the most favourable channel by which firms obtain strategic information to innovate, with respect to the other clusters. Economic and organisational obstacles seem to be the major limits to innovation, the former explained by the high costs of innovative processes, the latter by the organisational changes required to introduce product innovation.

The profile of this cluster is that of a very dynamic area, where innovation is mainly carried out by medium-sized and small firms, in traditional industries, and through product innovation, and where the local environment seems to provide strong support in terms of information on innovation and market possibilities: in other words, an area where the local district model is mixed with an advanced and creative industrial structure, which feeds itself with local know-how and cumulative knowledge, through cooperation.

The third cluster is labelled the *"Traditional Small Firms Area"*, and is clustered around four regions: Marche, Umbria, Toscana and Abruzzo-Molise, mainly located in the Centre (Figure 11). The industrial structure here is dominated by small firms, with proportions significantly above the national average, while the presence of medium-sized, and especially of large firms, is very much below the Italian level. Industrial productivity is extremely low, accompanied by a very poor rate of innovation. High-technology firms are not present in this area, and, consequently, R&D and patent intensity are very low. In synthesis, this cluster is a typical area of small firms, operating in traditional sectors, with local economies based on high levels of industrial specialisation but with a very limited capacity in pushing towards rejuvenation and modernisation. An interesting result is that the main obstacle to innovation reported by firms appears to be associated with the local environment, in terms of a lack of stimuli and possible cooperation among firms.

The fourth cluster is that labelled the *"Large Firm Lagging Area"*, which includes all the Southern regions, with the exception of the outlier Calabria-Basilicata (Figure 11). The industrial structure of this cluster is dominated large firms, whose public nature explains the very low innovation rate. Most are large branch plants of private enterprises, which rely on innovative decision-making processes developed in the North; from the innovation point of view, these are dependent regions, where innovation is mainly process innovation.

Private information remains the more relevant channel of information, probably via the headquarters in the North, and economic and environmental obstacles are seen as the main limits towards innovative trajectories.

Finally, the outlier region has a profile very similar to that of the Southern regions; the main differences however are in the industrial structure, such as a higher presence of small firms than in cluster 4, and in contrast a lower presence of large firms. However, there are close similarities with cluster 4 in terms of innovative patterns, which are extremely poor in comparison with the other areas.

These profiles of innovative behaviours provide an interesting framework of contrasting regional innovative patterns. A first, and entirely logical, result is the clear-cut distinction between the North and the South of Italy, in terms of both industrial structure and innovative behaviour, a difference which was predictable and therefore does not need further attention.

However, much more astonishing results emerge from these profiles:

1. the distinction between North-Eastern and Central regions. Two completely different patterns of innovative behaviour characterise the old "Third Italy" regions. The first more dynamic and advanced area is that of the North-Eastern part of the country, whose modernisation in terms of industrial structure is similar to that of old industrial (and now restructuring) regions like Liguria. Firms in this North-Eastern area innovate, and prioritise product innovation as one way to overcome local difficulties. The second, much more traditional area, comprises the Central part of the country, which exhibits a less dynamic and innovative economic structure, with a lower productivity level;

2. the existence of two spatial innovative systems in Italy, one more technologically oriented, the other more "market niche" oriented. The high-technology innovative system is clustered around the old industrial areas of Piemonte, Lombardia, together with the more modern large firms areas of Lazio and Friuli. In these regions product innovation related to high-technology industries takes place, thanks to high R&D expenditure, resulting in a high level of innovation output and patent intensity. A less technologically oriented innovation system is however to be found in the remaining Northern regions; there, product innovation is mainly related to the rejuvenation of traditional sectors, whose competitive advantages are based on the creation and acquisition of market niches, targeted through product innovation. Both these systems, however, seem to rely more on the presence of large or medium-sized firms, while the capacity of small firms to innovate in these areas seems more a spin-off effect due to the presence of leading medium-sized and large innovative firms.

5. The Role of Spatial Elements in the Innovative Process: When Small is Beautiful

As was apparent in the previous discussion, spatial aspects and territorial specificities appear to play a major role in shaping the performance of regional industrial systems. Therefore, the usual simplification often adopted in industrial economics debates, focusing only on the dimensional structure of the industrial fabric, has to be complemented by and integrated with a thorough analysis of territorial variables.

This enlargement of the relevant explanatory factors creates a potentially significant risk: the risk of fragmentation of the analysis in a host of local inquiries, focusing on the specificity of each local condition. Our approach does not go in this direction. We would argue that certain major macro-territorial elements do link together

regions and territories within broadly homogeneous macro-areas, belts, or development axes, as revealed by multivariate statistical elaborations like the one we presented in the previous section.

In this paragraph our intention is to summarise the role of spatial elements as they emerge from the previous analysis, leading to a more complex picture with respect to the simplified hypotheses followed in the industrial economics literature. These simplifications appear in two respects (when aggregate, non-sectoral development is taken into account):

a) in the role of small firm dynamism in determining regional development;

b) in the hypothesis that two major innovation paths exist: the first which is typical of large firms, relying on such "formal" processes as R&D investment, patenting and contractual agreements, and the second which is typical of small firms, relying on informal relationships with the external environment and on non-market cooperation agreements (Malerba, 1991; Storper, 1995).

As far as the first proposition is concerned, which associates regional industrial success simply with the presence of small firms, the following reflections may be proposed:

a1) in a country like Italy, small firms are overwhelmingly present in almost all regions (the figures for the country are astonishing: 41% of total industrial employment in 1991 was in firms with less than 20 employees, and 58% in firms with less than 50 employees). In fact, not only do they represent the typical industrial fabric in NEC regions, but also in non-metropolitan North-Western regions (where some industrial districts developed even before the ones of the Third Italy - namely Brianza for furniture, Vigevano for shoes, Mantova for brushes and dolls - and many others developed simultaneously in

the last two decades replacing the old industrial fabric) and in the South (mainly in the form of micro-firms with less than 20 employees). What really matters is not the differential share of these firms in the different regions but their specific characterisation in terms of integration with each other (cooperation capability), integration with local large firms (systemisation capability) and integration with urban services (capability of exploiting urbanisation externalities);

a2) usually, these capabilities are assumed as automatically present wherever small firms are present. Our analysis shows that this is not the case. Even in the case where the maximum intensity of common features are supposedly present, namely the NEC area with its district economies, our empirical evidence suggests that a dichotomy emerges between a dynamic North-Eastern part and the Central Zone:

- development patterns are completely different (virtuous cycle in the first case and restructuring in the second),
- the innovation rate is different,
- innovation patterns are statistically distinct and differentiated.

A structural feature that differentiates the two areas and that might explain, at least partially, the different performances, is the fact that in North-Eastern regions the small firm industrial fabric has evolved over time towards larger average firm sizes, with the emergence of a relatively substantial group of medium-sized firms (50-200 employees); this evolution has moved the overall firm size-structure of these regions closer to that prevailing in (non-metropolitan) North-Western regions like Lombardy (see Fig. 2).

A second differentiating feature among the two macro-areas is the presence, in the former, of a much more solid urban system, with

medium-sized, advanced cities like Bologna, Padova, Verona, Trieste and a network linkage among the lower ranked towns allowing cooperation, specialisation and complementarity (Camagni, 1993).

As far as the second proposition is concerned, namely regarding the presence of two different innovation paths, linked respectively to the specific innovative style of large and small firms - two paths that generally characterise different regions but that sometimes can coexist side by side in the same region - the following can be said:

b1) this theorisation looks sound and in line with common evidence, but, once again, it has to be complemented by some other elements, territorial in nature, which are essential for in-depth interpretation and forecasting. First of all, these paths are by no means linked to the simple presence or absence of large versus small firms: the relative presence of large industrial units in the South did not imply innovation, and, as said already, the two sub-regions characterised by small firms (North-Eastern and Central regions) have shown different innovation capabilities;

b2) cutting across the existence of large or small firms, but underlying a major territorial dichotomy, innovation rates show a clear-cut distinction between a dynamic North and a lagging Center and South. Spatial elements have to be taken into account;

b3) this last element is heavily underlined by the empirical evidence already presented. The marked intra-regional similarity in innovation rates among different firm sizes and the wide variability in inter-regional innovation rates (Figure 7). Spatial elements surrounding local firms, in the form of the presence of producer services, cooperative attitudes and culture, and *milieu* conditions generally, are likely to help them in a generalised way, irrespective of their size; furthermore, and this may be the second conjecture, interaction and systemisation among local firms of different sizes may help in

transferring an innovative attitude from core firms to satellite firms, from leading firms to lagging ones;

b4) these last elements, concerning both local external conditions and large/small firm integration, are also visible in relation to another variable, the intensity of patent activity (Figure 8). In this case also we can see some spatial association or systemisation effects at the territorial level, stemming from the interesting intra-regional homogeneity in innovative activities between the core metropolitan areas and their regional hinterlands[9]; this stands in huge contrast to the wide inter-regional variability of the same indicator;

b5) as far as the profiles of innovative behaviour are concerned, our cluster analysis shows two more successful and two less successful profiles:

- the first profile (cluster 1) encompasses elements that are associated both with large firm behaviour (advanced sectors, formalised innovation procedures, patenting and R&D) and that of small firms (local synergies and customer/supplier cooperation); it is difficult to understand whether these two behavioural patterns just coexist, as industrial economics theorisation suggests, or if they represent an integrated pattern, building upon a strong integration of the overall industrial fabric. From our indirect experience and some evidence collected here, we are more inclined to support this latter interpretation;

- the second profile also is not typical of an industrial district economy archetype: if it is true that production sectors are more traditional than in the previous one and that milieu effects do appear, we see also a significant share of R&D as a proportion of total technological expenditure and the presence of a few but very innovative large firms;

- the third profile is closer to an industrial district archetype, but unfortunately the result is relatively weak innovative behaviour; innovation is mainly incremental, process innovation;

- the fourth innovation profile relates mainly to a dependent economy where process innovation is enforced through the external control of local firms.

Turning to more general considerations, our analysis has confirmed that:

c) regional performance in terms of industrial productivity levels is strongly dependent upon innovation capabilities, much more than upon industrial structure. Table 1 shows some regression analyses in which innovation rates, and in particular product innovation rates, explain around 50% of variability in industrial productivity. Interestingly enough, while the inclusion of cluster 2 as a dummy improves the statistical results, inclusion of cluster 3 (central Italian regions with industrial districts but low innovative capability) yields a highly significant *negative* coefficient[10];

d) in its turn, innovation capability depends upon two, complementary elements (Table 2). Patent intensity (which could be interpreted as a proxy for innovative large firm behaviour) and the existence of a "milieu" effect, as measured by the presence of customer/supplier cooperation in the innovation process. On the other hand, the presence of large or small (innovative) firms per se does not come out as a significant element in the causal chain. The relevance of milieu effects is confirmed, in negative terms, once again by adding cluster 3 as a dummy (regression 6): the existence of traditional industrial district economies does not automatically lead to innovation, but can even represent an obstacle to it[11].

6. Network and Milieu as Vehicles for Innovative Behaviour

The last statement presented in the previous section requires some further reflections, especially on the role of the environment in the innovative process.

As the theory of the milieu innovateur underlines, the local milieu plays an extremely important role in supporting the innovative process: it acts as a generator of innovative behaviour in two respects (Camagni, 1991a):

- as a collective learning mechanism: the local milieu and in particular the local specialised labour market, provide the economic background and the continuity elements within which learning processes and tacit information transfer can embed themselves and accumulate in time, playing the same role as R&D departments and corporate culture do in the case of large firms. Collective learning enhances the local creativity, the capability of product innovation, and of technological creation;

- as dynamic uncertainty reduction mechanism; dynamic uncertainties are intrinsic in technological development and innovative processes, and the milieu with its synergies and imitation processes allows a better assessment of external information, easier forecasts, an easier transcoding of technological information, a faster control over other firms' strategies.

The effectiveness of the local milieu in the innovation process has, however, some limits (Camagni, 1995). Its role is mainly consigned to incremental innovation around an already established technological core. Sometimes, however, especially in periods of economic crisis at the local level, the exchange of local information is no longer sufficient to overcome economic decline. This is even

more true when radical innovative processes are underway, which constantly require sophisticated complementary assets and know-how which are not available locally. These limits push towards a new behavioural model, which does not replace that of the milieu, but is seen to play a complementary role in the evolution of local areas: networking, or more specifically interfirm cooperation through formalised and selected alliances or cooperation agreements on a supra local basis. In this way, local firms can obtain access to important complementary assets, markets and technologies, without incurring constraints imposed by the limits of local (and internal) competence.

In this perspective, then, the statement that the existence of industrial district economies does not automatically lead to innovation can be explained by two elements:

- the fact that these district economies have to turn into dynamic (local) externalities, if they have to support creative and innovative behaviour in the local area;

- moreover, in some extremely turbulent and innovative economic phases, these local dynamic elements need to be complemented by cooperative behaviour mechanisms, such as cooperation agreements with firms outside the area.

Our attempt has been to test this hypothesis with our data. We built two proxies, one for the existence of the milieu relationship, the other for the network, and measured regional behaviours in this respect. For what concerns the milieu, the best proxy available in our database was the use of club information as relevant to innovation processes. As far as the network was concerned, a proxy could be the presence of cooperation with other firms[12].

The results are sketched in Figure 12, for our four regional clusters, and some interesting results emerge supporting the theory previously

mentioned. The technologically oriented innovative cluster, that of the high-technology and large firms cluster, exploits both high milieu and network elements; being a cluster characterised by large firms, the milieu is less important, although significant, than network cooperation. The second innovative cluster, that of the "Innovative Traditional Firms Area", shows the importance of the milieu in its innovative process, but a lower presence of network cooperation. Both variables, however, are more significant in this cluster than in cluster 3; the latter seems to recognise the importance of the milieu, but seems to ignore network elements. Finally, the least dynamic cluster in terms of both innovative and economic performance, the so-called "lagging large firms areas", relies on network linkages (probably reinforced by the presence of large firms) but does not regard the local milieu as an important element in supporting innovative processes.

This picture brings us to the following considerations. As argued by the milieu innovateur theory, the presence of milieu and network elements accompanies the high and more technologically oriented innovation processes. The milieu supplies a highly specialised labour force, and "specific resources"; at the same time, the network allows control over long term complementary assets trajectories and the exchange of complementary know-how. This is even more important in a world where technological development does not take place in single industries, but influences vertically and horizontally related sectors.

Moreover, both clusters containing NEC regions accord the local milieu an important role in the innovative process. However, the more innovative group of such regions, the North-Eastern part, relies much more on network mechanisms than the less dynamic Central area: it does seem that in the context of structural changes brought about by new development models, local areas may in the short run strengthen development through synergy effects and collective learning processes, but in the medium and long run they may even

suffer from previous preconditions of success, when local synergies turn into "exit barriers" and into regressive and defensive behaviours.

7. Conclusions and Further Research Directions

The aim of the paper was to identify the present regional industrial structure and pattern of regional innovative behaviour in Italy, in order to test whether the role of small firms is still as crucial as it was in the past.

The framework presented by the empirical results is in many ways quite remarkable.

1. a first unexpected result is that the regional industrial structure in Italy seems to depart from the traditional tripartite model. This is evident in the presence of a considerable share of SMEs in the North-Western regions, outside large metropolitan areas, and the evolution towards a more balanced industrial structure in North-Eastern regions with the emergence of a considerable share of medium sized firms;

2. the emerging model is divergent from the traditional tripartite model even in the level of competitiveness of Italian regions; in this respect, a clear-cut distinction emerges between the North-West and the North-East on the one hand, and the Centre and South on the other. One result is the divergent competitiveness of old NEC regions;

3. this recent dichotomy between NEC regions is confirmed by the performance indicators. If, on the one hand, all the NEC regions show a good productivity growth, this result is obtained with completely different strategies: in the North-Eastern area, the good performance is associated with good industrial employment growth; in the remaining old NEC regions, namely

the Central ones, the good performance growth is unfortunately associated with severe employment cuts, as a result of a deep rationalisation process;

4. as far as regional innovation patterns are concerned, also in this case the empirical analysis reveals some interesting and unexpected outcomes. The clear-cut distinction between the North on the one side and the Centre and South on the other is once more reflected in the innovation patterns. The North confirms its economic dynamism through high product innovation rates, in both the Western and Eastern regions. The Centre and the South innovate at slower rates and mainly in process innovation, following an incremental innovation model;

5. the multivariate statistical analysis has demonstrated that different innovative profiles exist in the Italian regions; these profiles cluster around four specific macro areas. From this statistical exercise a major interesting result emerges: the importance of *spatial elements* in the innovative process. Spatial aspects and territorial specificities play a major role in shaping the performance of regional industrial systems. Firm size structure is not the most relevant element in this respect;

6. large firms, as well as small firms, may be innovative, or not; their innovation capability is strictly linked to the spatial environment in which they operate. The spatial environment provides in fact some key elements, some district economies, which can support local innovativeness: these include the level of integration among firms (cooperation capability), including firms of different sizes (systemisation capability), and integration with urban services (capacity to exploit urbanisation externalities);

7. the innovation behaviour profile, revealed by a cluster analysis, supports the existence of more complex and diversified patterns than the two abstract ones, typical of respectively large and small firm behaviour;

8. however, the existence of pure district economies does not automatically lead to innovation. This is witnessed by the fact that our cluster 3, a typical local district area, is much less innovative than cluster 1 and 2. Two main explanations are given for this result:

- district economies have to turn into dynamic (local) externalities, if they are to support creative and innovative behaviour in the local area;

- moreover, in some extremely turbulent and innovative economic phases, these local dynamic elements need to be complemented by cooperative behaviour mechanisms, such as cooperation agreements with firms outside the area.

This paper has provided a picture of Italy's regional industrial structure in the 1990s, in terms of performance and innovative behaviour, and some new elements for reflection have emerged. One of these elements is the capacity of small firms to innovate only in certain spatial contexts, where dynamic spatial elements support this process: collective learning is one of these elements and plays a crucial role, by providing innovation assets to small firms. However, where small firms obtain their innovative producing inputs is still an open question from a theoretical point of view. This is the research direction that the authors would like to follow in their future work.

Notes

1. For a literature on "Third Italy" see, among others, Bagnasco and Trigilia, 1984; Becattini 1979 and 1987; Bellandi, 1982; Pyke et al., 1990.

2. For the theory of the 'milieu innovateur' see, among others, Aydalot, 1986; Aydalot and Keeble, 1988; Camagni, 1991 and 1992; Maillat et al., 1992; Quévit, 1992, Quévit et al., 1991; Ratti et al., forthcoming.

3. The isolated metropolitan areas are: Milano, Roma, Venezia, Bologna, Torino, Naples, Cagliari, Palermo, Genova, Bari.

4. Objective 2 regions of the Community are those regions characterised by industrial decline. Toscana is one of the Italian Objective 2 regions, and Prato itself receives Community funds for its industrial crisis.

5. On the use of this data, see also Silvani et al., 1993.

6. Moreover, in the case of Piemonte and Valle d'Aosta, the data provided is an aggregate figure for the whole region, and for this reason this will be treated as a unique macro region. This also holds for Abruzzo-Molise and Calabria-Basilicata, regarded as two macro-regions.

7. The variable "patent intensity" has been calculated as the number of patents for each region between 1986 and 1991 relative to the number of industrial employees. The number of patents has been obtained from the EPO-CESPRI database.

8. Very similar results are obtained if the small firms share is plotted with only the small firms innovation rate. This result is not surprising since it is explained by the very low variance

within the same region of the innovative behaviours of firms belonging to different firm sizes (see Figure 7 before).

9. A further interesting observation in the same context regards the difference in patent activities between core areas and peripheral areas in northern regions: in more advanced regions like Lombardy and Piedmont the difference is not huge, while in new industrial areas, like Veneto and Emilia Romagna, the difference is wider, showing a pioneering role of core metropolitan areas.

10. Industrial productivity growth, on the contrary, seems too complicated a phenomenon to be explained only through simple models. In fact, as already shown, the same productivity performance may be the result of both a virtuous development path and of a severe reduction in employment levels.

11. This thesis was advocated by Camagni and Rabellotti, 1997, considering the possibility of the creation of defensive alliances within the district and its possible regressive role of "exit barrier" with respect to less competitive firms.

12. The specific variable used is the non relevance of obstacles in the innovative process related to cooperation with other firms.

FIGURES AND TABLES

Figure 1. Share of Small Industrial Firms by Regions - 1991 (Employment)

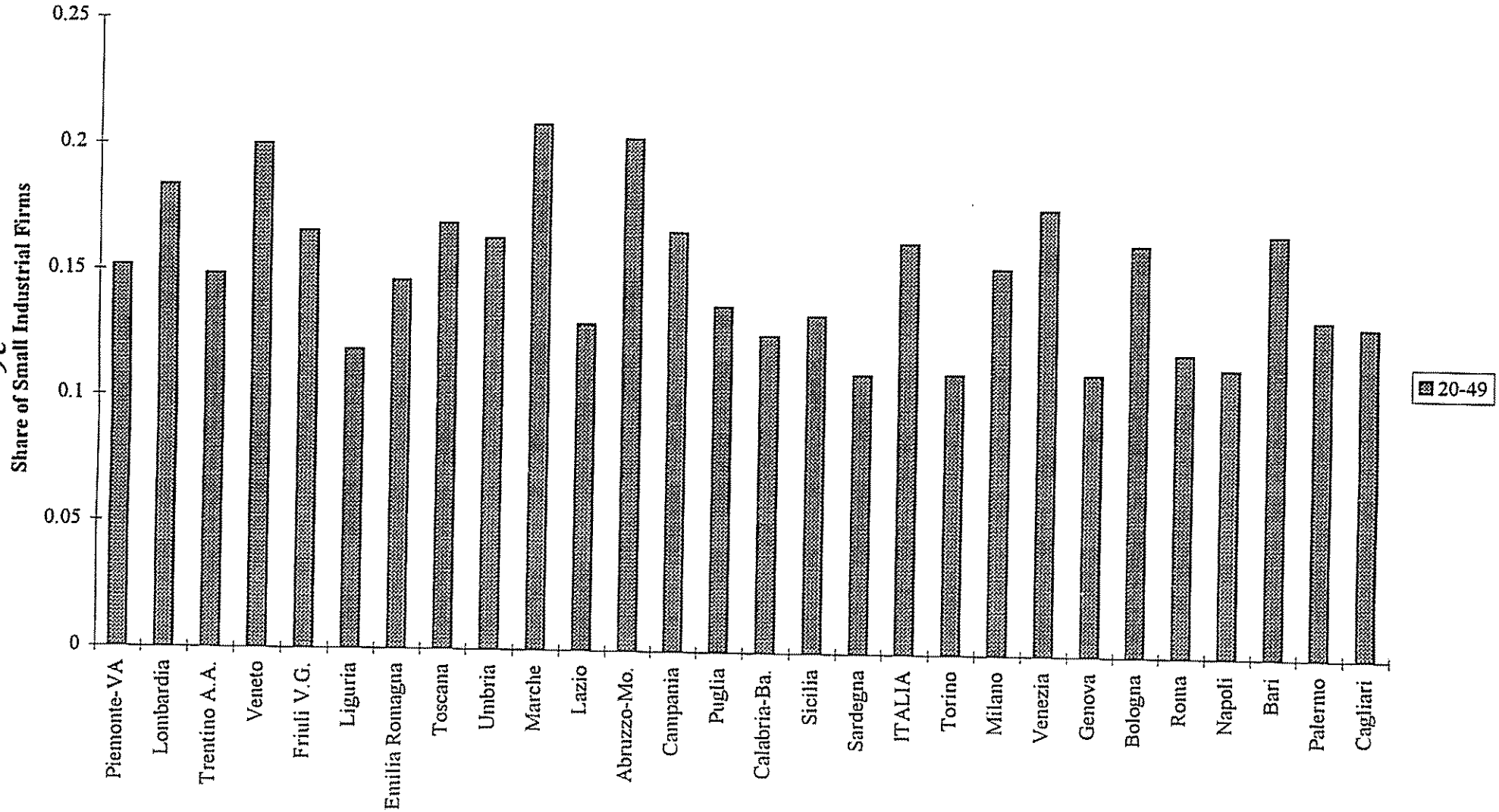

Figure 2. Share of Small, Medium and Large Firms by Regions - 1991 (Employment)

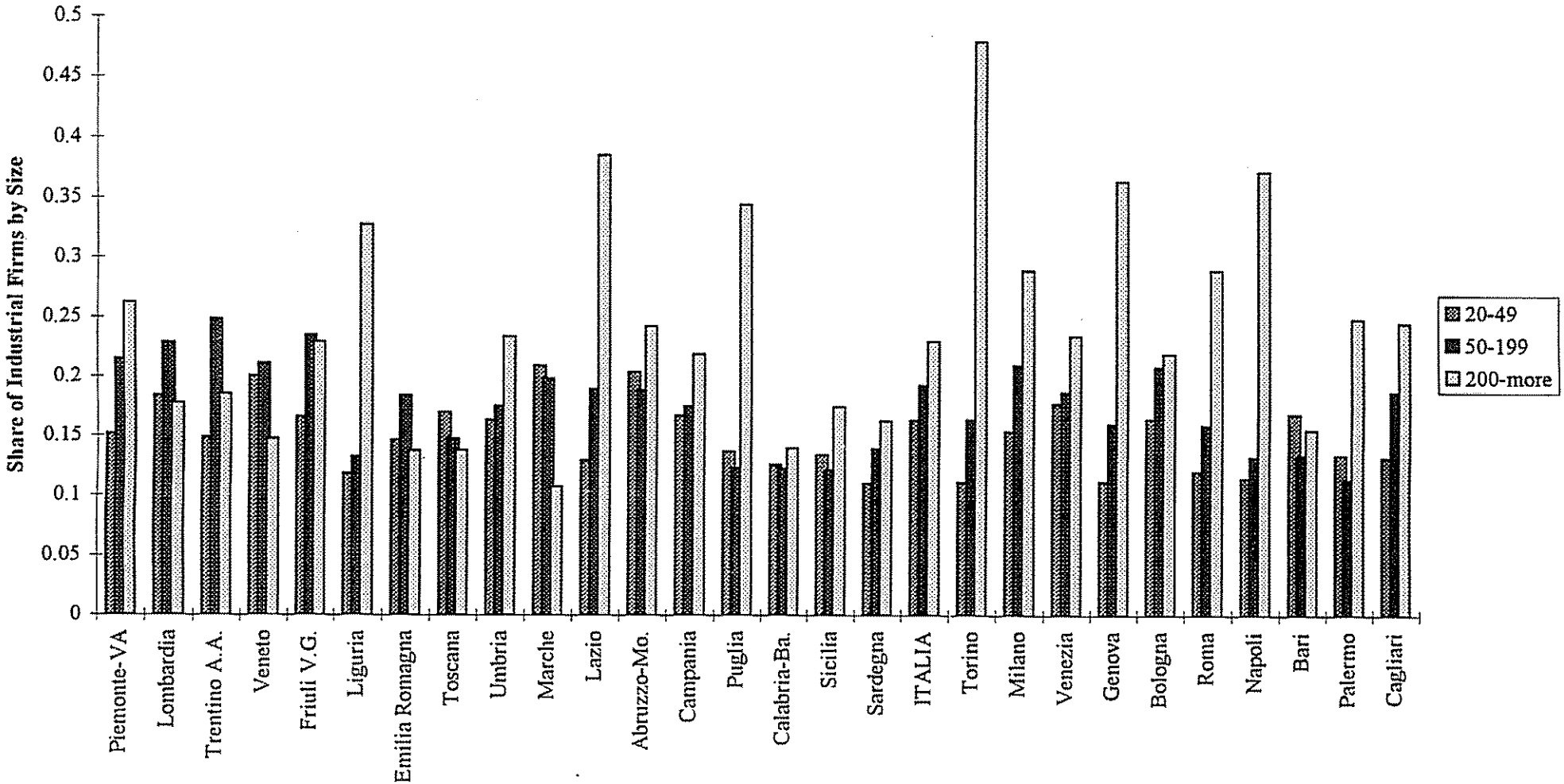

Figure 3. Industrial Productivity - 1986 and 1991

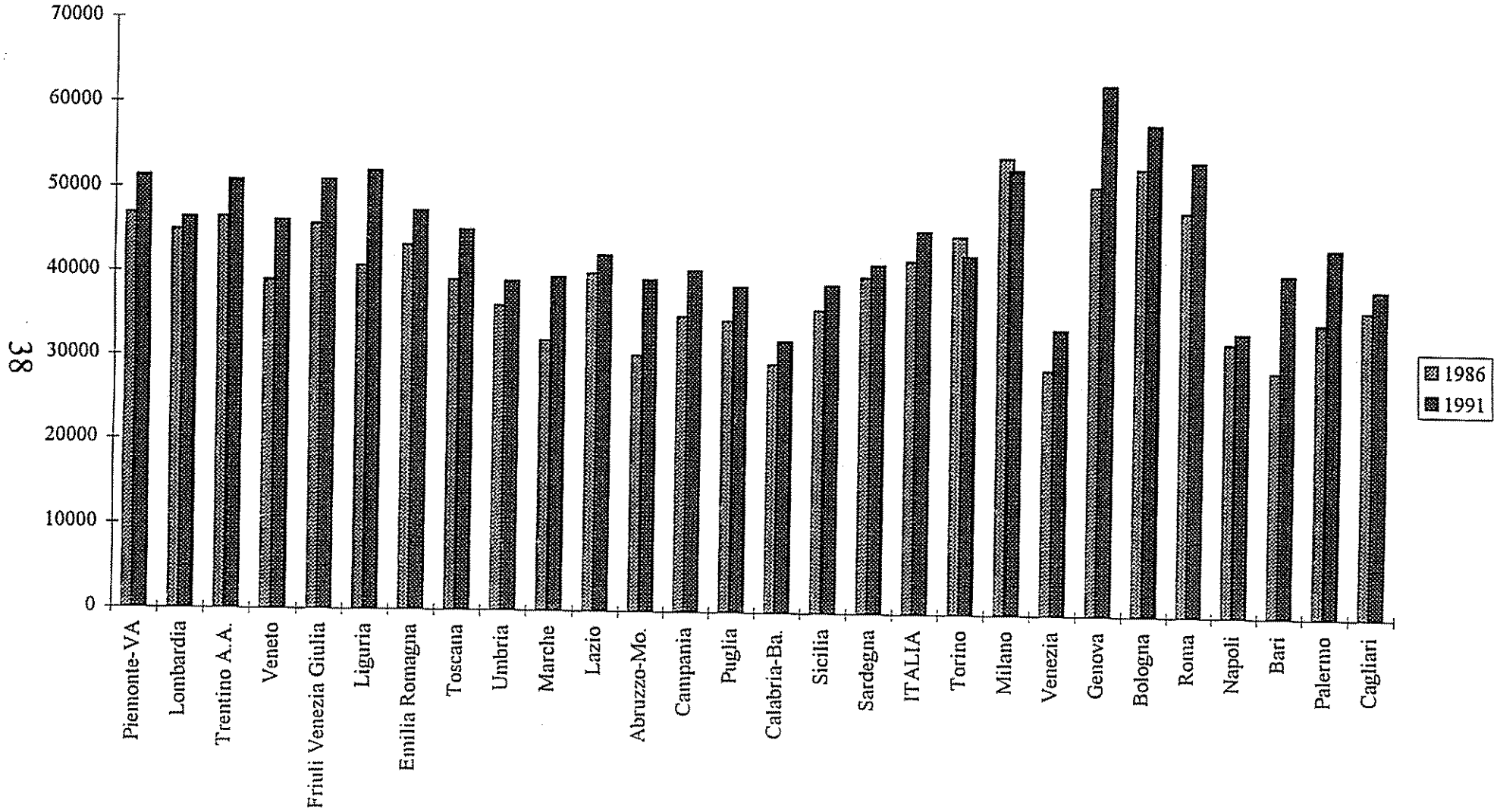

Figure 4. Regional Development Patterns in the Period 1986-1991

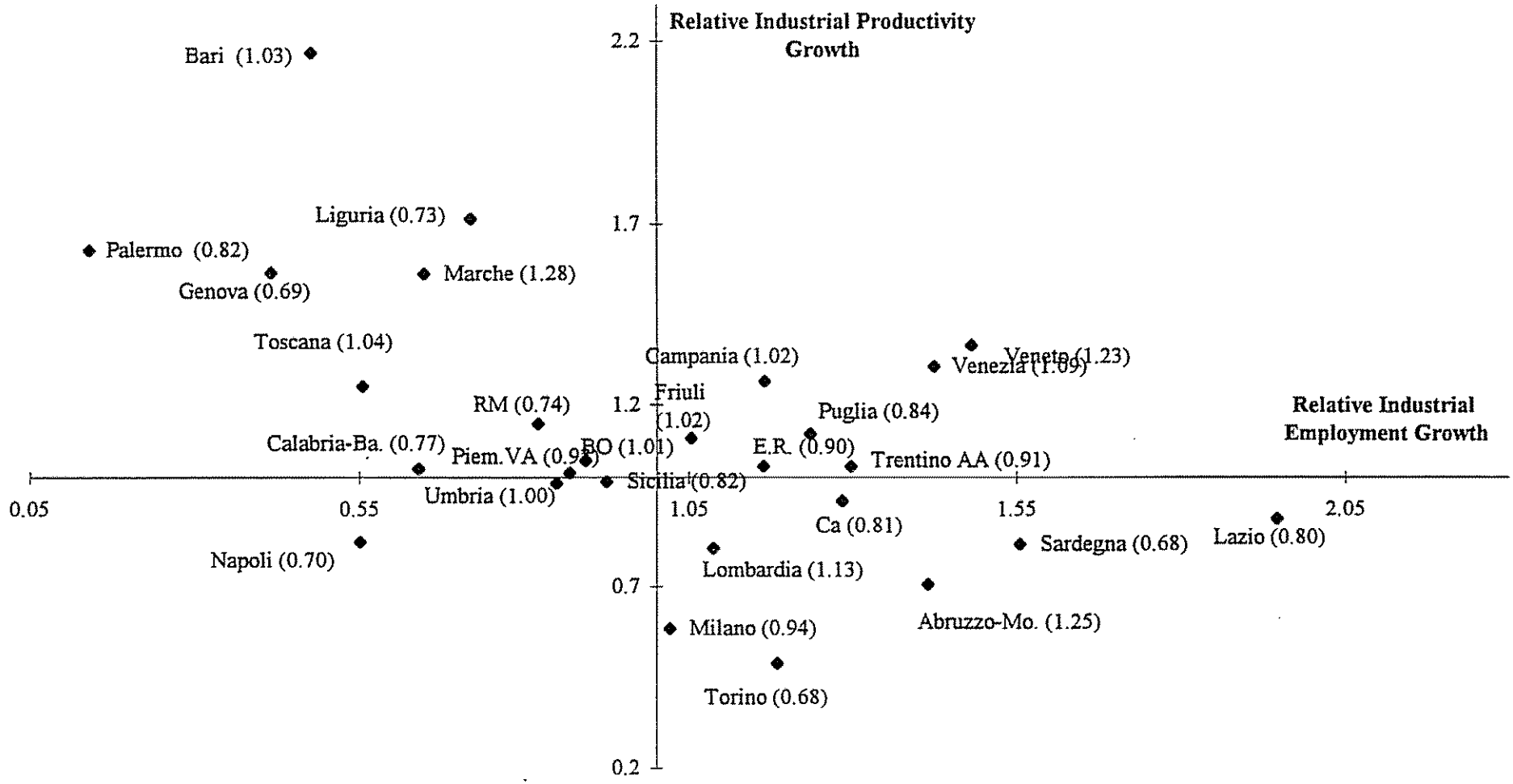

Figure 5. Innovation Rate by Regions - 1992

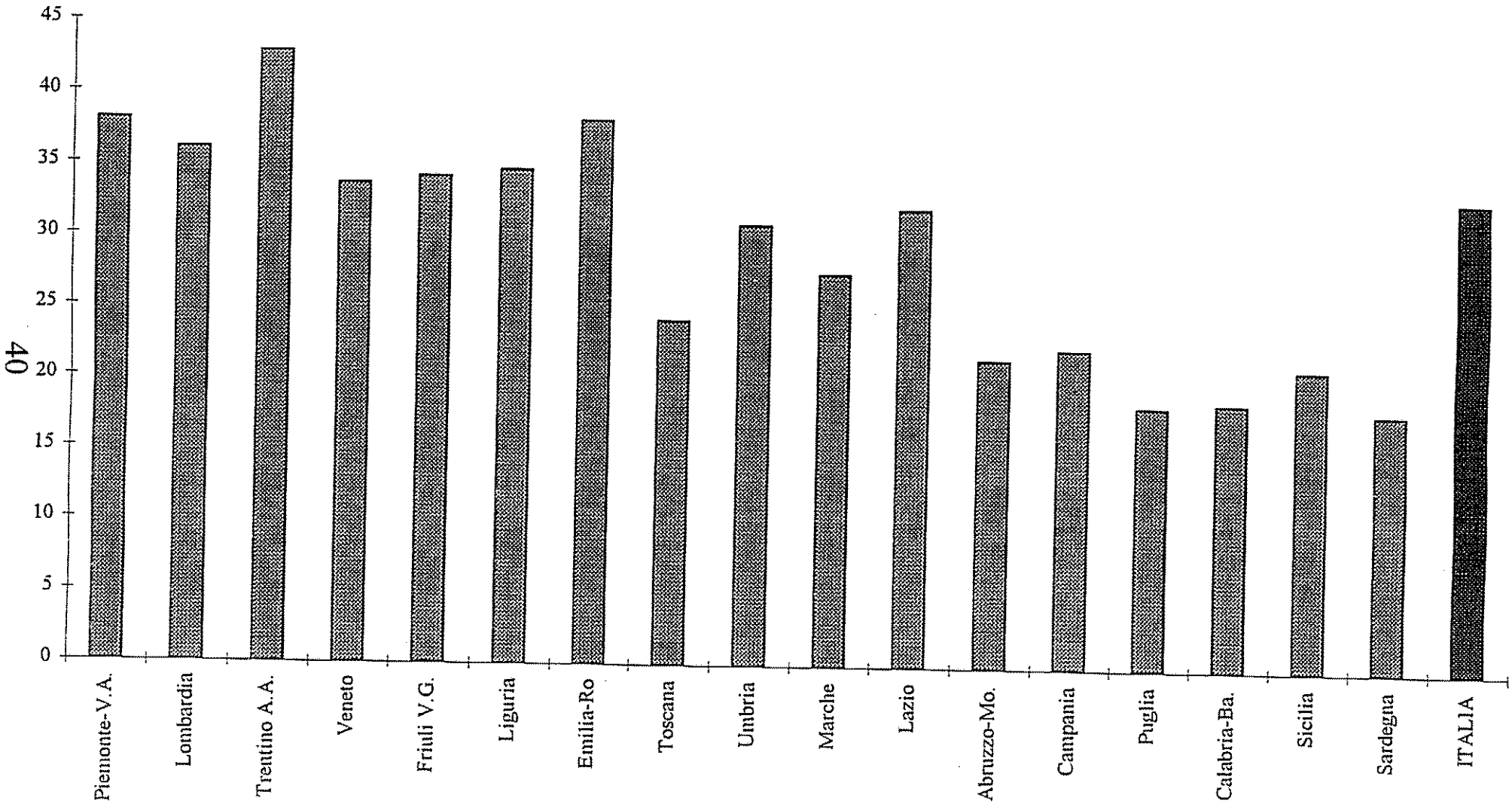

Figure 6. Product and Process Innovation Rate - 1992

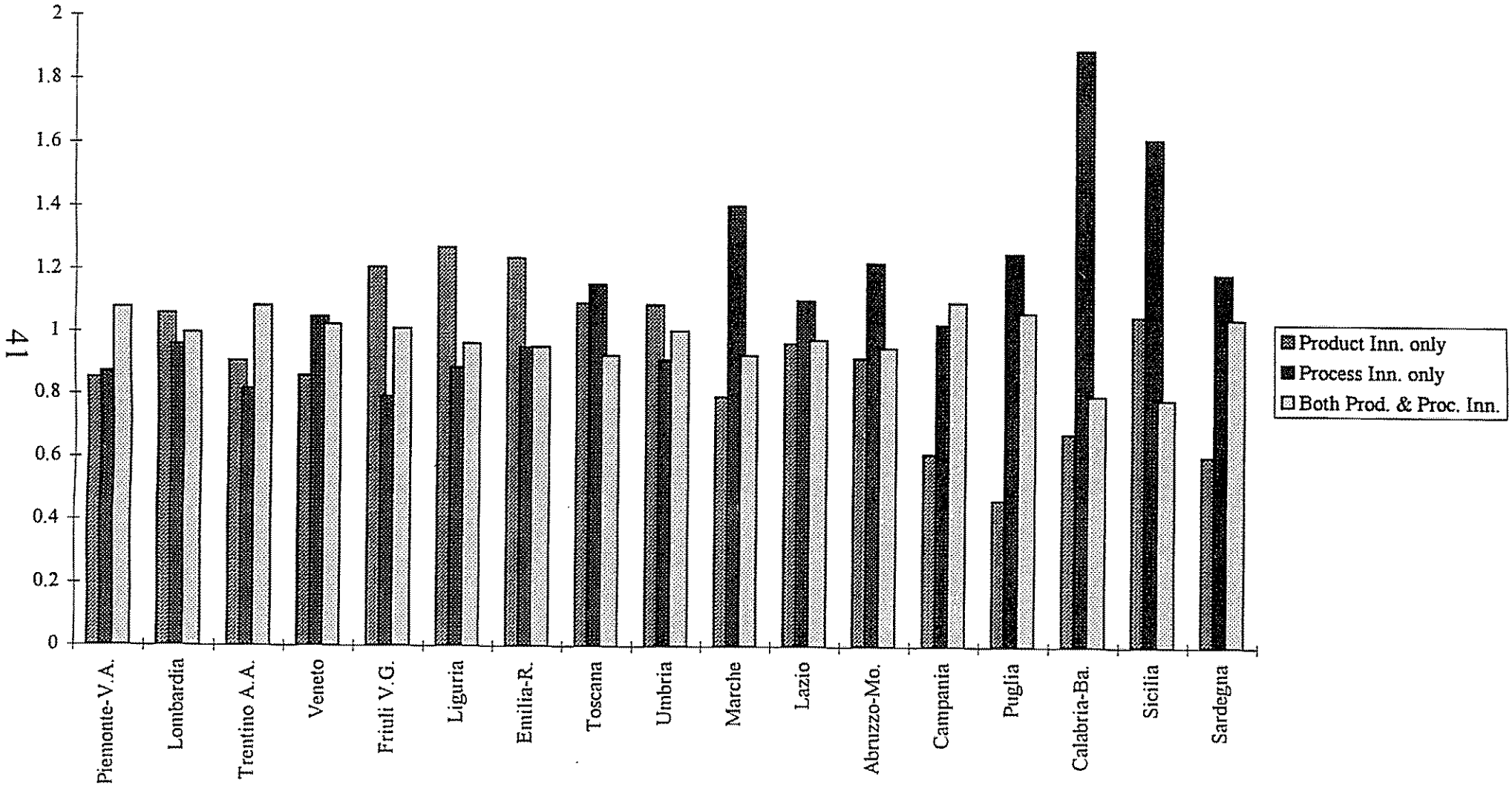

Figure 7. Innovation Rate by Regions and Firms Size - 1992

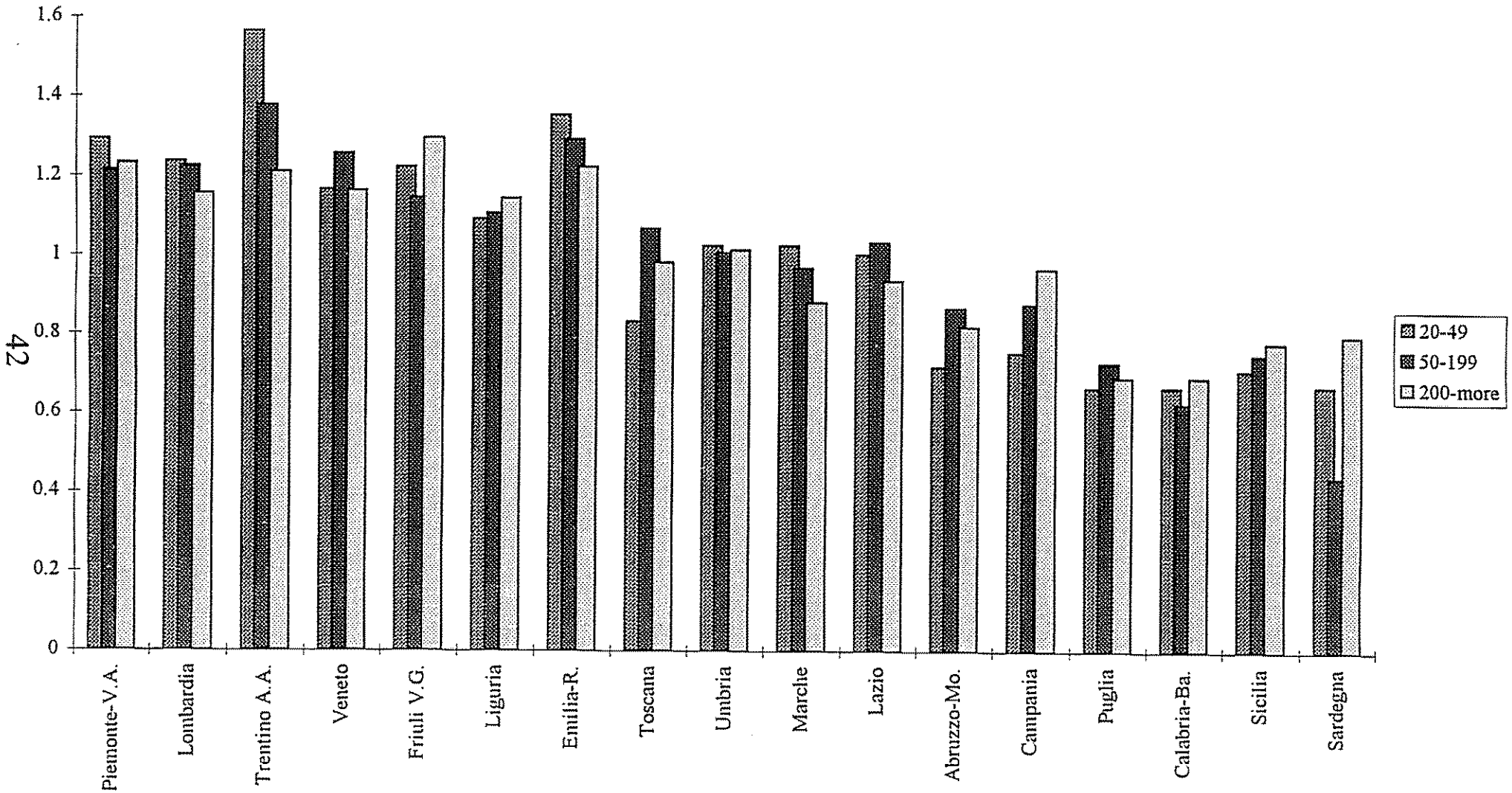

Figure 8. Patent Intensity by Regions - 1991

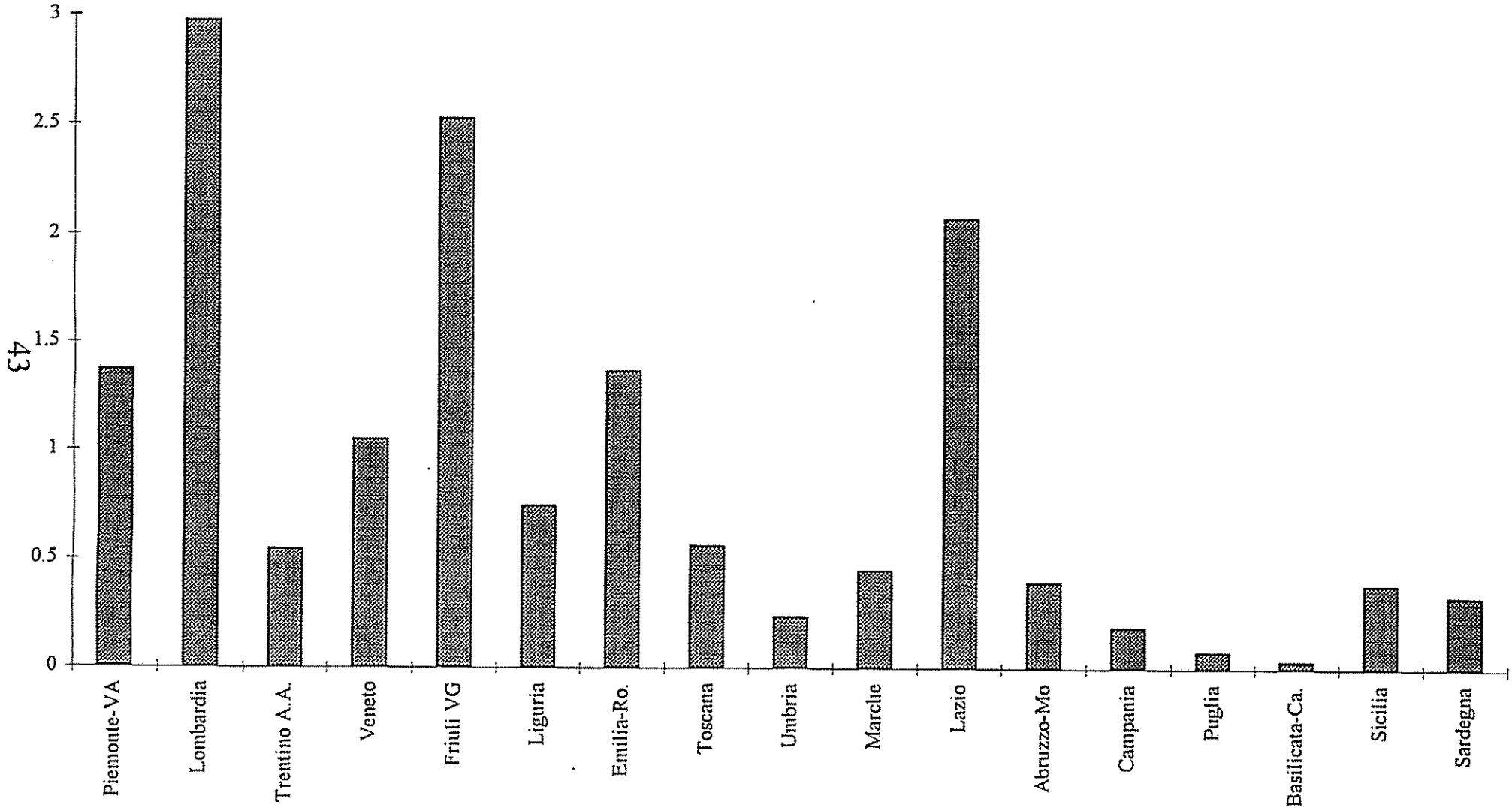

Figure 9. Share of High-tech Firms by Regions

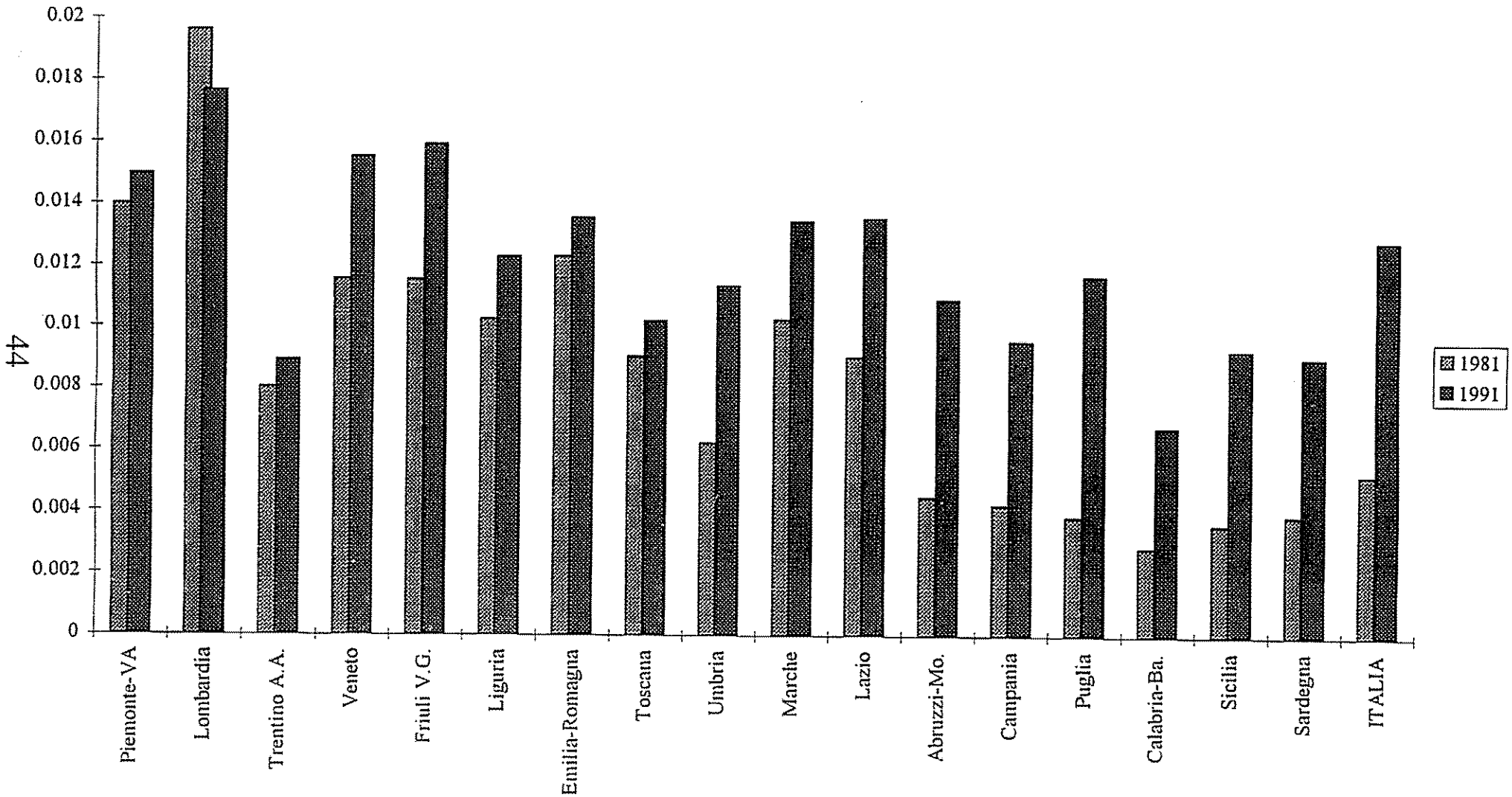

Figure 10
A Taxonomy of Regions by Small Industrial Firms Concentration and Innovation Rate

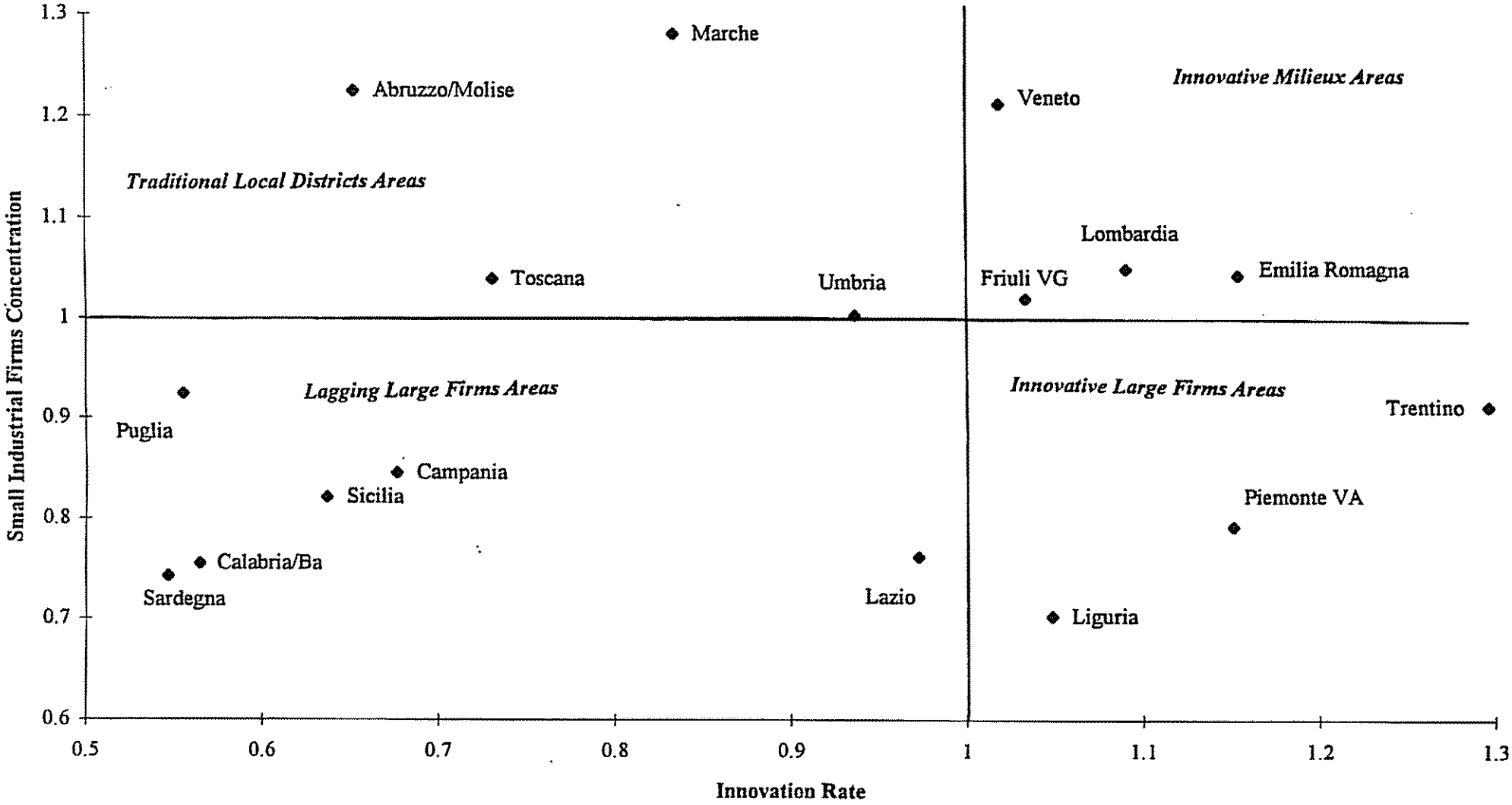

Figure 11 - Profilesof innovative behaviours

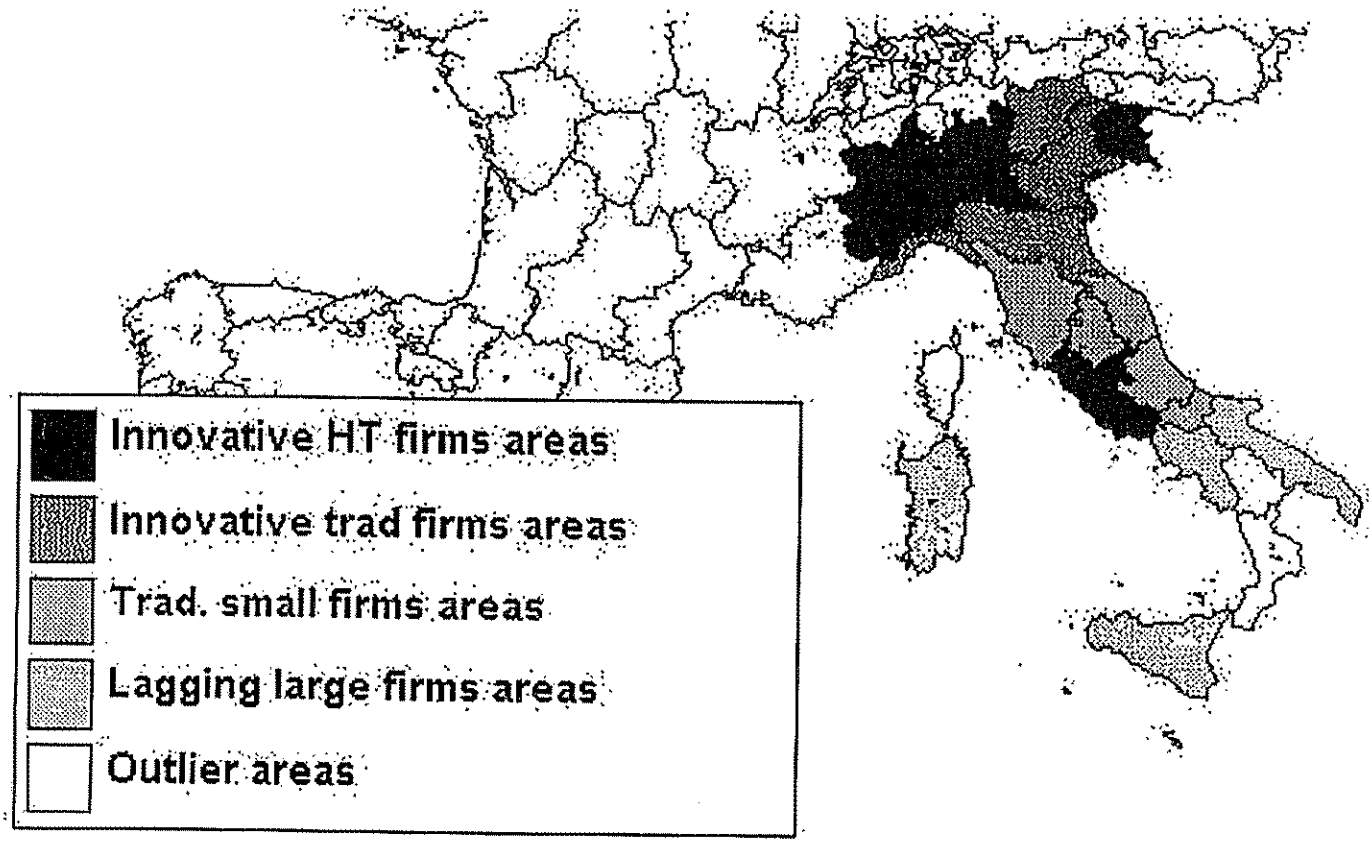

Figure 12. Presence of Milieu and Network Behaviours in the Italian Clusters

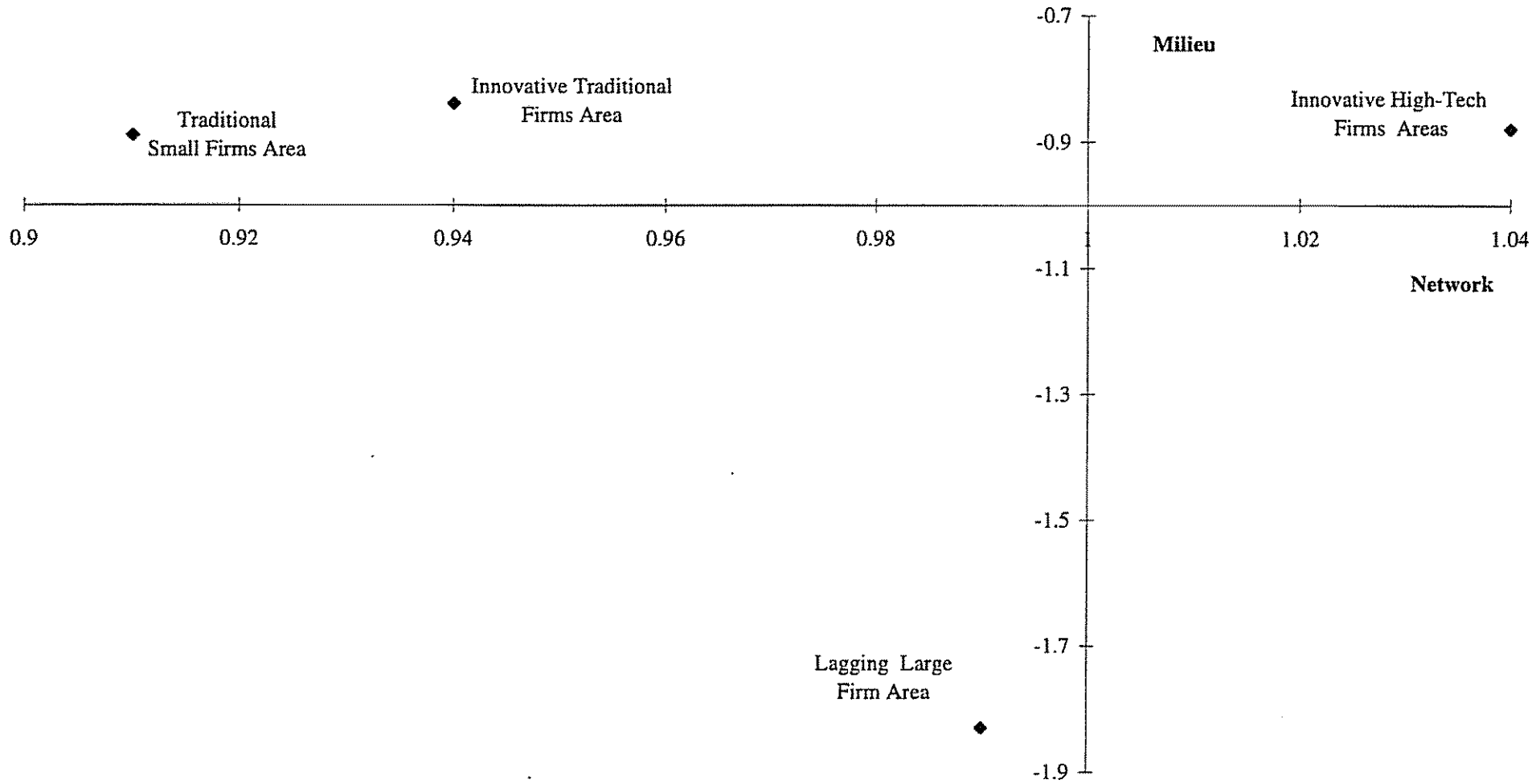

Table 1: Results from Linear Regression Analysis Dependent variable: Industrial Productivity

	1'	2'	3'	4'	5'	6'	7'	8'	9'
Constant	0.89	0.62	0.61	0.64	0.67	0.62	0.69	0.72	0.76
	(2.36)	(6.2)	(7.5)	(6.5)	(7.3)	(7.7)	(5.2)	(11.3)	(7.9)
Patent Intensity	0.09								
	(3.001)								
Product Innovation Rate		0.38		0.34	0.30	0.41	0.32	0.18	0.30
		(3.63)		(3.301)	(3.025)	(4.82)	(2.47)	(2.43)	(3.22)
Innovation Rate			0.41						
			(4.62)						
Cluster 1				0.081				0.16	
				(1.43)				(4.09)	
Cluster 2					0.12			0.19	
					(2.23)			(4.70)	
Cluster 3						-0.13			-0.16
						(-2.97)			(-3.82)
Cluster 4							-0.05		-0.11
							(-0.792)		(-2.17)
R-Square	0.37	0.46	0.58	0.53	0.60	0.67	0.49	0.82	0.76

* T-Student in brackets

Table 2: Results from Linear Regression Analysis Dependent variable: Innovation Rate

	1'	2'	3'	4'	5'	6'	7'
Constant	0.72	1.18	0.98	1.09	1.04	1.28	1.01
	(10.3)	(9.4)	(7.2)	(8.19)	(8.4)	(10.01)	(6.32)
Patent intensity	0.16		0.12				
	(2.88)		(2.35)				
Relevance of the		0.27	0.20	0.23	0.20	0.32	0.06
milieu effect		(2.67)	(2.13)	(2.28)	(2.18)	(3.26)	(0.38)
Cluster 1				0.17			
				(1.44)			
Cluster 2					0.25		
					(2.38)		
Cluster 3						-0.21	
						(-1.86)	
Cluster 4							-0.29
							(-1.52)
R-Square	0.35	0.32	0.51	0.41	0.52	0.45	0.41

* T-Student in brackets

Annex: The Cluster Analysis

In the hierarchical clustering process, a sequence of cluster solutions is obtained with an "ideal" solution appearing for each possible number of clusters from n to 1. A second step of the cluster analysis is often to select an optimal number of clusters. To assist with the determination of the appropriate solution an optimality criterion is usually used. As the number of clusters g declines from n to 1 the cluster solution is evaluated by computing one or more available optimality criteria.

The simplest approach to cluster choice uses the value of the group proximity measure for the two groups joined at each step. As the process moves from step 1 to step (n - 1), the value of the group proximity measure, say s, will increase (for dissimilarity measures).

In our specific case two approaches have been used for the selection of an appropriate value of g. The first measures the group proximity s with an agglomeration coefficient. If a large change in the agglomeration coefficient value occurs at some value of g then the solution (g + 1) immediately prior to this step should be chosen. In our specific case, first large change in the list of the agglomeration coefficient values is when it changes from 1.03 (corresponding to 5 clusters) to 1.16 (corresponding to 6 clusters). Thus the choice of 5 clusters was made. The second and alternative graphical approach used involves plotting the changes in s, as a function of the number of clusters (the so-called dendogram). When a drastic change occurs, the number of cluster associated with that point is indicative of the appropriate end to the clustering process.

The following Table contains the mean values of the different variables in the different clusters.

Clusters	1'	2'	3'	4'	5'
Industrial Productivity	1.07	1.11	0.89	0.86	0.85
Patent intensity	2.23	0.92	0.41	0.24	0.03
High-tech firms concentration	1.21	0.98	0.91	0.77	0.98
Small firms concentration	0.90	0.96	1.14	0.83	0.77
Medium firms concentration	1.05	1.06	0.92	0.73	0.63
Large firms concentration	1.27	0.94	0.78	1.04	0.60
Large innovative firms	1.15	1.18	0.92	0.80	0.69
R&D expenditure	1.13	0.96	0.65	0.54	0.56
Innovative firms concentration	1.06	1.12	0.78	0.60	0.56
Ratio of small innov. firms on medium and large fims	1.05	1.11	0.99	0.89	0.66
Process innovation	0.93	0.92	1.17	1.27	0.68
Product innovation	1.02	1.06	0.97	0.68	0.67
Non relevance of:					
- private information	0.86	0.75	1.28	1.83	0.59
- club information	0.88	0.84	0.89	1.83	1.18
- public information	1.02	0.75	1.05	1.51	0.69
- economic obstacles	1.14	0.76	0.97	0.99	0.62
- environmental obstacles	1.04	0.94	0.91	0.99	0.80
- information obstacles	1.03	0.86	1.01	1.22	1.15
- organisational obstacles	1.06	0.81	0.96	1.28	1.14

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