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Common Frameworks for Regional Competitiveness: Insights from a Number of Local Knowledge Economies

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Abstract: In a reference framework towards the knowledge economy concept and in relation to the notion of Regional Innovation System (RIS), the paper analyses a set of European regions that in the last two decades experienced a process of economic and industrial renewal, with a two-fold aim. Focusing on the time dynamics of the territories' renewal, we first classify the different *regional development paths* followed by the very regions under investigation in their process towards a knowledge economy. Secondly, we compare the above territories with a sample of Italian regions (those with the highest employment level in manufacturing activities and the largest income per-capita). Even though the European benchmarking regions are specialized in high-tech sectors, they had an industrial past based on heavy and traditional industries. In this respect, the two groups are not so different in nature, and their comparison reveals some interesting local policy implications and strategic insights for the regional transformation process.

1 Introduction

The most competitive modern economies are often referred to as 'knowledge economies' meaning economies which are directly based on production, distribution and use of knowledge and information (OECD, 1996). The basic thesis behind the emergence of the knowledge economy concept is that firms' competitive advantage and economic growth in general, both at national and at local level, are more and more determined by knowledge creation and technical progress (Abramowitz and David, 1994; Foray and Lundvall, 1995; Smith, 2002). Knowledge, viewed as human and

technical capital, has always been central to economic development, but only over the last few years has its importance been recognized and accounted for in the literature. The emergence of this new concept to conceive the economy has been favoured, particularly in the 1990-2000 decade, by the rapid technical progress in the areas of computing, biotechnology, telecommunication and transportation, leading to a notable change in the way in which economies, organizations and governments work. Furthermore, the rapid growth in high-tech and high-skill services and the new by-products and by-services have induced an in-depth change in the lifestyle and the nature of workplaces, signing the transition from the industrial to the post-industrial era. In this framework, knowledge accumulation and technological progress, together with the liberalization of international markets and globalization, have both created new opportunities for firms and increased competition, pushing firms to redesign their organizational structure in order to seize new opportunities for change and to maintain a competitive advantage.

The region, defined as a homogeneous administrative, cultural, social and political unit, is a unique economic system and represents a community of shared interests and rules. Regions, as the centre of value added activities, institutions and organizations, benefit from synergies and interdependencies among territorial actors and need to maintain a high level of competition and attention to local processes of change in order to support firms in their renewal processes. In the present economic context, in fact, firms' competitiveness relies more and more on the competitiveness of the territorial systems they belong to. The strategic effort of territorial actors must then be aimed at creating a favourable business environment, sustaining "a 'virtuous circle' where knowledge attracts knowledge, knowledge workers attract knowledge workers and knowledge-based firms attract other knowledge-based firms" (Normann, 2002). In this context, the most active regions take the responsibility to coordinate the local development process based on other examples of support of regional competitiveness.

In a reference framework towards the knowledge economy concept and in relation to the notion of Regional Innovation System (RIS) (Cooke et al., 1997; Braczyk et al., 1998), this research work takes the moves from the analysis of a set of European regions that experienced in the last two decades a process of economic and industrial renewal, leading to a significant increase in their competitiveness. The regional

investigation was pointed at identifying the key competitiveness factors driving the recovery. In such a framework, the aim of the paper is two-fold. First, focusing on the time dynamics of the territories' renewal, we classify the different *regional development paths* followed by the very regions under investigation in their process towards a knowledge economy. All regional 'success stories' are strongly dependent on the presence of a tri-polar regional innovation system 'gluing' firms, institutions and academia. As such, the regional innovation system seems to act as 'catalyst' for the territorial transformation, easing the competitive repositioning of the regions involved. Secondly, we compare the above territories with a sample of Italian provinces, characterized by the highest employment level in manufacturing activities and the largest income per-capita. Even though the European benchmarking regions are specialized in high-tech sectors, they had an industrial past based on heavy and traditional industries. In this respect, the two groups are not so different in nature, and their comparison might reveal some interesting local policy implications and strategic insights for the regional transformation process. In other words, the 'lessons' emerging from the experience of the European innovative regions may support the local decision making process and increase regional attractiveness and local entrepreneurship in the economic transformation process.

The paper is organized as follows. Section 2 reviews the main concepts of regional science the paper refers to. Section 3 analyses the development process of the European knowledge-based economies considered as virtuous models of competitiveness, trying to capture the key elements that fuelled their economic renewal. Based on the regional cases above, Section 4 provides a tentative classification of regional transformation paths. Section 5 describes the economic structure and performance of the sample of Italian provinces under inquiry and highlights their competitive advantages and structural limits relative to the European benchmarks. Section 6 concludes.

2 Literature review

The idea that regions may act as key players in the economic growth process is embedded in the increasing attention that the economic literature has devoted in the last decade to regional dynamics. The challenge of competing in a global, knowledge based economy stresses the need to understand how different regional economies, with their

own specificities and features, influence the innovation process. In this respect, the analysis presented in this paper is focused on the Regional Innovation System literature (Cooke et al., 1997; Cooke and Morgan, 1998; Braczyk et al., 1998, Asheim, 2003) which, by now supported by the analysis of many case studies, gives relevance and emphasis to the institutional foundations of regions' competitive advantage, for example in the areas of education, research and development and financial services. Innovation is seen as a collective and interactive process emerging from the intensity of inter-firm networking, but, more importantly, supported by the pro-active role of local institutions. An important empirical contribution to the RIS literature is represented by the REGIS project coordinated by Professor Cooke, financed in 1998 by the European Commission within the Targeted Socio-Economic Research Programme with the aim to identify, through a statistical survey, the presence of a regional innovation system in eleven European regions (Cooke et al., 1998). The study recognized a number of innovation systems both at regional and at local level.

The concept of Regional Innovation Systems integrates two different aspects: the systemic character of innovations and the regional dimension of innovation processes. The first aspect – the systemic and interrelated nature of innovation – is rooted in the National Innovation System literature (Freeman, 1987, 1991; Lundvall, 1992; Nelson, 1993). In particular, Freeman (1987) defines a National Innovation System as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". In other words, the system approach stems from the specific character of innovation being the result of social interaction between different actors in producing, diffusing and applying new and economically useful knowledge (Lundvall, 1992). The active role of territorial actors within regional development dynamics was recognized in the economic literature more than a century ago. In fact, from Marshall (1890, 1919) on and until the end of the Nineties, the model of local development has always been bi-polar, built upon two fundamental components of change, firms and local institutions. More recently, Etzkowitz e Leydesdorff (1997, 2000) have highlighted the active presence of an additional variable, the (technical and scientific) university, and have developed the so called Triple Helix model. The conceptual model tries to account for the existence of a new configuration of institutional forces (university, firms, local institutions) within the

innovation system. Configuration in which the university, defined as an institution aimed at the production and diffusion of knowledge, represents a key element for the innovativeness of the local system, being able to play "an enhanced role in innovation in increasingly knowledge-based societies" (Etzkowitz and Leydesdorff, 2000). In this sense, universities are referred to as 'entrepreneurial universities', involved in a 'spiral' of relations with the other two institutional spheres along the paths of industrial innovation and policy-making.

The second aspect of the Regional Innovation System concept – the regional character of innovation processes – is based on the assumption that the regional level of economic coordination is crucial for the achievement of competitive advantages in a global competition framework. At the end of the past decade, researchers belonging to what is referred to as the New Regional Science recognized the salience to cooperate locally in order to compete globally (Sabel, 1989, 1995; Cooke, 1992; Storper and Scott, 1995; Scott, 1996; Lundvall and Borras, 1997; Tödling and Sedlacek, 1997; Boekholt and van der Weele, 1998). It seems that "the essential of systemic interaction, tacit knowledge exchange, the building of 'untraded interdependencies' (Dosi, 1988), the forging of trustful relations and development of innovative networks are better understood at the sub-national or regional level" (Cooke et al., 1998).

Within the models of local development based on RIS and in a research work accompanied by a number of case studies on Scandinavian industrial clusters, Asheim (2003) has recently highlighted the existence of a (logical and time) relationship between the regional innovation system and the clusters which they insist on. The main idea behind this relationship is that firms' innovation processes are strongly shaped by their specific knowledge base and that it is possible to distinguish between two types of knowledge base: synthetic (engineering-based) and analytical (science-based). Synthetic knowledge is typical of engineering-based sectors such as plant engineering, specialised advanced machinery and shipbuilding, where innovations take place through the adoption, application and adaptation of existing knowledge or through new combinations of existing knowledge. According to Asheim, in these sectors applied research is more important than R&D, occurring often in response to the need of solving specific problems arising from the interaction with customers and suppliers; tacit knowledge is more important than codified knowledge, especially because in these

sectors knowledge often results from experience gained on the job trough learning by doing, using and interacting and essentially stems from inductive processes of testing, experimenting, computer-based simulation or through practical work; finally, in engineering-based industries innovation is typically incremental, often oriented towards the achievement of certain efficiency and reliability standards of new solutions, or towards the user-friendliness of products for customers. By contrast, analytical knowledge is typical of science-based sectors such as genetics, biotechnology and information technology, which are characterised by intense basic research, codified knowledge, systematic development of new products and processes and by strong university-industry linkages. In this context, innovations are typically radical in nature and spin-offs activities are more frequent than in the former case.

Asheim (2003) shows that the above classification of knowledge has implications for the relationship between firm clustering and the local Regional Innovation System (RIS). In engineering-based industries the relationship between the cluster and the local RIS (firms, institutions and universities) typically develops at a later stage of a cluster's life cycle so that the RIS often originates in response to the existence of 'pure' industrial clusters. In this respect, the logic behind building a RIS is to support localised learning and innovation and strengthen existing local specialisations, i.e. to promote technological trajectories of the region's historical cluster, developed thanks to a local 'sticky' knowledge base. By contrast, in science-based industries the presence of the RIS is a often a necessary input in the development of the cluster, and therefore the RIS may be viewed as providing the conditions for the very emergence of industrial clustering, which develops thereafter benefiting from the interaction and cooperation with local institutions and universities.

3 Regional Innovation Systems in Europe

With the aim of recognizing the drivers of structural change and shaping the possible trajectories of regional development, we analysed and compared a set of six European regions that in the recent past were able to restructure their economic base through a process of industrial and institutional renewal: Baden – Württemberg and North Rhine – Westphalia (Germany), Göteborg (Sweden), Tampere (Finland), Nord Brabant (Netherlands), Wales (UK). The first criterion considered in their selection was

the existence of an industrial past based on heavy and traditional industries. In Wales and North Rhine – Westphalia the industrialization process started in the nineteen century in coal and steel mining; in Tampere and Baden – Württemberg the first industrial development was in the textile sector, including machinery and equipment for the textile sector; finally, in Göteborg and Tampere the main industrial forces were represented by wood and paper products. Secondly, the selected regions, though dynamic and competitive during the industrial era, experienced within the last two decades a period of recession, or at least of economic slowdown, or a financial crisis. This situation gave them the opportunity to foster a structural change in the economy, leading among other things to a decrease of employment in traditional manufacturing sectors. In Wales, Baden – Württemberg and North Rhine – Westphalia this course of development started in the second post-war period, in Tampere and Göteborg in the 1970s, but, in any case, in all regions under scrutiny these aspects have intensified during the 1990s. Hence, if on one hand these regions faced a period of crisis, on the other hand they have by now shown clear signs of renewal. In this regard, their GDP per-capita and unemployment rate highlight the effects of the process of structural change occurred and the high level of competitiveness achieved. In particular, these regions exhibit a higher value of GDP per-capita[1] and a lower (or at least equal) unemployment rate[2] than the average of both the European Union and their own country (Table 1).

To ascertain the economic performance of the group of European regions, we identified a set of indicators highlighting the regional competitiveness level in attracting foreign direct investments (FDIs), developing high tech sectors and promoting research and development, innovation and education. The results of this analysis are detailed below.

As regards Baden-Württemberg, the rapid process of economic growth in the manufacturing industry, particularly in automotive, mechanical and electrical engineering sectors, started out during the 1950s and reached an absolute peak in 1970,

[1] With the exception of the Göteborg region, showing a lower figure than the Swedish average due to the high value attached to Stockholm.

[2] With the notable exception of Finland, still suffering from the crisis of the early 1990s, when the unemployment rate peaked 20 % at national level and 21% in the Pirkanmaa region (Braczyk et al., 1998).

when the share of employment in the secondary sector accounted for 56% of total labour force (Braczyk et al., 1998). Due to the consolidation in the above mentioned sectors, local productivity doubled between 1980 and 1993, reaching a value of 45,000 DM. In the same period the amount of inward FDIs tripled to 32 billion DM, while outward FDIs quintupled to nearly 45 billion DM (Cooke et al., 1998). Today, also thanks to the ability of the region to attract FDIs, Baden-Württemberg is the EU region with the highest share of employees in high tech manufacturing (Table 2) and one of the leading EU regions in R&D investments (Table 3).

Also the Göteborg area, in the region of Västverige, is characterized by a high level of innovativeness, measured both in terms of input indicators, such as R&D investments, and output indicators, as patents applications. The main sources of R&D investment in the region are large industrial firms specialised in sectors such as information technology, telecommunications, medical technology, automotive and industrial electronics. Table 3 highlights that Västverige is the first EU region in terms of R&D expenditure as a percentage of GDP in the business enterprise sector, with a share of 5.27%. In this respect, it is interesting to notice that half of the total Scandinavian industrial capacity is located within a radius of 300 km from Göteborg (Lindholm-Dahlstrand, 1998 and 1999) and that giant corporations such as Volvo and Ericsson are headquartered in Göteborg. With respect to the second indicator, Västverige in 1998 exhibits 525 patent applications, equal to 299 patents per million inhabitants, ranking well beyond the EU average and second in Sweden after the Stockholm area (Table 1).

Tampere, located in the region of Pirkanmaa, is another example of highly innovative system, as measured in terms of patent applications. In 2001 Pirkanmaa accounts for more than 7% of national value added and for 15% of R&D expenditure, while Tampere accounts for more than 5% of national value added and for 14.5% of R&D expenditure (Statistics Finland, Regional Account). Looking at data on productivity, the continuous growth of the region during 1990s is evident. Between 1995 and 2001, Tampere, the second largest town after Helsinki, has developed more than any other region of the country: from a value added per-capita of 16,136 € in 1995 to 23,181 € in 2001. The main boost to the development process of the region is due to

the ICT sector which, mainly thanks to Nokia, has registered growth in employment at a rate of 20% per year.

Also the region of North Rhine – Westphalia shows a good level of innovativeness, both in terms of input and output indicators. After the decline in traditional sectors such as mining, steel and durable goods, and the shift towards industries such as chemicals (e.g. Bayer), plastic, mechanical and electrical engineering, electronics and food, today North Rhine – Westphalia is the most industrialised German region. As highlighted in Table 1, Table 2 and Table 3, North Rhine – Westphalia is one of the leading EU regions as far as employment in high tech manufacturing (especially in the area of Freiburg), it is one of the top ten EU regions in terms of R&D expenditure as a percentage on GDP (especially in the area of Koln) and it accounts for a high share of patent applications with respect to the EU average.

Nord Brabant in Netherlands, specialized in automotive and electronics also thanks to the presence of large multinational enterprises (such as Philips and Daf), is another interesting case of innovation system to be analysed. As data in Table 1 show, the region is characterized by a strong performance in terms of productivity and richness per-capita, employment and innovation, both with respect to the European Union average and to the other regions under investigation. This is due to the industrial system, characterised by large high tech firms which heavily invest in R&D (Boekholt, 1996). Besides the automotive and the electronic clusters, the region hosts other industrial clusters, which have had a role in the local transformation process. These include agro food, logistics, transportation and environmental technologies (Cooke et al., 1998).

Wales was taken into consideration as the foremost destination of overseas investments among the British regions. As underlined by Hill and Munday (1992), there was a shift in the inflow of foreign investments from the South East of England to the most peripheral UK regions. This is partly due to the lower costs of production and the financial incentives granted by these areas. Between 1980 and 1993 the stock of FDIs increased from 36 to 220 million €; at the same time, inward investment projects contributed to a 37% increase in GDP. At the beginning, FDIs were essentially made up by industrial settlements of large high tech firms requiring low-skill low-wage labour in manufacturing as R&D activities were carried out by the headquarters. Later, most

multinational companies invested in R&D in the region, increasing R&D investments as a share of GDP (from 1.1% and 1.4% between 1980 and 1993) (Cooke et al., 1998).

As mentioned, the European regions analysed above share a long industrial tradition followed by a period of structural decline and a renewal process towards knowledge-based sectors. A vast body of literature emphasizes these aspects. The REGIS project, financed by the European Commission (Cooke et al., 1998) with the aim of promoting regional innovation strategies through EU Structural Funds, analysed the main features of some of these regions (Baden-Württemberg, Tampere, Wales and Brabant). The North Rhine – Westphalia case was studied in many research works mainly as to the evolution of iron and steel clusters in the Ruhr area (Schlieper, 1986; Radkau, 1989; Weber, 1990). Furthermore, the ICT clusters developed in the regions of Tampere and Göteborg were the object of a number of empirical analyses (see, among others, Saemundsson et al., 1997; Lindholm-Dahlstrand, 1998, 1999; Rikne e Jacobsson, 1999). The above research works highlighted that the renewal process occurred in the regions analyzed took place systemically, as a result of strong interactions among territorial actors, these interactions representing the main source of production, spread and application of new ideas and knowledge.

4 Italian traditional manufacturing regions

Next, with the aim of drawing some insights regarding regional attractiveness in the knowledge economy context, we compare the development route followed by the above European regions with that of a sample of Italian regions. More specifically, in what follows we describe the economic structure and performance of a sample of Italian regions relative to the European benchmarks in order to highlight both their competitive advantages and structural and organizational limits and to learn some important lessons from the experience of the innovative European areas concerning regional processes of change. Clearly, the comparison with a group of European success territories, considered as virtuous models of economic renewal, is of interest not only to the Italian selected regions but to any region in the global context of knowledge-based economies.

The sample selection of the Italian regions is based on criteria regarding the productivity level and the employment level in manufacturing activities. Using a methodology analogous to the one adopted by Eurostat (2001) in the classification of

the European regions corresponding to the NUTS2 level (which classifies regions on the basis of GDP per-capita and the employment share in the secondary sector), fifteen Italian regions were selected as exhibiting in 2001 a GDP per-capita greater than 20,000 € and a share of employment in manufacturing sectors above 40%. The resulting sample (shown in Table 4) comprises regions which are located in Northern Italy, in the same areas classified as highly industrialised by Eurostat (2001). The same sample (with the exception of Belluno) is included in the group of the Italian 'industrial regions' according to IRS (2003). Based on 2002 Istat[3] data, these regions account for about a quarter of total Italian employment and industrial value added (24.5% and 23.3%, respectively) and for 29.2% of national exports and 17.2% of total imports (Table 7). Furthermore, based on Census data, over the 1991-2001 period they exhibited an average 0.8% increase in the share of employment in manufacturing sectors compared to an average 9.6% decrease in the rest of Italy. The contribution of these regions to the Italian economy in terms of productivity, industrial employment and international trade validates the interest towards the selected sample of regions.

The high industrial specialization of the areas under scrutiny emerges also from the analysis of a number of structural economic indicators (Table 5). The fifteen regions show a higher industrial density than the national average (5.8 manufacturing enterprises per km^2 compared with a national average of 2.2), which is reflected even in terms of electric power consumptions per-capita in the secondary sector (on average 4,880 kWh per inhabitant against a national average of 2,640 per inhabitant) and in terms of economic infrastructure endowment (measured with an index estimated as high as 103, made 100 the Italian average). These regions also exhibit a high level of industrial concentration, measured by the number of firms belonging to an industrial district[4] (76.8% compared to a national average of 26.5%). This factor, according to the marshallian concept of agglomeration economies (Marshall 1890, 1919; Piore and Sabel, 1984; Pyke et al., 1990), can foster the process of local economic development. In this respect, the advantages of industrial concentration in a geographically bounded area refer both to the improvement of efficiency in the production process (labour

[3] The Italian Statistics Department.

[4] The industrial district is defined as a socio-territorial entity characterised by the presence of both a community of people and a large number of small industrial firms in a geographically bounded area (Becattini, 1990).

supply, purchasing, logistics, etc.) and to the simplification of the exchange and transfer of knowledge (Collinson, 2000).

The strong industrial orientation of the selected Italian industrial regions is certainly responsible for their competitive advantages but also brings in their structural limits. First, a renown strength of the Italian sample regions is their high level of employment, as highlighted by the analysis of a group of indicators concerning the labour market (Table 6), showing not just a better performance in comparison to the national average, but also a positive trend between 1995 and 2002: in the fifteen regions the unemployment rate has fallen on average from 4.6% in 1995 to 3.1% in 2002, against a decrease from 11.6% in 1995 to 9.0% in 2002 in the whole country. Indeed, the industrialized local economies under scrutiny are characterized by a higher rate in international trade than the rest of Italy (index as high as 66.3 against the national average of 47.0). This peculiarity of the sample regions is confirmed by their strong orientation to export (the index is estimated to be as high as 43.3 compared to a 23.9 average for the whole country) and their high contribution to the trade balance, which exhibit a high surplus (balance of 33,563 million € as compared to 8,441 million € at national level); the export to import ratio is twice as high as the national average (1.93 against 1.03) (Table 7).

With the aim of ascertaining further factors of competitiveness of the Italian sample regions, we assessed regional attractiveness and regional delocalisation. Specifically, as a measure of a region's attractiveness degree we used the share of workers employed in local branches of firms headquartered outside the regional borders whereas as a proxy of a region's delocalisation degree we used the share of workers of firms headquartered within the regional boundaries employed in outside branches. The data show that the industrialized regions are particularly attractive to new enterprises and that they localize branches in external areas much more than the rest of the country (Table 8): in 2000 both the attractiveness and the delocalisation indexes are higher than the Northern Italy average (17.4% compared to 8.1% and 13.0% against 11.3%, respectively). Finally, also the economic standards of life, as assessed by disposable income, domestic final consumption and value added per-capita, highlight a positive picture of productivity and richness of the fifteen industrialized regions relative to national standards. For each of the above indicators, the sample average (equal to

16,531 € for disposable income, 13,326 € for domestic final consumption and 22,400 € for value added per-capita) is higher than the national average (+11% for disposable income, +3% for domestic final consumption and +17% for value added per-capita); in particular, as far as disposable income and value added per-capita, no one of the regions under scrutiny shows a lower level than the Italian average (Table 9).

Regarding value added, it is important to highlight that, although the fifteen regions show higher values than the national average, the trend is slowing down. Comparing value added per-capita in 1995 and 2002, one finds out that the Italian industrialized regions grew less than the rest of the country in terms of productivity[5]. Breaking down value added by sector, it can be noticed that in the majority of the regions analysed the slowdown occurred in manufacturing sectors, which have traditionally represented their main source of competitiveness (Table 10). The most rapid increase in terms of productivity came about in the service sector, even if, in general, the trend is quite similar to the national average and, with some exceptions, it is not enough to counterbalance the slowdown in the manufacturing sectors occurred in the industrialized regions in comparison to the rest of the country.

The picture described so far suggests not underestimate the slowdown of value added, so crucial to economic development in a long run perspective, particularly because growth in terms of value added and employment may be affected by the slow development of the new activities and products typical of the knowledge economy. In this respect, it is interesting to analyse some limits to the competitiveness of the selected Italian regions, primarily concerning innovativeness and educational level.

[5] With the exception of the Belluno region, which has rapidly grown thanks to the industrial district specialised in optical products.

Figure 1 shows the relationship between employment in high tech sectors and the number of university enrolments as a share of inhabitants between 19 and 24 years old. In general, the regions under review show a lower level than the national average for both indicators, revealing their weakness with respect to key aspects of the knowledge economy. Furthermore, comparing the share of employment in high tech sectors with the (extra-agricultural) value added per employee, it is clear that the low level of innovation can have a negative impact on local productivity (

Figure 2).

In sum, the analysis highlighted that the most industrialised Italian regions are currently growing at a slower pace than the rest of the country, as a result of the slowdown of manufacturing industries. Although it is not possible to claim that they are facing a deindustrialisation problem, the slowdown justifies the attempt to recognize the potential future scenarios for these regions. In this respect, we have already highlighted some of the weaknesses they will have to cope with: a low attention to the driving factors of economic development such as innovation, technological R&D and human capital formation within a development model characterized by slow growth and based on traditional manufacturing activities.

5 Regional transformation paths: the cluster – RIS relationship

Within the Regional Innovation System (RIS) framework and considering the time relationship between cluster and RIS introduced by Asheim (2003), we are now in the position to classify the development dynamics of the regions investigated above along the paths of economic restructuring. The case studies allowed us to identify three different regional development paths, the first two finding a confirmation in Asheim (2003)'s classification.

The first path is typical of industrial clusters in sectors based on synthetic knowledge. Here the relationship with the regional system (other firms, local institutions and universities) is developed at a later stadium of the cluster life. In this case, the region follows a transformation process here defined as '*RIS-into process*' because the RIS originates in response to the presence of the cluster and in support of local economic development

Figure 3.a). This is the case of Baden-Württemberg and Brabant, specialised in engineering-based sectors, where the Regional Innovation System was specifically designed to strengthen local industrial specializations, i.e. to support and promote the technological trajectories developed within the region. Indeed, for these regions the development strategy adopted to overcome the crisis occurred in the early Nineties was designed to strengthen existing manufacturing activities, focusing on the sectors that could still guarantee competitiveness to the local economy. Crucial to the effectiveness of this development path was the cooperation among the three poles of the economy (industry, government and academia), that aimed at recouping innovativeness by raising the regions' technological infrastructures.

The second regional development path, typical of industrial clustering in sectors based on analytical knowledge, follows an opposite direction. In fact, in this case the RIS is the main source of the cluster creation. The cluster develops from the Regional Innovation System by exploiting all regional resources in terms of cooperation and interaction with universities and local institutions. This is the case of regions such as Cambridge (UK) and Shannon (Ireland) (Brioschi and Cassia, 2004), which followed a transformation process here defined as '*RIS-from process*', where the pre-existence of the RIS represents a key factor for the organization of a science-based industrial system (

Figure 3.b). In Cambridge, the development of a high tech cluster was made possible by the existence of a unique 'business environment' dominated by the active presence of the university. In Ireland, the economic transformation was fostered by the development strategy pursued by the local government. Hence, the two cases are alike with respect to the creation of a local system of production 'from scratch', by means of a Regional Innovation System, but differentiate from each other for the degree of planning of the process. One might infer that the establishment of a RIS is a qualifying condition for the transformation to take place, being it planned or unexpected.

In the light of this classification and based on the regional cases analysed in the present work, a third development path was identified. It is the result of a combination between the two different base 'entities' of the regional development process described above. In fact, in regions such as Wales, Tampere, Göteborg and North Rhine – Westphalia, science-based clusters, characterised by analytical knowledge, developed

from declining engineering-based sectors, characterised by synthetic knowledge, passing through the formation of a RIS. In this respect, the transformation process can be defined as '*RIS-through process*' (

Figure 3.c). In this group of regions, characterized by a long past of economic development based on traditional sectors of manufacturing activities, the Regional Innovation System developed after severe periods of industrial decline with the aim of supporting new technological trajectories. In this vein, the RIS acted as catalyst for the local system transformation process, driving the regional competitive repositioning through the development of clusters of innovative and high tech firms. In this respect, the process of territorial transformation was activated thanks to a 'systemic effort' and as a result of social interdependencies among regional actors. This is particularly true for the regions under investigation, where the sectors which the local economy was based on showed signs of decline, and the ability to adapt to external changes was therefore crucial. Also in this case, the regions characterized by an analogous reconversion path differentiate from each other for the degree of strategic planning. For instance, in Göteborg and Tampere the reconversion was driven by industry, whereas in Wales the competitive repositioning was primarily due to the regional development policies and related agencies and institutions. Again, the RIS seems to have acted as 'catalyst', i.e. as an element without which the activation of the transformation process would have been delayed.

6 Concluding remarks

In this paper we analysed the development paths of a number of European knowledge economies within a Regional Innovation System framework with the two-fold aim of classifying regional development paths and gaining some precious insights on the possible development scenarios of highly industrialised Italian regions.

The analysis of the European regions allowed us to identify the main determinants of regional economic development and territorial attractiveness. A number of these factors is specific to knowledge economies: skilled human capital, innovative capacity, research and development in high technology industries. The common factor behind the development trajectory of each of the regions under investigation in this paper seems to be the formation of a Regional Innovation System. In this respect, the paper

corroborates the centrality of the systemic component of regional innovation processes. We next outlined the time transformation path of the European regions, coming up with the identification of a number of common development stages: first, industrialisation; then, the deindustrialisation phenomenon; and, finally, the transformation process into a knowledge economy through the formation of a Regional Innovation System.

The analysis of the fifteen most industrialised Italian regions made it clear that they are experiencing a slowdown in economic growth, fitting within the general movement of developed economies away from traditional manufacturing. Although they are not facing a deindustrialization phenomenon yet and although they display some relevant competitive factors (e.g., a marked orientation to exports and a high level of employment), the selected regions lack a number of key features typical of the transformation path into a knowledge economy. Indeed, these regions exhibit a low level of education of the workforce coupled with a low degree of specialization in high tech manufacturing sectors and in knowledge intensive service sectors. Moreover, they show a lower propensity to innovation, research and technological development relative to the European knowledge economies employed as benchmark.

Within this framework, some implications may be drawn as to the future development of the Italian most industrialised regions. By virtue of their high degree of specialization in engineering-based sectors, these regions are still in the first of the development stages outlined above. However, our analysis clearly highlighted a slowdown of these regional economies, possibly heading to the reaching of the second stage. The Italian regions may perhaps prevent the crisis by adopting the same transformation model followed by their European counterparts and favour the formation of a Regional Innovation System in the attempt to make up for their weaknesses and recoup productivity. In this case, the main objective of territorial actors should be that of 'acting as a system', formulating common strategies to foster regional competitiveness. In this vein, the most desirable transformation process would be the '*RIS-through*' process.

Yet, the Italian regions might continue to follow a more 'traditional' development model, not passing through the formation of a RIS. In this case, their renewal process would unquestionably take longer, indeed because the catalyst role of a RIS is that of accelerating the transformation process. Moreover, should this be the choice, our

regional economies (though armed with a number of strengths typical of a sound economic system) should be more and more concerned about the growing global competitiveness of new territories entering the context of the knowledge economy. And, at this point, they might not have enough time.

Tables and figures

Regions (NUTS2003)	PIL per-capita (PPS),	PIL per-capita (PPS) EU-15=100	Unemployment rate *		Patent applications per million inhabitants
	2001	2001	2001	2002	1998
Baden-Wurttemberg	26,636	114.1	4.0	4.7	445
Nordrhein-Westfalen	23,695	101.5	6.7	7.9	220
GERMANIA	23,456	100.5	8.5	9.4	
Nord Brabant	26,039	111.6	1.9	2.4	477
OLANDA	26,456	113.4	2.3	2.8	
Etela-Suomi	28,428	121.8	9.3	9.1	206
FINLAND	24,317	104.2	9.1	9.1	
Vastsverige	23,933	102.5	4.3	4.9	299
SVEZIA	24,789	106.2	4.8	5.1	
East Wales	24,832	106.4	5.0	5.1	82
WALES	19,323	82.8	5.8	5.6	
UK	24,535	105.1	5.0	5.1	
EU-15	**23,338**	**100.0**	**7.5**	**7.8**	**112**
Best Performer, Tirolo (Austria)			**2.3**	**2.0**	

Table 1. *PIL per-capita (Purchasing Power Standard) 2001, Unemployment rate, 2001-2002 (Note: * ratio between number of unemployed persons and labour force) and Patent applications per million inhabitants, 1998 (Source: Eurostat).*

Regions	Nations	Employment in high-tech and medium-high-tech sectors		Employment in high-tech sectors
		Thousands	% of total employment	% of total employment
Stuttgart	DE (Baden-Wurttemberg)	393	21.0	3.0
Tubingen	DE (Baden-Wurttemberg)	152	18.1	3.4
Braunschweig	DE	123	17.8	1.6
Karlsruhe	DE (Baden-Wurttemberg)	209	16.9	3.4
Franche-Comtè	F	82	16.6	3.5
Niederbayern	DE	92	16.2	2.1
Unterfranken	DE	96	15.6	2.1
Mittelfranken	DE	118	14.6	3.2
Schwaben	DE	122	14.4	1.6
Freiburg	DE (Nordrhein-Westfalen)	139	14.1	4.3
EU-15		**12,125**	**7.6**	**1.4**

Table 2. *Leading EU regions in employment in high-tech and medium-high-tech sectors, 2001 (Note: * The classification is based on the OECD classification (on the ratio of R&D expenditure to GDP). The following NACE Rev 1 sectors are included: High-tech - Manufacturing of office machinery and computers, manufacturing of radio, television and communication equipment and apparatus, manufacturing of medical precision and optical instruments, watches and clocks; Medium-high-tech – Manufacture of chemicals and chemicals products, manufacture of machinery and equipment n.e.c., manufacture of electrical machinery and apparatus n.e.c., manufacture of motor vehicles, trailers and semi-trailers, manufacturing of other transport equipment) (Source: Eurostat).*

Regions	Nations	R&D expenditure as a % of GDP	R&D expenditure as a % of GDP in the business enterprise sector
Braunschweig	DE	6.21	4.5
Vastsverige	SE	5.27	5.27
Stuttgart	DE (Baden-Wurttemberg)	4.82	4.36
Oberbayern	DE	4.72	3.72
Pohjois-Suomi	FI	4.36	3.29
Stockholm	SE	4.33	4.33

Tubingen	DE (Baden-Wurttemberg)	4.22	3.47
Uusimaa	FI	4.21	2.87
Berlino	DE	3.68	-
Eastern	UK	3.56	3.11
Dresden	DE	3.47	-
Rheinhessen-Pfalz	DE	3.42	-
Karlsruhe	DE (Baden-Wurttemberg)	3.35	-
Ile de France	FR	3.34	-
Koln	DE (Nord Rhein-Westfalen)	3.29	-
EU-15		**1.99**	**1.3**

Table 3. *Top 15 EU regions in terms of R&D expenditure as a % of GDP, 2001 (Source: Eurostat).*

Regions	Share of employment in manufacturing sectors	Value added per capita
	2001	2001
Lecco	49.8%	20,688
Prato	47.8%	23,047
Vicenza	47.3%	22,734
Bergamo	46.8%	22,570
Biella	46.8%	20,443
Treviso	45.5%	22,064
Modena	43.6%	25,970
Reggio Emilia	43.3%	24,040
Novara	42.2%	21,633
Varese	42.2%	21,030
Brescia	41.4%	22,972
Belluno	41.2%	23,229
Como	40.9%	20,419
Mantova	40.9%	23,162
Pordenone	40.3%	21,994

Table 4. *Italian regions with a share of employment in manufacturin sectors higher than 40% and value added per capita higher than 20 thousand euros, 2001 (Source: author's elaborations on Istat data).*

Regions	Share of local units belonging to an industrial district*	Economic infrastructure endowment **		Industrial density per km^2	Electric power consumptions per-capita in manufacturing sectors (kWh)
	2002	1999	1991	2002	2002
Biella	94.4	98.1	100.9	3.2	6,512
Novara	47.5	130.8	142.3	3.4	4,742
PIEMONTE	*16.1*	*92.0*	*92.1*	*2.0*	*3,695*
Bergamo	83.4	108.0	107.1	5.0	5,465
Brescia	82.2	77.5	74.9	3.8	8,249
Como	90.6	110.2	114.4	6.9	3,011
Lecco	100.0	106.4	101.5	6.2	4,311
Mantova	63.9	80.7	80.8	2.3	6,142
Varese	72.6	187.9	183.4	10.6	3,891
LOMBARDIA	*48.5*	*121.6*	*114.0*	*5.4*	*3,943*
Belluno	24.8	51.7	50.9	0.7	2,591
Treviso	97.1	115.0	109.7	5.4	3,234
Vicenza	92.1	93.9	93.0	5.7	4,588
VENETO	*64.6*	*119.9*	*115.8*	*3.8*	3,744
Pordenone	16.5	65.9	60.8	1.7	4,687
FRIULI	*37.4*	*125.2*	*144.6*	*1.7*	*5,146*
Modena	92.4	87.5	83.3	4.7	4,243
Reggio Emilia	94.4	81.1	84.2	3.7	4,024
EMILIA-ROMAGNA	*49.4*	*110.7*	*114.8*	*2.7*	*3,194*
Prato	100.0	150.1	124.6	23.6	4,036

TOSCANA	*38.4*	*117.4*	*122.5*	*2.6*	*2,923*
ITALY	**26.5**	**100.0**	**100.0**	**2.2**	**2,640**
15 Regions avarage	**76.8**	**103.0**	**100.8**	**5.8**	**4,880**

Table 5. *Structural economic indicators, 1991-1999-2000-2002 (Notes: * According to Istat classification, based on manufacturing concentration (higher than national avarage), industrial employment concentration in firms with less than 250 employee (higher than 50% of manufacturing employment) and industrial specialization of sectors (higher than 50% of manufacturing employee in the district); ** Represents the quantitative and qualitative infrastructure endowment, made 100 the Italian average, measure in terms of roads, railways, ports, airports, environmental structures, postal and banking systems and telecommunication networks)(Source: Istituto Tagliacarne's elaborations on Istat data).*

Regions	Activity rate*		Employment rate**		Unemployment rate***	
	2002	1995	2002	1995	2002	1995
Biella	52.0	51.0	49.9	48.5	4.1	4.9
Novara	51.9	47.1	49.5	44.5	4.5	5.5
PIEMONTE	*50.7*	*49.5*	*48.1*	*45.4*	*5.1*	*8.2*
Bergamo	52.8	50.4	51.5	48.7	2.5	3.3
Brescia	53.4	51.5	51.5	49.3	3.5	4.3
Como	51.9	52.2	50.4	50.4	3.0	3.5
Lecco	52.6	54.4	51.5	52.8	2.1	2.9
Mantova	53.6	50.1	51.9	47.9	3.2	4.3
Varese	54.1	51.2	52.1	47.8	3.7	6.5
LOMBARDIA	*53.1*	*51.2*	*51.1*	*48.1*	*3.8*	*6.1*
Belluno	58.0	56.0	56.3	54.4	3.0	3.0
Treviso	55.5	51.4	53.8	49.6	3.0	3.5
Vicenza	55.7	54.8	54.3	52.8	2.5	3.8
VENETO	*52.7*	*50.4*	*50.9*	*47.6*	*3.4*	*5.6*
Pordenone	51.4	49.6	50.4	46.8	1.9	5.8
FRIULI	*49.7*	*47.1*	*47.9*	*43.7*	*3.7*	*7.3*
Modena	55.9	53.8	54.6	51.7	2.3	3.9
Reggio Emilia	56.8	52.7	55.5	51.1	2.2	3.0
EMILIA-ROMAGNA	*53.4*	*51.2*	*51.6*	*48.2*	*3.3*	*5.9*
Prato	55.5	54.6	52.4	49.1	5.5	10.1
TOSCANA	*49.4*	*48.0*	*47.0*	*44.0*	*4.8*	*8.3*
ITALY	***48.8***	***47.1***	***44.4***	***41.6***	***9.0***	***11.6***
15 Regions avarage	**54.1**	**52.1**	**52.4**	**49.7**	**3.1**	**4.6**

Table 6. *Activity, employment and unemployment rate, 1995-2002 (Notes: * ratio between labour force and population of 15-65 years old; ** ratio between number of employed persons and population of 15-65 years old; *** ratio between number of unemployed persons and labour force) (Source: author's elaborations on Istat and Istituto Tagliacarne data).*

Regions	Imports (million €)	Exports (million €)	Balance (million €)	Export/ import	International trade index *	Orientation to export index**
	2002	2002	2002	2002	2001	2001
Biella	1,100.3	1,500.6	400.3	1.36	66.4	37.5
Novara	2,081.2	3,140.2	1,059.0	1.51	65.9	41.8
PIEMONTE	*20,751.5*	*29,468.8*	*8,717.3*	*1.42*	*53.8*	*31.6*
Bergamo	5,479.7	8,277.8	2,798.1	1.51	67.2	40.9
Brescia	4,947.3	7,492.8	2,545.5	1.51	50.9	31.2
Como	2,340.8	4,503.6	2,162.8	1.92	61.8	40.6
Lecco	1,283.8	2,388.9	1,105.1	1.86	59.9	38.9
Mantova	2,587.8	3,798.7	1,210.9	1.47	71.7	42.3
Varese	5,085.9	6,384.6	1,298.7	1.26	64.7	35.6
LOMBARDIA	*74,827.5*	*94,932.2*	*20,104.7*	*1.27*	*75.0*	*33.2*
Belluno	597.8	1,756.7	1,158.9	2.94	45.5	34.0
Treviso	4,026.5	8,204.6	4,178.1	2.04	70.4	47.8

Vicenza	6,614.7	11,189.4	4,574.7	1.69	98.0	62.3
VENETO	*29,309.9*	*38,637.2*	*9,327.3*	*1.32*	*66.2*	*38.0*
Pordenone	1,043.9	2,940.6	1,896.7	2.82	66.8	50.7
FRIULI	*4,550.3*	*9,022.4*	4,472.1	*1.98*	*54.0*	*35.4*
Modena	3,340.2	7,960.8	4,620.6	2.38	64.7	45.4
Reggio Emilia	2,272.3	5,332.5	3,060.2	2.35	66.8	47.0
EMILIA-ROMAGNA	*18,986.8*	*31,506.5*	*12,519.7*	*1.66*	*49.4*	*31.5*
Prato	1,102.5	2,595.7	1,493.2	2.35	73.9	53.5
TOSCANA	*15,664.2*	*21,466.2*	*5,802.0*	*1.37*	*51.0*	*29.0*
ITALY	**256,857.5**	**265,298.4**	**8,440.9**	**1.03**	**47.0**	**23.9**
15 Regions Total	**43,904.7**	**77,467.5**	**33,562.8**			
15 Regions Avarage				**1.93**	**66.31**	**43.30**
15 Regions/Italy	**17.1%**	**29.2%**				

Table 7. *Import-export, International trade and Orientation to export 2001-2002 (Notes: * The international trade index is measured as the rate between regional imports plus exports and value added; ** The orientation to Export is calculated as the rate between export and value added) (Source: author's elaborations on Istat data).*

Regions	Region's attractiveness degree*		Region's delocalisation degree**	
	N	%	N	%
Novara	17,685	23.2	27,660	32.1
Biella	9,104	18.2	5,841	12.5
PIEMONTE	*131,250*	*14.6*	*142,907*	*15.7*
Varese	52,633	27.0	21,292	13.0
Como	23,817	20.1	10,961	10.4
Bergamo	42,132	16.7	36,524	14.8
Brescia	37,478	13.8	22,928	8.9
Mantova	14,962	18.6	11,746	15.2
Lecco	19,427	25.5	5,773	9.2
LOMBARDIA	*180,113*	*8.0*	*536,756*	*20.6*
Vicenza	29,306	13.0	24,886	11.3
Belluno	11,354	23.3	5,991	13.8
Treviso	31,912	15.2	11,844	6.2
VENETO	*157,698*	*14.2*	*78,104*	*7.6*
Pordenone	12,454	17.8	16,292	22.1
FRIULI VENEZIA GIULIA	*45,614*	*17.9*	*28,531*	*12.0*
Reggio nell'Emilia	14,635	12.5	21,925	17.6
Modena	25,708	14.6	21,651	12.6
EMILIA ROMAGNA	*116,168*	*12.1*	*98,831*	*10.5*
Prato	9,594	16.2	5,828	10.5
TOSCANA	*111,468*	*15.9*	*42,767*	*6.8*
North of Italy	**141,876**	**8.1**	**120,482**	**11.3**
Centre of Italy	**275,397**	**13.8**	**299,809**	**14.8**
South of Italy and Island	**314,742**	**15.4**	**72,432**	**4.0**
15 Regions Avarage		**17,4**		**13.0**

Table 8. *Region's attractiveness and delocalisation degree, 2001 (Notes: * Share of workers employed in local branches of firms headquartered outside the regional borders; ** Share of workers of firms headquartered within the regional boundaries employed in outside branches) (Source: author's elaborations on Centro Studi Unioncamere data).*

Regions	Disposable income, 2001		Domestic final consumption, 2001		Value added, 2001			
	Total (million €)	per-capita (€)	Total (million €)	per-capita (€)	Total (Gross SIFIM) (million €)	Manufacturing (million €)	Per employee (€)	per-capita, (€)
Biella	3,243	17,254	2,884	15,341	4,253	1,714	48,880	20,443
Novara	5,768	16,672	5,049	14,595	7,758	3,221	49,734	21,633
PIEMONTE	*73,092*	*17,274*	*59,559*	*14,076*	*97,067*	*32,313*	*50,221*	*22,122*
Bergamo	14,922	15,120	11,870	12,027	22,127	9,636	49,534	22,570
Brescia	18,041	16,018	15,444	13,712	26,695	10,150	49,546	22,972
Como	8,952	16,469	7,135	13,126	11,657	4,470	50,769	20,419
Lecco	5,225	16,579	3,926	12,457	6,767	3,091	51,191	20,688
Mantova	6,106	16,012	4,852	12,725	8,905	3,479	49,037	23,162

Varese	13,951	17,035	10,656	13,012	17,668	7,043	50,975	21,030
LOMBARDIA	*162,294*	*17,818*	*134,374*	*14,752*	*235,980*	*80,849*	*54,123*	*24,806*
Belluno	3,482	16,542	3,427	16,281	4,949	1,892	48,375	23,229
Treviso	12,200	15,097	9,496	11,751	17,980	7,380	47,204	22,064
Vicenza	12,549	15,549	9,875	12,235	19,113	8,357	47,473	22,734
VENETO	*71,141*	*15,542*	*65,250*	*14,255*	*103,676*	*35,539*	*47,497*	*21,955*
Pordenone	4,523	15,583	3,509	12,089	6,292	2,353	47,206	21,994
FRIULI	*19,903*	*16,703*	*16,652*	*13,974*	26,321	7,159	47,735	21,448
Modena	12,580	19,563	8,915	13,863	17,303	7,325	50,996	25,970
Reggio Emilia	8,257	17,846	5,834	12,609	11,194	4,948	47,472	24,040
EMILIA-ROMAGNA	*75,325*	*18,690*	*62,432*	*15,491*	*99,768*	*33,235*	*49,285*	*24,048*
Prato	3,846	16,636	3,252	14,067	5,641	2,382	47,728	23,047
TOSCANA	*60,160*	*17,109*	*50,635*	*14,400*	*77,545*	*22,639*	*47,264*	*21,276*
ITALY	**857,008**	**14,951**	**738,400**	**12,882**	**1,140,830**	**316,679**	**47,845**	**19,171**
15 Regions Avarage		**16.531**		**13326**			**49,075**	**22,400**
15 Regions/Italy	**15.6%**		**14.4%**		**16.5%**	**24.5%**		

Table 9. *Disposable income, Domestic final consumption, Value added, 2001 (Sources: author's elaborations on Istat data).*

Regions	Value added variation (%), 2002 against 1995				
	Agriculture	Manufacturing	Services	Total (Net SIFIM)	Per-capita
Novara	6.98%	28.27%	42.11%	35.65%	32.25%
Biella	-27.63%	8.08%	39.60%	23.68%	24.81%
PIEMONTE	*-4.68%*	*19.91%*	*38.98%*	*31.33%*	*31.16%*
Varese	34.67%	18.85%	47.15%	35.09%	31.41%
Como	46.69%	12.00%	32.21%	23.83%	19.73%
Bergamo	44.54%	20.88%	44.07%	33.15%	25.68%
Brescia	14.46%	21.71%	45.13%	33.29%	24.99%
Mantova	19.61%	21.93%	45.26%	33.05%	29.05%
Lecco	39.68%	14.04%	31.81%	22.44%	16.98%
LOMBARDIA	*21.39%*	*18.92%*	*44.20%*	*33.10%*	*28.86%*
Vicenza	26.66%	21.67%	47.44%	34.12%	26.43%
Belluno	22.97%	31.46%	49.71%	42.52%	42.81%
Treviso	12.00%	28.62%	54.72%	41.56%	32.33%
VENETO	*14.35%*	*23.44%*	*47.65%*	*37.40%*	*32.43%*
Pordenone	-17.68%	21.59%	36.60%	27.39%	22.17%
FRIULI-VG	*8.05%*	*15.80%*	*33.73%*	*27.10%*	*26.45%*
Reggio Emilia	23.14%	32.39%	36.38%	34.12%	22.93%
Modena	18.86%	26.59%	44.57%	35.98%	28.66%
EMILIA-ROMAGNA	*17.54%*	*27.82%*	*41.29%*	*35.99%*	*31.48%*
Prato	22.02%	14.37%	39.47%	27.18%	19.62%
TOSCANA	*9.24%*	*28.30%*	*41.60%*	*36.93%*	*35.42%*
ITALY	**9.57%**	**23.03%**	**42.34%**	**35.85%**	**33.76%**
15 Regions Avarage	**19.13%**	**21.50%**	**42.41%**	**32.20%**	**26.66%**

Table 10. *Value added variation by sector, total and per-capita, 1995-2002 (Source: Istituto Tagliacarne's elaborations on Istat data).*

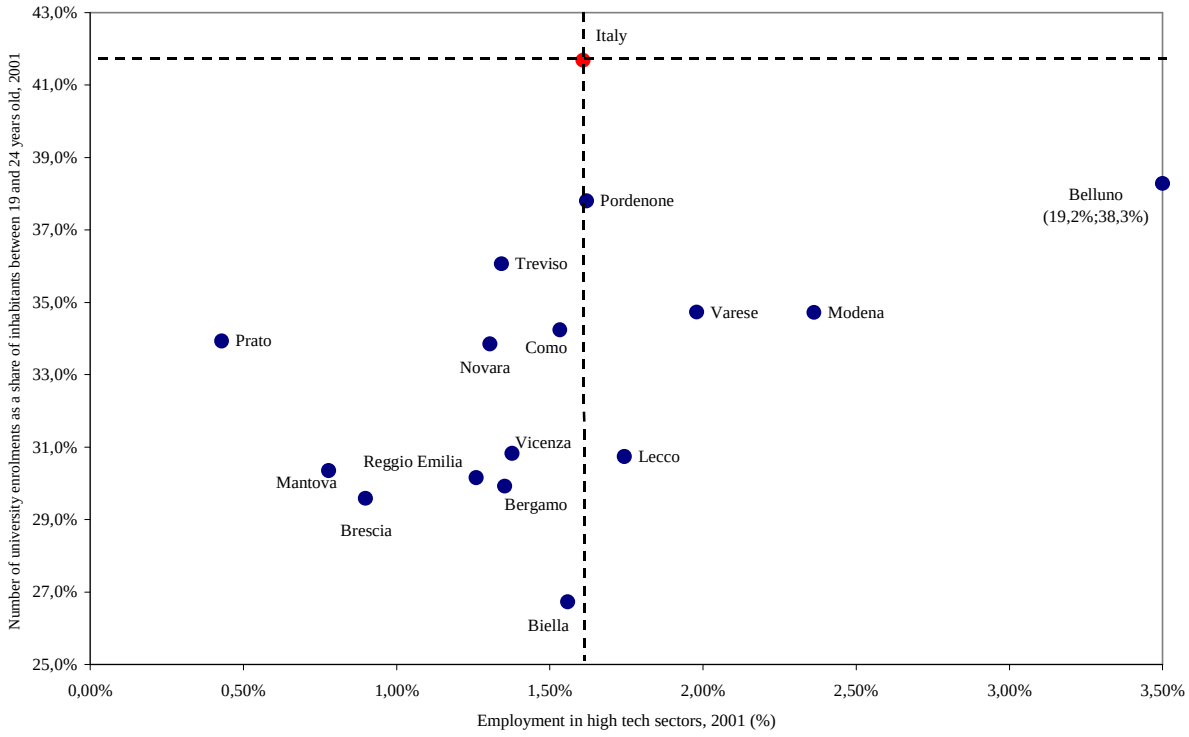


Figure 1. *Relationship between employment in high tech sectors* and the number of university enrolments as a share of inhabitants between 19 and 24 years old, 2001 (Note: * see Table 9) (Source: author's elaborations on Census 2001 and MIUR – statistical office, 2002).*

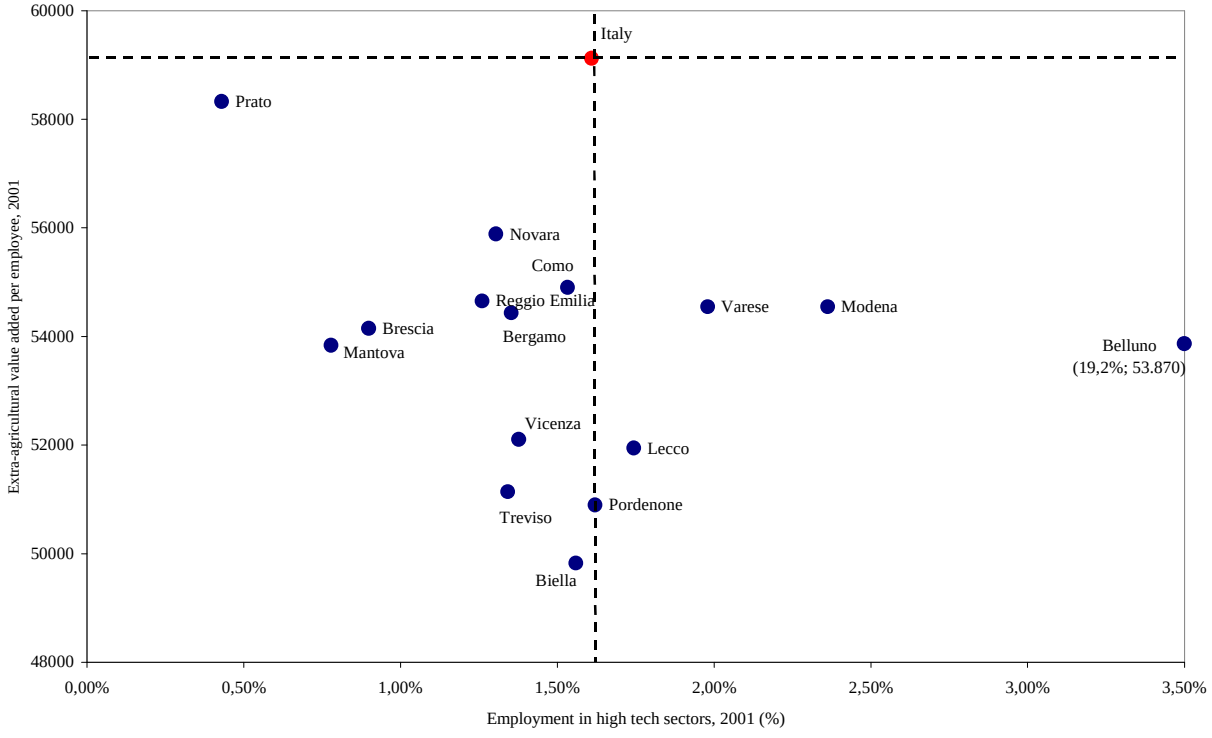
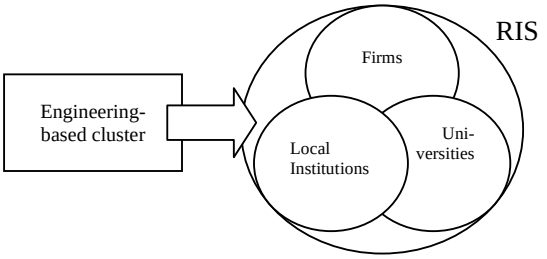
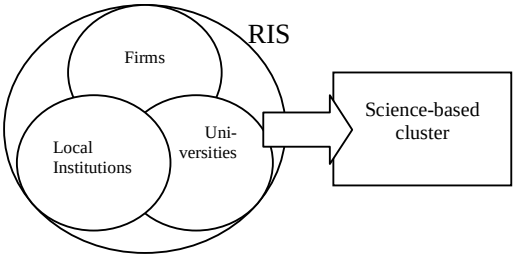


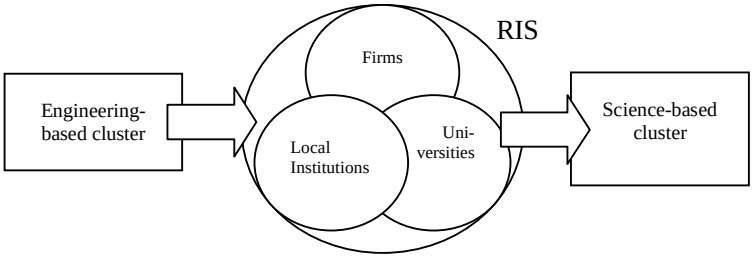
Figure 2. *Relationship between employment in high tech sectors* and (extra-agricultural) value added per employee, 2001 (Note: * see Table 9) (Fonte:author's elaborations on Census 2001).*



*a) **RIS-into process***



*b) **RIS-from process***



*c) **RIS-through process***

Figure 3. *Regional transformation paths:the cluster-RIS relationship*

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