Conference on "Regionalisation of Innovation Policy"

Berlin (Germany) – June 4-5, 2004

On the definition of regional system of innovation (RSI): an application to the Italian case

Simona Iammarino[*]

Preliminary draft, incomplete, not for external circulation.

1. Introduction

Since the appearance of the first literature on National Systems of Innovation (NSIs) the idea of applying *tout court* such a conceptual perspective to a small geographical breakdown - regional, or even local - has been highly tempting (Breschi, 1995; Cooke et al., 1997; Howells, 1999). However, whilst on the one hand a NSI can by no means be considered the simple sum of regional systems, on the other any step in the direction of searching for a kind of standardisation of sub-national systems of innovation has so far encountered two major problems. The first one, theoretical in nature, arises from the fact that NSIs have been conceptualised and applied by considering actors, institutions and linkages which operate and are governed mainly at the national scale. Such a 'national-bias' has strongly affected the identification of the relevant actors, relationships and attributes operating at the regional level, to the extent that very rarely has this regional dimension effectively been considered in its historical evolution, implicitly assuming that history *really* matters *only* at the national level. This tendency has contributed to create some confusion on the distinction between "hypothetical" and "actual" RSIs, arguably leading to overcriticise the conceptual framework rather than to look for better methods to test its validity.

The second problem is the well known and broad 'regional measurement issue'. At the sub-national scale the availability of information, data and indicators on the characteristics and behaviours not only of firms, but of the multitude of actors and sets of institutions whose interactions determine the innovative performance of the region, is far more inadequate than at the national level. This has

further constrained the possibility of exploring the nature and evolution of regional systems of innovation on the basis of statistically robust evidence (Braczyk et al., 1998; Evangelista et al., 2002).

This paper takes the view that the top-down conceptual perspective, i.e. the mere 'shift' of the NSI features to the regional scale, indeed provides the necessary but not the sufficient conditions to distinguish RSIs. Therefore, not only it becomes imperative to integrate the top-down view with a bottom-up perspective – tackling also the internal dynamics of regionally embedded social, institutional and economic structures –, but an analysis of such structures in terms of historical origins and evolution of regional cultures may further help overtake the nationally-biased 'Listian' view of innovation systems (Cooke, 2001). In addition, whilst a clear thinking on RSIs is obviously a prerequisite for sensible definitions, adequate data and methodologies are nonetheless crucial to determine whether the conceptual approach is suited for a description of the regional system as it is (versus what it should hypothetically be).

The paper is divided into 5 sections. The next section reviews the main literature on the concept of RSI, adopting an integrated view which brings together top-down and bottom-up characteristics and evolutionary mechanisms for the purpose of the identification of RSIs. Section 3 discusses the relevance and applicability of the integrated evolutionary concept of RSI, addressing in particular the following two questions: 1) is the system portrayed in such a framework a "hypothetical" or "actual" RSI?; 2) do currently available data and indicators reproduce "characteristics" or "impacts" of RSIs? Section 4 attempts an application of the RSI dynamic concept to the Italian case, which offers strong grounds to support the argument that the historical perspective on regional cultures is often an inevitable filter in order to assess future opportunities for regional development. Section 5 provides some concluding remarks, addressing general policy issues and directions for future research.

2. *Top-down, bottom-up* and *integrated* views of RSIs

The broad literature on the analysis of the advantages of geographical agglomeration, with particular reference to innovative and technological activities, has mostly developed along a twofold perspective to study the relationship between innovation and space. The first, and antecedent to the other, kind of approach has followed the Marshallian tradition in trying to identify such advantages

* SPRU, The Freeman Centre, University of Sussex, Brighton, BN1 9QE, United Kingdom. Tel: +44 (0)1273 877565. Fax: +44 (0)1273 685865. E-mail: s.iammarino@sussex.ac.uk

and their implications for the overall economic growth (see, for instance, Perroux, 1955; Pred, 1967, 1977; Malecki, 1977, 1983). The pioneering works and intuitions of Marshall suggested that the accumulation of skills, know-how and knowledge takes place within spatially bounded contexts, which create a kind of favourable "industrial atmosphere" capable of enhancing economic growth and spurring the generation and diffusion of technological innovation. The empirical literature flourished over the last decades has confirmed that spatial-specific factors strongly influence firms' innovative performance and regional patterns of technological specialisation. However, in such a perspective, the geographical dimension represents a factor characterising economic development, in relation to which the local innovative potential is assumed to be only a variable among others. A second and more recent line of research has instead addressed the localised structural and institutional factors which shape the innovation capacity of specific geographical contexts. This has given rise to heterogeneous sub-national innovative typologies, all bringing back to a broadly defined model of spatial organisation, the 'innovative cluster': milieux innovateurs (Aydalot, 1986), new industrial districts (Becattini, 1987), technological districts (Markusen, 1985, 1996; Storper, 1992), learning regions (Morgan, 1997; Asheim, 1995) and regional systems of innovation (Cooke, 1992; Howells, 1996, 1999; Braczyk et al., 1998).[1]

Focusing in particular on the latter, along with the importance of contextual elements the presence of systemic interactions in the process of generation and diffusion of innovation is recognised as a key determinant of the technological and economic performance of countries and regions. In particular, the literature on National Systems of Innovation - introduced by the evolutionary theorists in the late 1980s (Freeman, 1987; Lundvall, 1992; Nelson, 1993; Nelson and Rosenberg, 1993; Edquist, 1997) - has pointed out that the performance of national economies cannot be explained only in terms of strategies and performances of firms. Beyond the latter, other factors and actors play a vital role in favouring the generation and diffusion of knowledge, among wich: inter-organisation networks, financial and legal institutions, technical agencies and research infrastructures, educational and training systems, innovation policies, etc..

The notion of regional system of innovation (RSI) has emerged as a territorially-focused perspective of analysis from the broader concept of NSI: a RSI may thus be defined as 'the *localised* network of actors and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies' (Howells, 1999; Evangelista et al., 2002). Indeed, the highly uneven pattern and spread of innovation in space suggests that it could be better depicted by assuming subnational units of analysis, which can avoid the distortions and the loss of information

[1] For a critical review of territorial innovation models, see Moulaert and Sekia (2003).

of hypothesising national systems as homogeneous entities. As Carlsson and Stankiewicz appropriately remark, "high technological density and diversity are properties of regions rather than countries" (1991, 115).

It is therefore implicitly maintained that the same elements characterising a national system can be transferred to a smaller territorial scale and used to help define the RSI. These elements are a mix of *components* (the various actors, i.e. individuals, firms and other organisations), *relationships* among them (market and non-market) and *attributes* of the components (competencies and functions) (Carlsson, 2003). Building on Howells (1999), such a top/down approach to RSI (i.e. from the national to the regional level) implies the identification of the following characteristics (*top-down view*):

- internal organisations of firms, the latter being the principal agents of innovation;
- inter-firm relationships and, more generally, the type and intensity of interactions between the business sector and other organisations;
- role of public sector and public policy (assuming that, at the local level, formal policies interact to a much greater extent with informal habits and conventions);
- institutional set-up of the financial sector (i.e. whether based either on a developed capital market, or on a regulated and strictly controlled credit, or on relatively "free" access to funds, etc.);
- R&D intensity and organisation (both private and public);
- institutional framework and governance, that is organisational forms and processes for regional coordination and control (administrative, political, legal, fiscal, educational, etc.);
- industrial structure (i.e. average firm size, degree of competition and collaboration among firms, pattern of sectoral specialisation, demand, etc.);
- spatial structure (e.g. degree of urbanisation, regional network externalities) and intra-regional scale and scope of geographical agglomerations (i.e. sub-regional clusters with specific advantages in local labour markets, specialised suppliers, knowledge spillovers);
- degree of openness, capacity to attract/absorb external resources, global integration;
- core/periphery hierarchical forces driven by historical evolution of regional culture and society.

The above list is clearly not exhaustive and underlies a broad definition of system of innovation, encompassing the specific institutions which deliberately promote innovation and knowledge, as well as the wider socio-economic system in which political and cultural influences and policies

determine innovation structures and performances (Lundvall, 1992; Freeman, 2002). Moreover, the definition of components, relationships and, particularly, attributes is more problematic in regional systems than in other cases (Carlsson, 2003). Nonetheless, the top-down view is helpful to take on a comparative view of RSIs, both within and across national boundaries, assessing the nature of the innovation system in terms of space and networks of forces, which escape the broad and diversified national dimension insofar as they "can never be made precise by their outline or by their container" (Perroux, 1950, 102).

Yet, within the systemic approach to the geographical dimension of innovation, the distinction between the aspects related to the agglomeration of innovative activity (i.e. the Marshallian type of agglomeration forces) and the contextual mechanisms for the generation and diffusion of innovation – i.e. the impact of space on innovation through informal and formal social networks (Pred, 1967; Hagerstrand, 1967; Lundvall, 1988, 1996) – has become increasingly blurred. The first implication of merging together the two aspects is that the top-down perspective may give account of the necessary but not of the sufficient conditions to identify RSIs. Therefore, the integration of the top-down view with a bottom-up perspective, tackling also the internal and dynamic dimension of the regionally embedded socio-cultural and socio-economic structures, has become compelling (Asheim, 1995; Asheim and Gertler, 2003).

As highlighted by the evolutionary theories of technological change, the dynamism of a national or regional system, that necessarily builds on access to and efficient use of knowledge, rests upon three main functional dimensions:

1. *absorption* of new knowledge, technology and innovation for the adaptation to local needs;
2. *diffusion* of innovations throughout all constituent parts of the regional social fabric to strengthen the existing knowledge base;
3. *generation* of new knowledge, technology and innovation.

Hence, the dynamism of a regional system may be sustained through several channels related to these different dimensions and based on collective *learning* processes through which knowledge and technology are used, diffused and created. Such learning processes are central to questions of growth and competitiveness, and provide a strong argument in favour of sub-national perspectives of analysis (Cooke and Memedovic, 2003). Learning dynamics and exchanges of knowledge are in fact usually embedded in distinct environments of interactions among various actors and organisations, sharing common attitudes, habits and conventions, and institutional settings towards particular types of learning (Lundvall, 1988). The employment of informal channels for the diffusion

of tacit and 'sticky' codified knowledge provides another argument for innovation to be geographically specific (Hägerstrand, 1967; Lundvall, 1992, Asheim and Isaksen, 1997, 2002). Furthermore, according to technological gap theories (Abramovitz, 1986; Fagerberg, 1987, 1994; Fagerberg et al., 1994), concepts such as *social capability* and *technological congruence* are particularly relevant when considering RSIs, insofar as both appear to be highly variable across space, even within the same national economy. While the first concept refers to the overall ability of the region to engage in innovative and organisational processes and to make institutional change, the latter points to the distance of the region from the technological frontier, or, in other words, its capacity to implement the technical properties connected to the new technologies (Fagerberg et al., 1994). Following this approach, regional systems with stronger social capabilities and knowledge base tend to be better equipped also to exploit new technological opportunities, to adapt existing activities to the new business environment, and to learn faster how to build new regional advantages through the generation of innovation. In fact, even the most specialised forms of knowledge are becoming a perishable resource due to the accelerating pace of technological change; valuable competencies have to be created fast; continuous learning and adaptation determine the innovative performance of individuals, firms, and geographical systems (van der Meer et al., 2003). The remarkable regional divergence in growth rates observed in Europe must be attributed in large measure to the presence or absence of social capabilities for institutional change, especially those which stimulate high rates of technological change (Freeman, 2002).

On the other hand, creating competencies fast means to establish links at all levels, from the 'global' to the 'local': the extent to which a region attracts innovative resources from outside – i.e. spurring its external integration – depends first and foremost upon its extant absorptive capacity (Asheim and Isaksen, 2002; Cantwell and Iammarino, 2003). As learning curve advantages are mainly people- and institution-embodied, human capital and skill upgrading rise the ability of a region to absorb, diffuse and generate new technology. Technology diffusion is proportional to the ability of a region to absorb innovation: as large differences in terms of absorptive capacity give rise to a considerable degree of geographical agglomeration, knowledge will flow more easily and socio-economic development in general will be more spread if high absorptive capacity exists across space. Importantly, absorptive capacity depends on diversity: innovation is where diverse (technological, social, economic) culture is, and the most dynamic capabilities are a mixture of both exploration and exploitation of new and existing assets.

Regional systemic advantages (or disadvantages) are therefore supposed to depend on attributes such as 'untraded interdependencies', informal flows of knowledge, interactive learning, degree of

embeddedness[2], which generate the bulk of territorial externalities. Moreover, dense social networks may prove to be critical channels of knowledge diffusion and learning, recombining old and new pieces of knowledge. It has been recently argued that geographical proximity would not cause knowledge spillovers *per se*, but social proximity in the region would (Breschi and Lissoni, 2001). Adapting from Howells (1999), the region-specific characteristics can be proxied as follows (*bottom-up view*):

- localised communications patterns relating to the innovation process, both at individual and corporate level;
- localised invention and learning patterns (individual, organisational, institutional and societal);
- localised knowledge sharing (inter-individual, intra- and inter-organisation linkages, intra- and extra-region networks);
- localised search and scanning procedures relating to innovation and technology;
- localised innovation performance.

This list, again, may not be complete, but it helps grasp the degree of regional embeddedness of knowledge and technology generation and diffusion processes, as well as the type of learning attitudes and the potential for endogenous capabilities building of a particular RSI. These are crucial elements, insofar as regions with similar response to the top-down criteria may show different capacities to accommodate innovation and adjust in ways that enhance innovative capability.

The RSI integrated approach, by combining top-down and bottom-up views of regional structures, emphasises evolutionary mechanisms such as routines, technological trajectories, selection environments, diversity and path dependency. As argued by Lambooy and Boschma (1999, 2001), variety in characteristics, behaviours and performances is a key assumption of evolutionary perspectives, and such a variety is formed by its surrounding selection environment, which includes market and non-market factors. The regional environment acts as a sort of selection mechanism that may, or may not, provide conditions favourable to meet the new requirements of technical change (i.e. social capabilities for institutional change). Hence, new growth opportunities are shaped and constrained by the regional path dependency, or, in other words, by the inheritance of regional structural characteristics from past knowledge accumulation and learning.

[22] Following Cooke (2001), embeddedness refers to a set of characteristics appropriate for systemic innovation and reflecting the extent to which a social community operates in terms of shared norms of cooperation, trustful interaction and untraded interdependencies (see also Dosi, 1988).

In such a dynamic perspective, the interdependence between structural characteristics and actors should be regarded as a 'feedback' mechanism: not only the characteristics of the selection environment (market and non-market) and their change influence the actors, but the latter also change the environment (Lambooy and Boschma, 2001).

When integrating and applying the two lists of identifying features of RSIs, however, two related questions have emerged rather often in the literature, one mostly theoretical and the other empirical in nature:

- Is the RSI identified on the basis of an integrated evolutionary view a "hypothetical" or "actual" RSI?
- Are available information and data describing "characteristics" or "impacts"?

The next section discusses the relevance and applicability of the evolutionary integrated view of RSI by addressing in particular these two questions.

3. Relevance and applicability of the *evolutionary integrated* RSI view

3.1 "Hypothetical" or "actual" RSIs?

The answer to the first question might be that, paraphrasising Cooke (2001), given that the "hypothetical world is only a special case", the framework resulting from the integration of top-down and bottom-up approaches is arguably sufficiently broad and consistent to address specific and diverse empirical cases. The integration of the two views[3] helps undoubtedly define the "hypothetical" RSI, but the identifying features in practice combine in different ways, have different intensity, quantity and quality and depend on historic paths of regional cultures – made up by socially accepted values, norms, routines and generally customary practices –, degree of centralisation of governance in nation-states, evolution of social networks and capital, etc.. It is intuitive that the more diverse is the cultural base of a national system, the more meaningful the empirical analysis of its sub-national units appears to be, and the least the assumptions of a Listian view of innovation systems can hold.

Indeed, the presence of strong geographical asymmetries in socio-economic and innovative variables poses the question of to what extent the top-down and bottom-up criteria can be applied,

[3] A different and complementary perspective is to integrate the "regionalisation approach" and the "regionalism approach", the first relating the region to its competence capacity, the second connected to the region's cultural base which the degree of systemic potential stems from (Cooke et al., 1997).

or, in other terms, whether the identification of 'systems' as such is always feasible. The question thus is: to what extent the defining criteria justify the application of the concept of RSI (even accommodating for strong and weak RSIs)? The answer is clearly "to a limited extent", as any 'system' requires, to be distinguished as such, to have an internal coherence, a collective identity and 'rules of the game' which result in a regional whole or cultural model (Cooke et al., 1997). Such a limited applicability, however, does not seem to challenge the guidelines for empirical analysis, the latter being in principle oriented to test the goodness of the theory in describing the world as it is, and not as it might hypothetically be. The frequent inexistence of RSI in the real world does not provide grounds for the rejection of the concept of RSI as such (this being a misconception of the null hypothesis); it rather gives an indication of the fact that not all regions are (innovation) systems. Indeed, it has to be bore in mind that

> '[…] *there are a few fully functioning RSIs and even fewer where the economic performance of such regions is outstanding, at least in Europe* [….]' (Cooke, 2001, 958).

Indeed, building again on Howells (1999), the lack of agglomeration and localisation advantages for innovative activities in some regions may be attributed to a combination of top-down and bottom-up factors such as, for example:

- low density of interactions, both at individual and firm level;
- periferality, with respect to political and economic centres of power and decision sittings;
- presence of social and cultural marginalisation;
- weak social networks and capital;
- lack of dynamic innovative firms and institutions;
- feeble access to and attractiveness towards external knowledge and information flows;
- inflexibility of organisational and institutional structures, which hampers the capacity to adequately monitor, evaluate, absorb and diffuse innovation produced elsewhere.

These are indicators of weakness or lack of regional social capabilities, i.e. the capacity of the region as a social system to make institutional change for growth. The integration of the top-down and bottom-up characteristics defining RSIs renders highly questionable the inclusion of *weaker* regions in a systemic vision. It is not only the lack of a critical mass to generate, import, modify and diffuse new technologies, but also the dearth of an internal coherence of the societal structures that make up the regional governance, which prevents the attribution of the distinctive status of 'system' to the region. Weak and vulnerable regions are bound to be highly dependent from actual innovation systems, particularly from those belonging to the same NSI; their need of new

technologies is satisfied mainly by mere adaptation of imported knowledge and innovation; the intensity of relationships for innovation is higher with the outside world, due to the scarcity of endogenous capabilities; the high dependency from external providers couples with a low degree of openness and attractiveness towards external resources (weak regions are usually dependent from the outside, showing at the same time rather high levels of closeness in terms of participation to networks and activation of inflows/outflows of innovation). Even *intermediate* regional cases are often not eligible for the RSI status: this is, for instance, the case of either those regions whose industrial base is open to innovation, showing at the same time a feeble scientific system; or regions where, in spite of the relative strength of the localised scientific and research system, this is anyway not sufficient to ensure spillovers effects (Evangelista et al., 2002).

On the other hand, technological change and the breakthrough of new techno-economic paradigms are likely to have a significant impact upon the evolutionary concept of RSI, as well as on actual regions. The Information and Communication Technology (ICT) spread is far from being uniform across space; it changes the nature and the relative balance of contextual and systemic features of RSIs; it might broaden (or help reduce?) the gap between actual RSIs and regional peripheries. For instance, the rising techno-economic paradigm is having major consequences for labour markets - particularly visible within Europe -, leading to more unstable environments, transformation of work regulations, individualisation of labour processes, changing institutional protection and unemployment structure. Such changes, which are going to largely alter the links between the individual and the society, not only may create opportunities for rising RSIs, but also increase the scope of locking-in for 'low road''regions (Iammarino et al., 2004). New paradigms and structural change puts also in question the stability of the actual RSI, once identified as such. In an evolutionary perspective, the capacity of regions to hold within the process of technological change and globalisation is determined by the comparative advantage on which they can rely; besides, as seen above, the features of the region's internal organisation are subject to change over time (as learning processes are not stable by definition). This may lead to the strengthening or the breaking up of the systemic coherence, even whereas a system had been neatly identified (Maillat and Grosjean, 1999). Hence, whilst the conceptual framework as intended here – that is the evolutionary integrated view of RSIs – is believed to provide a suitable tool of interpretation of the variety of actual regional configurations, the main challenge is to keep it at pace with rapid techno-economic and institutional change and the consequent evolution of social capabilities necessary to cope with it. To successfully accomplish the task of updating the interpretative framework to

respond to the increasing complexity and variety of the actual world, however, the opportunities for empirical testing of its validity should be considerably improved, as discussed in the next paragraph.

3.2 "Characteristics" or "impacts" of RSIs?

The answer to the second question is indeed more problematic. The issue of the empirical identification of RSIs is rather broad and actually one of the most discussed in this field of research. The conceptualisation of the regional innovation system has never overcome the serious drawback of measurement and data collection connected to smaller (than the national level) geographical units. It may be argued that, somehow surprisingly, in spite of the long-standing acknowledgement of the interactive nature of innovative processes - which led to the substitution of the linear model with the chain-linked model based on feedbacks, interactions and networks (Kline and Rosenberg, 1986) - the empirical analysis of RSIs is still stuck to the consequential and oversimplified logic of the old theoretical models of technology-push and demand-pull (Evangelista et al., 2002).

Two different issues are worth pointing out here. The first is that, most commonly, available data and indicators are appropriate to measure "impacts" of RSIs – usually expressed in terms of economic performance – but they provide little help in examining the "characteristics" of the region in order to assess its system nature and overall quality, restraining the scope for testing the conceptual framework sketched above. Noticeably, the performance of firms – as measured by value added, exports, patenting, employment, etc. – cannot say that much when the identifying structural features of the regional system have not been clarified: are we measuring "the impact *of* what"? The limited possibilities to measure, for instance, interdependence at inter-regional level are not only constrained by the lack of data at subnational scale, but they suffer also for the scantiness of indicators appropriately devised to give account, for example, of the degree of attractiveness, dependence and openness of a region or, in other words, of interregional innovation flows. If then one turns to bottom/up characters, the drawback becomes even more serious: the state of the art on the estimation of intra-regional features and flows (i.e. embeddedness, interactive learning, social networks) is, to say the least, at a backward stage, in spite of the weight given by regional evolutionary economists to systemic innovation and interactive learning.

The second and related issue is that there are anyway inherent difficulties in drawing inferences on performance from data used in regional analysis. The concept of competition among RSIs is indeed well established as far as some aspects are concerned – i.e. conventional economic strengths and weaknesses – but much less as regard to others, such as innovation, which is usually determined at the national level (and, often, simply "regionalised"). In the majority of empirical analyses of RSIs

the competitiveness of a specific region corresponds simply to the sum of selected individual behaviours – e.g. the innovative activities of the resident firms – and not at all to that of the regional *system* as a whole. Hence, what is taken into account is not the overall competitive strategy of the region, but rather the local reaction to external decisions and strategies: yet, are we measuring "the impact *on* what"? Data on performance in general do not reveal whether regional behaviour *actually* affects firms' behaviour, or it is simply the aggregation of firms behaviours. There is evidence both of regions identified as RSIs displaying poor values of traditional economic indicators and of relatively weak (or non-) RSIs scoring rather well in terms of the same conventional measures (Cooke et al., 1997; Evangelista et al., 2002).[4]

Therefore, it is argued that little progress has been made in testing the definition of RSI on the basis of the importance attributed to localised knowledge generation and diffusion and contextual learning capacities. Even more rarely has this definition been applied in a historical perspective, that is likely to be enlightening on central questions such as: what regions are RSIs? Why? What does this status imply? As recently emphasised by Freeman (1995, 2002), a long-term historical approach is essential for the purpose of establishing a true link between socio-economic growth and systems of innovation. The very nature of technical and institutional change implies that gaps between different countries or regions within a country may take even centuries to open up, and a proportionally long time is also required to close them. Carlsson points out that only a small percentage of innovation systems studies "can be considered 'dynamic' in the sense that they focus on a historical process or development over time rather than on a snapshot of a system in a particular time period" (Carlsson, 2003, 11): the prevailing approach still adhere to a static view of the world! The persistence of the empirical and historical 'national bias' is all the more serious in countries characterised by a high degree of spatial imbalances - such as Italy, shortly discussed in the next section - in which, therefore, the scope for either the existence or the inexistence of actual RSIs is rather broad.

4. The application of the RSI concept to the Italian case

4.1 The 'geographical heterogeneity' of Italian history

[4] A further element needs to be highlighted, given its increasing importance in innovative processes and technological change, particularly in the ICT paradigm: the role of the demand for innovation. This implies that regions might be ranked according to their capacity to generate a demand (and to create the conditions to provide a supply). Such a demand for innovation comes from an articulated variety of actors (public sector, firms, social institutions) and their interactions and it is usually difficult to be detected by available information (Evangelista et al., 2002).

The Italian 'regional problem' is arguably at least a thousand years old. For the sake of brevity, in what follows an attempt is made to provide a short overview of this centuries-old path by aggregating the current 20 (NUTS2) Italian regions in broad areas or macro-regions according to their main historical commonalities (for a finer regional breakdown and a more documented discussion see Iammarino, 2004). Starting from around the 12th – 13th century, it is possible to roughly identify the following *historical clusters*:

North-west (Piemonte and Valle d'Aosta, Lombardia and Liguria): the economic wealth and the strong industrial orientation of this area are rooted in the substantial stability, both political and administrative, of the Savoia family in Piemonte (since the 11th century), and of the power of the Visconti and Sforza families (1300-1500) and, later on, of the Asburgo (up to the Italian unification in 1860) in Lombardia. Agricultural development, with sophisticated irrigation techniques, was already advanced at the end of the Middle Age; this allowed intensive crops (e.g. rice, fodder, etc.) and breeding with derivative products (milk, cheese, etc.). The water abundance of the area favoured the diffusion of water mills and looms, which played a crucial role in the establishment of the first industrial settings for the production of wool, cotton, linen and silk and manufactured textiles. Indeed, such activities stimulated related manufacturing productions in the area, such as that of specialised machinery for textiles, that provided the basis for the creation of the machinery and equipment industry (still one of the distinctive points of strength of the Italian and North-western specialisation model). The industrial development had actually overlapped, particularly in Lombardia, with the blooming merchant activity – flourishing since the 11th century – of the autonomous and prosperous communes of Milan, Como, Lodi, Cremona and Pavia, where social institutions and networks operated in a modern sense since their establishment. Moreover, since the 16th century the North-west experienced wide reform and restructuring processes aiming at diminishing ecclesiastic and nobility powers, as well as diffusing education across social classes, providing significant dynamic and innovative characters to the regional knowledge bases. Especially after the entrance in the Austro-Hungarian empire (1714), Lombardia benefited from the political and custom unification of the Asburgo leadership, becoming integrated in networks at the continental level; at the same time, the institutional reorganisation carried out by Vittorio Amedeo II (between 1720 and 1730) transformed Piemonte in the most organised and efficient bureaucratical state of the peninsula. As far as the Liguria region is concerned, its peculiar features connected to the history of Genoa – a crucial naval, merchant and financial core at the European level - were the basis of the regional development up to current times.

North-east (Veneto, Friuli Venezia Giulia and Trentino Alto Adige). The commercial, industrial and economic 'core' was certainly Venice which, due to its political influence and economic power, is to be listed among the first European cities for the whole period 1200-1700. Connected to the regional core of Venice, some clusters of manufacturing activities were mainly specialised in traditional skilled-intensive sectors (Murano's glass, Vicenza's jewel s, Bassano's ceramic tiles); others were oriented towards 'human resources building' (the prestigious university of Padua (1222) and the art centre of Verona); some others were more trade centres with dock and construction activities (Trieste). It might be argued that the pattern of development in the North-eastern area has followed a kind of 'urban driven' path: indeed, a part from the mentioned large urban agglomerations, the rest of the area suffered from the fact of being a 'boundary region' ruled by both Austrian and Venetian political powers, mainly devoted to agriculture and with a strong orientation towards primary activities (wood, breeding, agricultural products). However, in the 20th century the North-east went through one of the most striking socio-economic changes ever occurred in Italy, with the rapid transformation of its areas into industrial fast-growing and entrepreneurial regions (from essentially agriculturally-based production systems and societies), which has been labelled 'the miracle o f the 'Third Italy'".

Centre-north (Emilia Romagna and Toscana). These are rather different regions, yet showing similarities in some critical characters of their regional knowledge bases. As in the case of the communes in Lombardia, local governance and entrepreneurship and indigenous culture were soundly rooted in both Emilia and Toscana. In the first region, various types of sophisticated activities flourished under the strong traditions of the dukedoms of Parma and Piacenza (Visconti-Sforza in 1300-1500; Farnese family until 1730), Modena and Reggio (Estensi, 1300-1800), Ferrara and, particularly, of the autonomous commune of Bologna which, with its University established in 1088, exerted a powerful influence on the historical evolution of regional knowledge linkages.[5] Industrial districts like Carpi, Sassuolo and Faenza are among the oldest in Italy, whilst agricultural production systems, favoured by the illuminated political leaderships of the big families, by the rather anti-clerical, innovative and open local culture, and by the natural fertility of the soil, moved rapidly towards industrialisation (food industry). It is interesting to note that the provinces of Emilia-Romagna that benefited least of the general wealth and openness of the region are those of the east, subject to the Catholic Church State since 1500. The cultural and economic prosperity of Toscana started in the 11th century, with the unbeaten cultural traditions of its communes: Lucca,

[5] Actually, between 1513 and 1859 Bologna was formally part of the Church State, but it was ruled by an independent local authority.

Pisa, Pistoia, Siena and Arezzo were fierce competitors in market shares, product variety, trade and exchange intensity, cultural creativity and social dynamism, until Florence prevailed, absorbing anyway the most positive characters of Toscana's typical pattern of development. During the Grand Dukedom (1430-1859) important land reclamation works were carried out and sophisticated process innovations were introduced in agriculture (vineyard and olive groves). Resources such as iron in Isola d'Elba and marble in Carrara provided grounds for related manufacturing activities; the strength of local communities and social ties gave rise to specialised dynamic geographical agglomerations, upon which the archetype of 'industrial district' has been build (e.g. the famous example of Prato).

Centre (Lazio, Umbria, Marche and Sardegna): The whole area was under the conservative political influence of the Roman Church: Lazio since ever, Umbria and Marche since 1500. Whilst in the two latter regions agriculture and ceramic industries were the major points of strength, in Lazio economic and social activities were basically linked to the needs of a wide bureaucratical structure (administrative, legal and representative services, paper industry, etc.): the tertiary-oriented nature of the region continued throughout the Italian unification and were even reinforced after the choice of Rome as the capital of the kingdom. Sardinia's development was strongly affected by its long colonisation, first by the Spanish, then by the Savoia from Piemonte. Such external influences were mostly directed at exploiting the natural resources of the island, without promoting any structural reform or innovation process.

South (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria and Sicilia). The so-called Italian Mezzogiorno knew its glorious age under the Normans (Frederick II), who made the area economically and culturally advanced and promoted the magnificence of cities like Naples and Palermo until 1266. Since then, the 'Southern Kingdom' was ruled by Spain: the colony was administered on the basis of undisputed power of the nobility and peasants' exploitation. The principal resource was agriculture, often damaged by famines and barely productive for the lack of any innovation under the system of large agricultural estates; only Puglia, with its eastern geographical position, could develop flourishing agricultural and trade activities. The Kingdom became 'independent' with the Bourbons (1734): the latter have been traditionally blamed for the backwardness of the area, but in fact were in power for only 126 years (between 1734 and 1859, subtracting few years of French domination). It is clearly beyond the scope of this paper to go into the details of the complex 'Mezzogiorno problem', whole relevance for the topic discussed here (where and why some regions are RSIs and some are not, and what are the implications) is however crucial: for a more extended discussion see Iammarino (2004).

This brief and approximate summary has the only purpose to highlight the relevance of history in understanding the link between regional socio-economic, cultural and institutional trajectories and innovation systems, particularly whereas sub-national diversity is so deeply rooted in historical paths as in the case of Italy. It is argued that an evolutionary approach to the study of such a link can be the only fruitful way to deal with the crucial questions highlighted by the recent literature on regional development in Europe: how can regional trajectories be abandoned? Is it possible to diverge from social, economic and institutional past? How can structural and localised change be planned and managed? Is there a the role for regional policy at all levels of governance? (Boschma, 2004). The empirical evidence summarized below broadly support the necessity of a long-term historical approach for grasping the diversity of technical and institutional reaction to change in the Italian regions.

4.2 Systems of innovation and regions in Italy

In the broader context of the European Union the Italian National Innovation System displays the characteristics of an *intermediate* NSI, between the most advanced NSIs of the Centre-north (UK, Germany, France and the smaller northern European members) and the more backward EU areas (southern and, recently, eastern European partners). It is beyond the scope of the present work to discuss the main characteristics of the Italian NSI, its strengths and, even more numerous, its weaknesses, which have in fact even worsen in recent years preventing Italy from catching up with the most advanced European NSIs.[6] Drawing mainly on previous work of the writing author and other colleagues (Silvani et al., 1993; Iammarino et al., 1996, 1999; Evangelista et al., 2001, 2002), the application of the RSI concept to the Italian case seems indeed to be rather limited: what emerges is a variety of regional patterns, differing not only according to the specific strategies and performances of firms but also with respect to the presence (or absence) of contextual and systemic characteristics, as well as the density and quality of systemic interactions and scope and effectiveness of functions (thus, regional diversity with respect to *components*, *relationships* and *attributes*).[7] Referring back to past works for accurate regional profiles, and recalling the constraints of regional empirical analyses emphasised above, the internal geography of the Italian NSI can be by and large depicted as follows:

[6] A number of studies have addressed structure and performance of the Italian NSI. See, among others, Antonelli, 1988; Malerba, 1993; Archibugi et al., 1991; Evangelista et al., 1997; Ferrari et al., 2001).

[7] It should be reminded that whilst some "administrative" regions correspond to functionally defined areas, others are extensive and economically very heterogeneous, including distinct local sub-systems within them. In fact, as the size of the administrative region diminishes the influence of actors, instruments and actions "external" to the defined space tends to increase.

North-west: ***Italian RSIs.*** Lombardia and Piemonte (and to a lesser extent Liguria) represent the technological heart of the Italian industry. The full range of links and interactions forming the skeleton of an innovation system is visible in the case of these two regions, as for example: structured links between firms and between them and other organisations (Universities, research institutes, industry associations, etc.); presence of a good scientific and technological infrastructure; strong R&D intensity; diffused networks of technological services; attractiveness towards external sources of technology; active role of regional innovation policies; institutional flexibility and adaptability to change; etc..

North-east and Centre-north: ***Learning Regions.*** Generally speaking, in these regions knowledge flows and systemic interactions in innovation take mainly the form of inter-firm user-producer interactions, which are particularly dense in those industrial areas organised as districts. Such technological links, largely informal in nature and loosely structured, are enhanced by spatial proximity and by an economic and cultural homogeneity based on localised competencies. The innovation process is accomplished with only modest efforts in R&D[8]: the public R&D system is also rather weak. Accordingly, proper RSIs cannot be identified. However, innovation activities carried out by firms rely upon a mix of codified knowledge (engineering skills) as well as local-embedded competencies which are a result of long lasting cumulative learning processes. Linkages are facilitated by a high product specialisation of firms as well as by tightly integrated organisational models of production and favourable context-specific conditions, represented by a plurality of active institutional actors (specialised business services, government-supported local agencies, knowledge-centres, technology-transfer agencies, private business associations, chambers of commerce and training agencies). In the bulk of this area the systemic dimension of innovative activities is much more based on informal technological linkages, knowledge flows and learning processes within a rather coherent and cohesive socio-economic environment.

Centre: ***Conservative regions.*** Lazio in particular, due to its role of capital region, concentrates a large section of the Italian public R&D infrastructures and activities. The most frequent forms of linkages are those found between a restricted number of science-based firms and public and private research institutes. Yet, a proper RSI cannot be identified: in Lazio systemic interactions do not play such a critical role; support from local governments is not particularly strong; collaborative relationships between firms as well as other forms of technological linkages are not as intense as in

[8] The innovation process which takes place in these regions has been rightly labelled as a model of "innovation without R&D".

Lombardia and Piemonte; the regional culture is not oriented towards change and institutional reform.

South and Islands (Mezzogiorno): ***Peripheral regions.*** The Mezzogiorno emerges as a backward area both in Italy and within the EU. Its weakness does not refer only to the poor technological performances of firms but also to the absence or weakness of any systemic dimension of the innovation process, at least at the level of administrative regions.[9] Other unfavourable factors to innovation are present in these regions, such as a poor technological infrastructure, a model of industrial specialisation focused on low-technology sectors, generally ineffective innovation and industrial policies. Indeed, some elements seem to suggest that firms in the main carry out their innovation activities in isolation, showing little contact with other firms, R&D institutes and the broader institutional context. The lack of a critical mass of qualified components, relationships and attributes suggests that the status of RSI can by no means be identified in these regions. However, the emergence of "many Mezzogiorni", stressed by the economic literature particularly in the last decade, seems to suggest that both *catching up* and *falling behind* processes are taking place in the area, giving rise to an intra-South increasing divergence (see, for instance, Giannola, 1999, Guerrieri and Iammarino, 2002).[10]

Such a concise picture seems to closely follow the broad *historical clusters* sketched in the previous section. Indeed, historical origins of regional cultures, though largely disregarded in academic and policy debates, might offer both sound explanations of regional socio-economic gaps and useful indications for 'system building'.

Finally, it is interesting to have a look at a few recent indicators - used as rough proxies of both RSI identifying characters and socio-economic performances - by the above broad macro-regions as recognized on the basis of historical analysis (Tables 1, 2, 3).

[Tables 1, 2, 3 to be added]

[9] Indeed, some elements (rules, incentives, structural and historical similarities, etc.) seem to suggest that the whole Mezzogiorno could be considered as a "uniform" macro - region but, within it, the degree of differentiation, particularly in terms of performance, is indeed quite striking.

[10] It is worth to remind that the technological distance between the South and the North of the country seems to have slightly decreased over the 1990s (Evangelista et al., 2001). Such a positive trend can in part be explained by the poor R&D performances of the North-west, which has experienced a consistent shrinking of its R&D infrastructure, both in absolute terms and in relation to the rest of the country. Other factors explaining the converging trend shown by the Italian Mezzogiorno are the remarkable export growth of the second half of the 1990s; the rapid spread of Information and Communication Technologies, particularly evident among Southern SMEs; the dynamic performance of local production systems and the emergence and consolidation of a few industrial districts. The relative technological dynamism observedin the 1990s in the Southern regions might also be the result of a set policy actions (most of them falling within the EU structural funds framework) specifically introduced to foster investment and innovation in the less favoured regions.

5. Conclusions

It has been argued that, by adopting an evolutionary integrated approach the RSI framework does provide an adequate conceptual definition in order to investigate whether or not a region is an *actual* innovation system and why. However, it is also argued that the constraints on empirically testing the joint significance of both *characteristics* and *impacts* of RSIs have seriously hampered a better delineation of the concept. In other words, such an evolutionary integrated view of RSI appears to be a satisfactory framework, which should be target of further refinement and adaptation on the basis of sound empirical analysis, rather than being constantly criticised on purely theoretical grounds. Its main limitation lies precisely in the still insufficient testing due to scantiness of information and methodological bottlenecks. Clear thinking is a prerequisite for sound research efforts, but it is not a sufficient condition: adequate data and indicators – on structural characteristics, interactions and performances – are critically required. Research on RSIs will arguably go ahead only if supported by richer sets of both quantitative and qualitative variables and indicators and more specific focus on historical paths and origins of regional cultures.

Great data availability and historical perspective – and therefore empirical analyses able to modify the conceptual framework in order to better describe the 'actual' world rather than the hypothetical one - are critical also for the third dimension of the studies on RSIs, that is regional policy. As evolutionary mechanism like 'technological trajectory', 'selection environment' and 'path dependency' are crucial in determining the geography of innovation, history in terms of inheritance of regional structures and behaviours often acts as a filter for assessing new opportunities for social and techno-economic growth. As effectively pointed out by Lambooy and Boschma (2001), this is all the more important when policy implications in such an evolutionary perspective are to be drawn: regional policy – at local, national and supranational (EU) level – cannot start from scratch, but rather it has to be based on a deep understanding of how historical paths of development affect change. As the two authors have argued, in an evolutionary systemic environment (based on market and non-market interactions), it is unlikely for policy makers to change fundamentally the course of development of a region:

> '*Regional policy is likely to fail when local strategies deviate considerably from the local context. In such circumstances, policy makers have to account for the fact that adaptation to change is largely constrained by boundaries of the spatial system laid down in the past. However, this also implies that the potential impact of regional policy may be quite large*

when the policy objectives are strongly embedded in the surrounding environment' (Lambooy and Boschma, 2001, 113).

The empirical evidence presented in section 4 gives some preliminary support to the fact that regions differ not only according to the specific strategies and performances of firms, but also with respect to the density of systemic interactions, quality of contextual factors, and historical paths of regional cultures favourable to innovation. This evidence leads to a major result: contextual factors and historic path dependence affect both the innovative behaviours of individual firms as well as the technological trajectories of the region as a whole. This is not to deny the importance of the national system, but rather to stress the complementarity between NSI and its regions/RSIs. Future research will be directed to explore more in depth the link between regional socio-economic, cultural and institutional trajectories and systems of innovation at both historical and empirical level, using for the latter a wider set of indicators (available in the Italian case) able to reflect the region as a "social system".

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