Competitive European regions through research and innovation\textsuperscript{1}

Different theoretical approaches to innovation policies

Report Working Paper of

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The European Policy for Innovation plays a central role within the reform of the Lisbon strategy. This policy that has conceptually evolved from a linear to a systemic approach is negatively characterized by stratification and insufficient integration of different tools that operate simultaneously without clear identification of specific and precise targets and results. Despite extensive experimentation, especially on a regional level, the learning process has been only partial both for the centre and the periphery. It is also for this reason that this policy has been strongly criticized and does not elicit homogeneous opinions even from its supporters. The traditional policy on public and private research has been called into question: there are some positions that accept local policies and others that refuse them or that, in theory would accept them but have strong doubts regarding their implementation (particularly in underdeveloped regions). A shared idea, developed in response to such difficulties, is that the transition from old to new types of interventions has to be completed; this means going beyond previous policy tools linked to the linear approach, and making room for new interventions belonging to the systemic approach: measures supporting start-ups and small firms, seed venture capital funds, technology transfer, R&TD valorization, cooperation and communication between research institutes and business.

Within this framework, regional policy has a central and, for some, even exclusive, role. Considerable criticism has been leveled against this key role given to local policy, considered inappropriate and too difficult to manage from the periphery. However, structuring this debate by reinforcing the contrast between different positions could harm the prospects of achieving useful and practical regional policy. Hence it is necessary to explore a different path resulting from the analysis of a crucial issue directly or indirectly tackled within the debate, namely the existence or otherwise of an inevitable alternative between the old and new kind of intervention. It may be argued that these two approaches are not really alternatives (even taking into account strict budget constraints) by critically analysing the arguments of those who consider them alternative.

The first argument is the idea that while in Europe there is little need of traditional research policies since science research is already of a high level, the capacity to convert results into of product, process and organizational innovation is lacking. This "European Paradox" might, nevertheless, be called into question given the substantial gap between Europe and the USA both in innovation and research. The second reason that underpins the asserted necessity to complete the transition towards new tools for innovation policy is that this change is required by the modern systemic approach to the innovation process. In reality, supporting policies for research does not entail the acceptance of the linear approach. The idea that the systemic approach to the innovative process implies new interventions that exclude traditional ones is not justified for theoretical and practical reasons. In the systemic approach context, we may find theories on economic change that point to a large number of both new and old obstacles to innovation. Many useful suggestions have been made for conditional interventions that might face specific constraints arising in particular contexts, always remaining in the framework of a systemic approach.
Bearing in mind the opportunities, apart from the constraints and obstacles, there emerge some ideas for regional policy on innovation that lends importance to human capital, public research and traditional industrial policy. However, some kinds of policies still need to be defined, for the support of "generative relations", besides those already known to support systemic innovation. It is far from easy to put together such articulated policies in a context of scarce resources. If the old policy tools cannot be fruitfully laid aside, then the solution that imposes a top-down or the opposite bottom-up approach is not sustainable. Attention is focused on an explicit integrated position, top-down and bottom-up both in content and management. Hence it is fundamental to define the expected procedural results, their timings and the forms of inter-institutional cooperation, in order to underline the conditions for evaluation to acquire a central role.
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1. **EUROPEAN INNOVATION POLICY**

1.1. **Rationale**

The Lisbon agenda was adopted in Spring 2000 to improve growth, innovation, employment and social integration of the European Union. With the Lisbon strategy (CONCL 2000), innovation and European competitiveness dependent on new products, services, production processes and organisation forms gained increasing importance. Innovation policies began to be considered as specific essential components of industrial strategies. A process in this direction was in fact already in place. Innovation was explicitly included in EU public documents from the early 1990s on the basis of the claim that the European Union suffered from an inadequate innovation performance in comparison to the United States (COM (1995/688)). The first step was taken in 1995 with the Green Paper on Innovation, followed one year later by the First Action Plan for Innovation in Europe.

In Spring 2005, judging the results as non-satisfactory (EC 2004), heads of state and government chose to refocus priorities on innovation and growth establishing a longer programming period, a single set of Integrated Guidelines, and the preparation by Member States of National Reform Programmes (CONCL 2005; CONCL 2006). The reform, based broadly on the recommendations of a mid-term review led by former Dutch Prime Minister Wim Kok to avoid the previous plethora of different targets and fewer synergies between the different strands, has been understood at most levels but the scenario between possible alternative settings is still unclear. This uncertainty especially concerns the role and weight of European, national, regional and local responsibilities. The Union has three instruments for innovation policy: Structural Funds (277 bn euro in 2007-2013) and the Cohesion Fund (70 bn), a total of 347 bn for the "Cohesion Policy"3, the Framework Programme (50 bn) and The Competitiveness and Innovation Framework Programme (3.6 bn). They are very different in size, but also in their legal basis, design and methods of allocating funds4. Nevertheless, the Commission is working

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2 In the Kuhlmann’s proposal, there are three alternatives: —“i) the idea of an increasing centralized and dominating European innovation policy arena; ii) the opposite, i.e. a progressive decentralization and open competition between partly strengthened, partly weakened national or regional innovation systems, and finally iii) the vision of centrally mediated mixture of competition and co-operation between diverse regional innovation cultures and related governance structure.” (Kuhlmann 2001).

3 "Cohesion policy focuses on promoting regional excellence. In the current programming period it has become a major source of investment in support of the Lisbon Strategy in fields such as RTD and innovation both in the least developed region where capacity for these activities needs to be created, and in the more advanced regions where they need to be reinforced. For Cohesion Policy programmes covering 2007-2013 Member States are required to 'earmark' between 60% and 75% of the resources available for Lisbon-related investment, notably in RTD and innovation.” (COM 2007/474 final, p. 3).

4 "Relating to their different Treaty basis, research and innovation instruments target specific themes, while cohesion policy instruments target specific geographical areas. The first set of instruments results in thematic specialisation, whereas the second seeks to promote an integrated approach. There are also differences in implementation methods. The 7th Framework Programme essentially uses competitive calls for proposals at European level. In the evaluation of proposals the Commission is assisted by independent experts and the proposals are selected on the basis of excellence. The Competitiveness and Innovation Framework Programme also uses calls for proposals at European level for the ICT and Intelligent Energy components, while the other financial instruments work with a permanent open call for expression of interest that will be considered by the European Investment Fund (EIF) and the Commission. Cohesion policy programmes are implemented on the basis of shared
towards their synergy and integration\textsuperscript{5}. For now it is unclear in which direction this integration will move. Perhaps towards "regionalization" of the Framework Programmes, although this appears highly improbable. Perhaps towards "nationalization with thematic specialization" of the Cohesion Policy. Or it could move in other ways.

1.2. The framework

Both the design and practical implementation of innovation policies have undergone several changes over time. Policy design has been driven by a framework issued by the European Commission and the European Council, influenced by theories of innovation process and their changes that have evolved from the "linear" to the "systemic" approach\textsuperscript{6}. In the former, innovation is seen as a well-identified sequence of consecutive actions. Innovation starts with research activities performed by an inventor or research group, which leads to an invention which is not yet ready for commercial exploitation. Then applied research and development activities, usually performed by industrial research laboratories, create a new or improved product or process with a real commercial value. The resulting innovations are sold, adopted, and eventually imitated by other firms. According to this approach, some actors "demand" and others "supply" innovations. Firms producing goods and services need innovation, driven by market competition. Research departments, technology centers, and universities supply R&D lured by the money they need in order to survive, and for prestige in the scientific community. The linear model was rooted in the design and results of the first practices of measuring innovation by means of R&D expenditures, in the 1930s, with the enquiry of Holland and Spraragen (1933). In the 1940s and 1950s it was common belief that supply would come first (Bush 1945) and demand would follow. Then, starting with the celebrated contribution of Schmookler (1966) in the 1960s, demand was conceived as making the first and critical move. But also the "demand-driven linear model" was criticized on the basis of empirical findings (Mowery and Rosenberg 1979). In the second half of the 1970s, indeed, some authoritative critics demolished the paradigm (OECD 1976).


\textsuperscript{6} According to Rothwell (1992), the evolution of models of innovation process presents five stages.

management between the EU and the Member States in a system of multi-level governance. Whilst they often also use competitive calls for tender, the scope of intervention is generally limited to a region (though some cohesion policy programmes also cover a Member State or a group of regions). Hence the selection process is based primarily on regional partnerships. Due to these differences, the direct beneficiaries can differ as well." (COM 2007/474 final, p.4).
According to the systemic approach (Nelson and Winter 1977; Nelson 1981; Kline 1985; Kline and Rosenberg 1986; Freeman 1987)\(^7\), on the other hand, innovation is seen as a non-linear process that involves linkages and feedback loops amongst actors whose role cannot be identified in advance. Their roles are economic and scientific, internal and external to the firm, linked together by multiple causalities and feedbacks and heavily dependent on the social, institutional and economic context (Lundvall 1985; Dosi, Freeman, Nelson, Silverberg, Soete 1988; Nelson, Rosenberg 1993, 1994). Innovation is then seen as not simply given by the competitive environment and resources for R&D, and is not described in a simple general way. In the systemic approach problems can arise not only on the resource side, but the whole innovation process may be problematic.

1.3. The policy in practice

Also in terms of practice European innovation policy has evolved significantly over the last fifteen years. In the early 1990s the emphasis was mainly on RTD expenses, whereas now there are more measures supporting start-ups and small firms, seed venture capital funds, technology transfer, R&TD+i promotion cooperation and communication between research institutes and business (Bachtler 2007). However, it was observed that the transition from the linear to the systemic framework is far from complete. "Although it is the systemic model that now dominates in policy discussions, many measures put into practice with the intention of promoting innovation still appear to owe more to the linear view" (COM 2003/112, p. 7)\(^8\). On the other hand, the process of regionalization has proceeded apace, supported by the idea of the important role of the social and economic context in shaping and sustaining the innovation process in the light of the systemic approach that entails a "territorial approach" (OECD 1992, Lundvall 1992, Cook and Morgan 1993, Cooke 1998, Storper 1995, Amin and Thrift 1995, Storper 1997, Howells 1999, Barca 2004). A practical aspect of this regionalization is the increase which has already occurred and has been projected in the share of funds allocated to innovation-related activities in cohesion policy. The result is that, today, many different policy tools operate simultaneously even within individual instruments such as cohesion policy. This is not wrong in itself. The problem is that there has been more stratification than integration among different tools and approaches, and there are good reasons for dissatisfaction. Greater clarity is needed to identify specific targets for the better implementation and assessment of policy tools. Without this assessment (Musyck and Reid 2007), in the field, actors and policy makers (both at the bottom and at the top) learn too little, and tend to proceed more on the basis of clichés than on effective practices and results. Consequently, funding is available locally, but not the perception of the strategy behind it. This state of affairs is not so recent. Criticism has already been expressed, at times harsh, denouncing the lack of a coherent EU innovation strategy (Lawton-Smith, Tracey, Clark 2003), or its considerable difficulties and shortcomings (Luukkonen 1998, 2002; Bradley 2006; Bachtler and Wren 2006).

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\(^7\) Godin (2007) shows that the idea goes back to several OECD papers (from 1963 onwards).

\(^8\) One reason is founded in the strength of routine, another in the retroactive effect on policy design made by assessment and evaluation practices often "implicitly still based on an outdated, linear view of the innovation process" (Molas-Gallart, Davies 2005, p. 1) and in the use of indicators (EC 2003) of innovation scoreboards (Grupp and Moogee 2004; Katz 2006).
2. DIFFICULTIES AND QUESTIONS

2.1. Two mind-sets

To deal with this difficult situation, previous considerations seem to suggest the need to complete the transition from a linear to a systemic approach. Indeed, this suggestion is found in many of the different analyses mentioned, but often without the relevant caveats to avoid possible adverse results. For many, this completion of the transition to the systemic approach means less traditional research and industrial policies, and softer measures, in the context of specific areas and local communities. In this perspective, there will be plenty of room for a regional innovation policy dimension that would become quite predominant as a "bottom-up" innovation policy. This position stems from the idea that the distinction between linear and systemic views of the relation between science and innovation fits with the distinction between traditional research policies and new policies for innovation. This is, however, a poorly founded idea, and there are good reasons for thinking that the two distinctions do not coincide, and there is instead compatibility between a systemic approach and traditional policies for research, in addition of course to new types of intervention.

Accepting this compatibility leads us out of the impasse brought about by strong dissent over full regionalization of policies for innovation. Dissent manifests itself in various ways. There are extreme opinions that follow influential contributions (Boldrin and Canova 2001, Tabellini 2003), arguing that the whole cohesion policy would only have redistributive results, a position that also emerges in the important report on the future of structural policy in Europe (Sapir 2003). There are, moreover, more or less skeptical opinions in favor too, outlining the poor administrative capabilities (Oates 2005) in many regions.

2.2. Systemic approach and research policy

For the very defense of realistic regional innovation policy it seems worth noting that there is no incompatibility between the systemic approach and traditional policies for research. Those who think the opposite are often not following theoretical arguments but pushed by the evocative force of the so-called "European paradox". The fact that Europe is lagging behind the United States in the field of technological progress was in this way qualified, *inter alia* by the European Commission, with the claim that EU scientific performance was excellent while its capability in transforming the results of research into innovations and competitive business advantage was weak. There are, however, recent data showing that European countries (with only few exceptions) are weaker than the US in research as well as in development and innovation. The Commission itself recently acknowledged this fact and has redirected its analysis accordingly.\(^9\)

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Secondly, it is sometimes claimed that universities in Europe operate too independently of business: greater focus on applied research which is useful to the immediate needs of enterprises often accompanies the idea that universities and research centers should change their attitude, which is traditionally too autonomous. Here also we can dissent. Better complex (systemic) synergies between firms and universities will emerge when both sides are at a similar, high level in their fields, and strongly defending their identity formally and informally, than when they try to interact by adapting to each other (Etzkowitz 2002 p. 10; Etzkowitz, Viale 2005, p.7). This also means that it would be better in a social sphere and for business or universities to keep defending the Open Science System and public funding for basic research (Dosi, Llerena, Sylos Labini 2006, cit.). The celebrated Stanford technology transfer program is a case in point 11.

The third consideration is theoretical. The distinction between the linear and systemic approach to the innovation process does not coincide, as often thought, with the distinction between neoclassical theory and evolutionary theory of economic change. The two distinctions concern different aspects. The first (linear - systemic) concerns the nature of the actors and their actions in relation to the results. The second concerns conditions, resources and constraints. Given actors with imprecisely defined roles ex ante and multiple and circular causations between them (systemic approach), what affects the results is both their knowledge and willingness to act and to risk (neoclassical point of view) and the conditions of their learning (evolutionary point of view). Innovation results are affected by the wide range of conditions, constraints and resources considered by both the great families of theories of economic change.

The divide between the neoclassical approach (traditional and modern, as in "endogenous growth" 12) and evolutionary approach is in what they see affecting the degree and nature of limits to the incentives for, and conditions of change in a market economy. In the endogenous models, economic changes are in a broad sense characterised as, or linked to "ideas" that are non-rival, they produce "economies of scale" that cannot be accommodated in the competitive market and social optimum framework (Jones 2005). In the traditional neoclassical approach, economic change is constrained by obstacles to the mobility of inputs and outputs that may require public intervention. This orthodoxy conceives public innovation policy as a way to remedy such failures. On the other hand, the evolutionary approach (in which we may group together old and new theories) emphasizes the trial-and-error learning process, which is not limited to optimisation of rational behaviour where results depend on the input. In trial-and-error learning processes you cannot achieve results even if there are resources. As a learning process, economic change requires in the evolutionary approach more public support, not limited to the provision of inputs and

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11 "The analysis demonstrates that […] it] was neither the result of purposeful design, nor driven solely by pecuniary goals on the part of key individuals. Rather, the program emerged from the confluence of multiple approaches […] The interaction of industry and academic science within the university took on diverse forms, reflecting faculty efforts to make sense of new opportunities in the context of their existing goals of preserving reputation and advancing their research programs. […] Norms of open science endured […]. While some faculty engaged in patenting and licensing efforts to expand their research programs, others approached commercializing as a means to protect their work from firms, drawing a boundary around their science." (Colyvas 2007, p. 474).

12 "In the broad sense in which I use the term, the endogenous growth model of Romer and Lucas and their many successors are entirely neoclassical" (Solow, 2005)
rules. This support will target the organization and action of various formal and informal learning approaches.

Thus the distinction between the neoclassical and evolutionary theory of economic change does not coincide with the distinction between the linear and systemic approach to the innovation process. The first concerns the intensity and purpose of public intervention, the second the actors and their roles we have to deal with in the policy design. The neoclassical approach can thus be combined with both a linear and systemic theory of innovation. However, when the unsatisfactory linear approach is crossed with the neoclassical theory, you get an unduly simplified policy. The neoclassical attention to resources, on the one hand, and the idea that the innovation process takes place in recurring stages, on the other, give rise to the possibility of designing policies simply addressed to the segment of this process which is deemed more worthy of special support. Thus the idea of poor European capability in the field of translation into innovations of scientific discoveries and the idea that neoclassical and linear approaches coincide would lead to policies designed solely or mainly for applied research. This would clash with the opposing entrenched evolutionary-systemic position, which would mainly propose policies targeting communication and cooperation between universities and firms, and supporting the formation and activity of business networks. The result would be a singular loss of interest in one case and another for basic research. This would be a serious mistake in view of the data that show a significant delay in Europe also on this crucial side. Neoclassical emphasis on resources combined with a correct nonlinear approach to the innovation process leads, instead, to properly designed funding for basic and applied research. The latter will then be usefully achieved by policies conceived in a systemic and evolutionary approach.

2.3. A pragmatic strategy

The innovative non-linear process requires both resources and learning support. While resources alone cannot overcome the lack of learning, the opposite also holds. Thus, a "properly designed" type of policy results from a systemic approach of innovation in which different theories of economic change suggest therapies for differentiated constraints. This strategy that conceives diagnostics as a central activity, is in line with the spirit of the position of the influential World Bank Report on "Economic Growth in the 1990s: Learning from a Decade of Reform" (WB 2005). As Dani Rodrik points out (Rodrik 2006, 2008), "the good news is that there is substantial convergence in the policy mindset exhibited by micro evaluation enthusiasts, on the one hand, and growth diagnosticians, on the other. The emerging "consensus" revolves not around a specific list of policies, but around how one does development policy. In fact, practitioners of this "new" development economics—whether of the "macro" type or "micro" type—tend to be suspicious of claims to ex-ante knowledge about what works and what does not work. The answer is neither the Washington Consensus nor any specific set of initiatives in health or education. What is required is recognition of the contextual nature of policy solutions. Relative ignorance calls for an approach that is explicitly experimental, and which is carried out using the tools of diagnostics and evaluation." (Rodrik 2008, p. 1). Within this setting the outdated idea that there are general recipes is rejected; and we can also therefore say that the "territorial dimension" of the design and implementation of policies should be definitively acquired.
2.4. The territorial dimension

For many, the need for a regional innovation policy is obvious (possibly as a partial revision of cohesion policy to avoid simple redistributive logics and practices) (Morgan, Nauwelaers 1999; Cooke, Boekholt, Tödtling 2000; Fritsch, Stephan 2005). There are, indeed, not only the reasons that underlie the constraints to economic change that may be local: constraints are accompanied by opportunities. It would not be easy, otherwise, to account for greater regional disparities than national disparities, and the correlation between regional disparities and technological capability (Gardiner, Martin 2004; Enflo, Hjertstrand 2006). In terms of causality chains, there is broad consensus on a few mechanisms that are local (Macpherson and Holt 2007; Cantwell and Iammarino 2003). Two appear the most relevant, often highlighted in the literature. In essence, one mechanism concerns relational learning, and the other links cumulative innovation and the dynamic context of social, economic, human development. The first relates to the exchange of knowledge which is so important in learning processes. Despite enormous progress in information technology, important differences remain between information and knowledge; spatial distance matters for knowledge spillover (Jaffe 1989, Keeble and Wilkinson 1999, but see a critic appraisal in Breschi and Lissoni 2001, Caniels and Romijn 2005). For the same reason, locally specific human capital skills and specialized labour pools are important sources of innovation, as well as local tried-and-tested company networks. The second mechanism relates to self-reinforcing processes of local knowledge, production, innovation and local development (Isaksen 2001).

Given the recognized presence of these localized opportunities and following the Lisbon agenda, there is a general trend towards policy experimentation at regional level (Bellini, Landabaso 2007). However, European regions should rapidly overcome the age of experimentalism and the endless search for some "new" good practice, and evolve into a more mature stage, both conceptually and in practice. There are then both good reasons and strong doubts concerning regional innovation policy. To better understand the difficulties we need a suitable definition of what differentiates "regional innovation policy" from other possible conceptions. We will return to this topic in the last section.

3. Theories of economic change

It may be useful at this point to set out a taxonomy of theories typifying the different conceptual approaches to economic change and classify them into diagnosis and therapy. This exercise is far from easy as it attempts to summarize both the historical developments of theory and the reality of policy making. The taxonomy will also attempt to separate into very distinct classes what may be quite complex and overlapping. Taking into account both practical and theoretical considerations, the matrix that follows has two main columns and two secondary columns, a total of four. In all cases, the non-linear hypothesis of innovation processes is assumed.
The two main columns correspond to the main distinctions that emerge among the theories with clear policy implications: i) the neoclassical view supporting the accumulation and employment of inputs of economic growth and of public and private R&D; ii) the evolutionary view supporting learning in trial-and-error processes\textsuperscript{13}. In the first main column we have a distinction between the traditional theory of growth (where the growth of TFP is "exogenous") and the theories of "endogenous growth". The fundamental theoretical background of the traditional neoclassical factor-based theory and the new endogenous growth theory are in fact quite similar in representing the crucial relevance of resources, some of which may have a social return which is greater than the private one, so that market failures may occur, thereby justifying public involvement in the economy. From the policy-making point of view, new growth theory amplifies national or public involvement in the economy through traditional means (defense, traditional infrastructure and competition policy) as well as through innovation-related activities (especially public R&D and the public education system). These policies tend to be national with some regional projections. The interventions supporting basic research and firms may have a local dimension as the policy menu is conceived according to the current regional situation and potential. The logic is, however, normally top-down. The main tool will be a national-sectoral plan, even it is disaggregated into regional sections.

In the second main column we have a distinction between the supporting actors' innovation activity (systemic actions for innovation) and those targeting actor relations supporting their positive character and potential (generative relations). In these approaches, self-reinforcing and differentiated local processes tend to emphasize regional policies (with some national projections). The logic is bottom-up, and conceptually the national plan would be the result of the sum of local programmes.

It is worth noting that approaches (3) and (4) have incompletely clarified margins. Approach (3) includes well-identified and practised policies, but its hypothesis of uncertainty is a little inconsistent; approach (4) is more consistent, considering radical (ontological) uncertainty in innovative processes, but does not yet have adequate policy specification. This distinction within evolutionary theory comes from an analysis of relational learning and changing (Maskell and Malmberg 1999). "Learning exhibits path-dependent features that can prevent learning outside the confines of existing knowledge and institutional routines." (Dosi, Freeman, Fabiani 1994). Thus, from a policy perspective similar limits of incremental learning have been outlined by Charles Sabel (1996). In a series of papers Sabel explored new forms of regional policy that attempt to move beyond programmes designed purely to encourage incremental learning on the part of firms (Henderson 2000). Consequently, in theory and in practice we may have two policy designs. Both field studies (e.g. from Henderson 2000 on Wales, to Rossi and Russo 2008 on Tuscany) and the specific literature (Davidson 1996, Lane and Maxfield 1997, Dequech 2004, Lane and Maxfield 2005, Lane, Pumain, Van der Leeuw, West 2008) show that policy design can be conceived (for example in order to support networks) either: i) as targeting the network activity, or ii) as targeting its generative character. There are substantial differences in practical terms. In order to assess the projects' achievements, in the first case (approach 3) indicators will relate to publications, workshops, training courses, software, patents and prototypes.

\textsuperscript{13} Consider also that in the neoclassical economy the basic structure of the system remains constant for long periods of time, while in the evolutionist view it is constantly changing.
In the second (approach 4) they will relate to changes in network composition, partners involved and their competences, its organization, kinds of interactions. Learning by monitoring entails, in the second case, studying the effects of the programme over a longer timespan while policy interventions have proven to be most effective when supporting "multivocal" actors (e.g. service providers) and when they were able to distinguish and support, among the network actors, the key actors in generating innovation potential. This could be considered difficult to implement and not strictly necessary in the 3rd approach. If the innovation is predictable, at least in terms of probability, agents are able to design, without support, the composition of the network, its organization, the right kind of interactions, their different roles and functions. The results can be assessed in the short to medium term. This shows that the main divide between approach (3) and (4) involves their different theories about uncertainty: epistemic (approach 3) versus ontological uncertainty (approach 4), and consequently the divide between incremental and "really new" innovations (products and processes that are new for the firm and the market, or the technology paradigm, the term _incremental_ referring to those innovations that are only new for the firm).
<table>
<thead>
<tr>
<th>Part 1</th>
<th>1 - Traditional</th>
<th>2 — &quot;Endogenous&quot; growth</th>
<th>3 – Systemic actions for innovation</th>
<th>4 – Generative relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Key issues</td>
<td>The traditional theory of growth stresses that resources are the main effective limit to development. The growth of product depends mainly on the accumulation of capital and on the aggregate elasticity of substitution of factors.</td>
<td>Theory of &quot;endogenous growth&quot; underlines the diverse capacity of different economies to acquire and apply new knowledge, even in the case of &quot;followers&quot;. These different capabilities lie in specific internal resources, especially R&amp;D expenditures. The aptitudes of different economies in this field are historically conditioned. On the other hand, the market and decentralized decisions are unable to provide such investments in a socially optimal amount.</td>
<td>Some &quot;evolutionary&quot; theories (old and new) state that productivity growth may be a result of dynamic economies of scale. Others outline a feedback between social environment and productivity growth. This makes the innovation definitively non-linear, mostly endogenous, partially auto-driven and partly independent of resources, depending instead on many actors' decisions.</td>
<td></td>
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<tr>
<td>B - Justification for public intervention</td>
<td>Market and decentralized decisions are, sometimes, unable to fully and efficiently employ, allocate and reproduce resources. This may happen in the case of natural monopolies or externalities or common and public goods. These circumstances may relate to factors of production as such or to goods and services complementary to them. In these cases, without public intervention, directly overcoming these bottlenecks or providing regulations or incentives, the rate of economic growth would be less than the potential.</td>
<td>R&amp;D activities have: positive externalities, public good nature, imperfect and asymmetric information. Projects with an unattractive rate of return from a private perspective might be beneficial for society at large; companies might be reluctant to fund risky but valuable projects and highly qualified personnel may be unaware of recruitment opportunities in innovative undertakings. Because of this, without public intervention regional differences in growth and productivity are likely to be self-reinforcing. Regions that initially lead in science and technology and have concentrations of skilled workers attract further resources and capabilities.</td>
<td>Those features commonly attributed to R&amp;D activities are in fact, widespread in all actions the many actors must play to learn in a trial-and-error process. Without public intervention the necessary cooperation between actors may be impossible where the local productive social an institutional structure is weak and fragmented. Regional differences are likely to be self-reinforcing, with little regional convergence or even divergence over time despite economic integration. This may occur not only because leading regions maintain their advantage but also because less developed regions cannot catch up.</td>
<td></td>
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<tr>
<td>C – Policy fields</td>
<td>Public goods and services, law and order, liberalization of markets, government efficiency.</td>
<td>Public funding of basic and applied research, support to high-tech and leading edge technological development, higher education.</td>
<td>Industrial and regional policy based on a broad definition of R&amp;TD+1 considering also innovation in services and organizational innovation.</td>
<td>Industrial policy embedded with a renewed regional policy.</td>
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</tbody>
</table>

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14 Ontological vs. epistemic uncertainty (Davidson 1996)
<table>
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<tr>
<th>Part 2</th>
<th>Neoclassical</th>
<th>Evolutionary</th>
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<tr>
<td>1 - Traditional</td>
<td>D – Policy tools</td>
<td>3 – Coordinate actions for innovation</td>
</tr>
<tr>
<td>2 — &quot;Endogenous&quot; growth</td>
<td>Provide basic R&amp;D infrastructures. Finance R&amp;D efforts, big science in particular. Utilize Tax incentives and rebates for companies undertaking R&amp;D efforts. Support critical masses in R&amp;TD+1 and centers of excellence, competence centers. Provide funding for tech-starts.</td>
<td>Cooperation-based policies. Cluster promotion, the geographical concentration of firms with active channels for transactions, dialogue and communications, that share common opportunities and threats. Technology transfer, entrepreneurial promotion, financial engineering targeting new ventures, technology parks.</td>
</tr>
<tr>
<td>4 – Generative relations</td>
<td>Manufacturing extension programs, incubators, university - enterprise networks, provision of advanced business services including knowledge management. Network monitoring. New tools to be designed in order to support generative characters of relationships and networks.</td>
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<tr>
<td>E – Main policy actors</td>
<td>National governments, national science foundations, public-private science foundations, universities, public R&amp;D labs, multinational high-tech companies with internal leading edge R&amp;D facilities. Local governments where the main research facilities are located.</td>
<td>Science and technology programs for economic development: clusters of firms in medium and high tech sectors, leading universities with R&amp;D facilities, technological platforms, technology &quot;corridors&quot;, public private partnerships. Local and regional governments.</td>
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<td>F – Expected outcomes and their times</td>
<td>The main result envisaged by this approach is a discontinuity in the rate of growth of GDP. This must be considered a very long-term result. Assessing the effective impact of policies requires, therefore, establishing some &quot;intermediate goals&quot;. They may be in terms of quantified supply of public goods and services, of progress in accessibility of wasted resources, of progress in education, financial services, efficiency of public administrations and markets.</td>
<td>The link between basic research investment and concrete results of new products and process is to be considered indirect, full of uncertainty, projected in the long term. The results to be monitored have to be, therefore, in terms of research outcomes and in terms of consolidation and the reputation of relevant groups of researchers in the public and in the private sector, and in terms of higher education.</td>
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<td>G – European approach</td>
<td>The actions supported by these policies are probably the most valuable also in the short term: number of new networks between firms and between research and business, number of stabilizations of such networks, number of firms and other subjects participating in technology transfer programs entrepreneurial promotion programs, financial engineering targeting new venture programs, technology parks, technology centers, measurement of volume and value of these activities. The final results (innovations), must be considered in the medium-term and mainly as incremental innovation.</td>
<td>The expected results of this policy are more radical innovations and &quot;really new&quot; products and processes. These results should be monitored by a specific activity built to detect the effects of policies in the medium-long term, also several years away from actual policy implementation. It is useful, moreover, to establish in this case intermediate objectives which are useful in the short term and coherent with the (new) policy tools to be implemented.</td>
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<td></td>
<td>Concentrate funding on European R&amp;D Framework Programme, based on pre-competitive research in a limited number of leading edge technological fields: maintain international character of projects and competitive tendering based on excellence criteria. Work with national governments and/or strong business associations and global corporate players.</td>
<td>Redirect Structural Funds towards catalytic incentives to promote innovation: especially technology and knowledge transfer between education establishments and business, and between large firms and SMEs. Improvement of evaluation targeted at establishing best practices in schemes and facilities dedicated to &quot;triple helix&quot; (universities, business, institutions)</td>
</tr>
<tr>
<td></td>
<td>Traditional national and regional economic policy</td>
<td>Still much to be done. It might be as on the left, but with more emphasis on learning for innovation policies; and for new evaluation capacities targeted not only towards &quot;networking&quot; but also towards medium term and uncertain - unexpected innovation results, as well as on intermediate objectives to be established (as above).</td>
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</table>
4. REGIONAL INNOVATION POLICY

4.1. Contrasting perspectives

The considerations set out so far suggest two different perspectives in designing a regional policy for innovation. In the first perspective the importance to be attributed to identifying constraints and providing resources tends to suggest top-down policies. In this setting, regional policy would be seen as a local projection, to overcome local constraints and obstacles, of national sectoral policies in the fields of public goods and regulation, for investment in research and development and human capital. In practical terms it would be the \"nationalization and sectoring\" of policy cohesion that would converge, despite its greater weight, to the logic of the Framework Programme. In the second perspective, the emphasis on specifically local opportunities, such relational learning and interrelated processes of innovation and overall improving of context, could suggest a bottom-up policy approach. These are two definitions that appear entirely alternative and that have been discussed in the debate on regional innovation policy. One of the more interesting positions sees them not as alternatives but as two integrated sides of a realistic and efficient regional innovation policy (Doloreux and Parto 2004; Acs and Varga 2002). Indeed, \"simple\" bottom-up policy has well-identified shortcomings: first, in terms of inefficient widespread interventions even in cases where there is no real potential or, more often, when it is blocked by strong local conservative interests; secondly, since it simultaneously requires measures and good administrative capacity, which is at best difficult, at worst impossible. However, the shortcomings of top-down policy are all too evident. It would be unable to discover and exploit potential which is still latent or not yet fully expressed. Secondly, centres of economic, technical and scientific excellence (which are typically priority objectives of these policies) would decline in the long run without the necessary attention to the overall quality of the context. Such attention is practically impossible or very difficult in a top-down sectoral strategy.

4.2. Integration, assessment and learning

What remains is thus the way of conceiving \"regional\" as widespread and differentiated. We may then define regional policy as support for real local capabilities, even if hidden, using incentives and by overcoming identified constraints and obstacles for improved use of potential resources and development of untapped relations between institutional actors, business, technical, social, aimed at achieving new products, production processes, and organizational solutions. This definition captures the elements of a report familiar to regional scholars. In the post-Fordist economy, where economies of scale are less relevant, small and medium sized firms can \"play the differentiation card\" through new, improved or different products and processes. The concept of marginality, that used to \"condemn\" all less-developed regions to the periphery of development, must be revised. These regions may have resources and inaccessible untapped potential that remains spontaneously so, even in the long term, which one can however make accessible and usable with intentional action. \"Regional innovation systems\" and clusters are often crucial for innovation processes to become effective. Innovation potential is often spread not only spatially but also sectorally, and there are bright prospects in those industrial and service activities involved in so-called (social and natural) sustainable growth.
What the definition does not consider is the bottom-up vs. top-down issue. Decentralization is not enough to guarantee effectiveness and efficiency. Rebuilding the economic future on innovation requires compliance with strict and challenging "rules of the game". Global connections are necessary and therefore the role played by "gate actors" has proved to be essential. Good government as well as good governance is also necessary. Policy-makers do not need to be visionaries, but they do need to be ready to exploit unplanned and unexpected windows of opportunity, to support new initiatives and new actors even against established constituencies, and to provide world-class services and manage global relations. Faced with these difficulties there are those who believe that the task has to be avoided in many regions. This dissenting view of the "practical" aspect emphasizes the rent-making risks of policies that disseminate funding in situations where administration skills, monitoring and assessment are weak. We must indeed consider the strict conditions necessary for greater efficiency in political and administrative decentralization with respect to centralization, as Oates (2005) stated in a literature review.

One might therefore propose explicitly to integrate the two perspectives, top-down and bottom-up, in cohesion policy in the matter of innovation. By integration we mean the construction of a sectoral and regional national plan in which central government and regions and/or local authorities have the faculty to make proposals. But for each proposal, which must be regional-sectoral and which must meet clear and strict selection criteria, the other party must add complementary interventions to create a concentrated set of functionally linked activities and initiatives. In this way innovation policy should be developed at regional (local) level, without necessarily abandoning traditional and national policy tools, such as human capital enhancing policies, basic public research support and traditional industrial policy. On the other hand, we should consider new regional innovation policies for systemic actor support and for generative relations. This idea of complementarities has theoretical and policy design implications, but it also has practical difficulties. Putting together different policy tools is a hard task since the selection of priorities is constrained by the scarcity of resources and the relevance of objectives. In the proposed framework this difficulty is addressed through specific attention to the nature of the procedural results expected, their timing, and the distribution of tasks between central and regional governments.
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