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RESEARCH INTENSIVE CLUSTERS AND REGIONAL INNOVATION SYSTEMS: A CASE STUDY OF MECHATRONICS IN APULIA[1]

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Abstract

This paper discusses some conditions under which the Cohesion Policy of the European Union can effectively contribute to enhance R&I in Europe and the extent to which it offers a relevant framework for devising Research & Innovation policies at regional level overcoming possible tensions and maximising potentials for synergy. To do so, the paper mainly relies on an in-depth illustrative case study of an Italian Southern region, Apulia. The paper describes the regional innovation system put in place by the Apulia Region and analyses the value added that can be attributed to such a system as far as innovation and economic development promotion are concerned; on this basis, findings from the case study are generalised in a set of lessons learned with hopefully more general relevance: these are discussed in Section 4.

Jel codes: L26, L62, R58

Keywords: Research intensive clusters; regional innovation systems; mechatronics.

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Background and scope of the paper

Since 2000 the Cohesion Policy has been playing an increasingly important role to promote research and innovation throughout the European Union (EU). During the new programming period 2014-2020, the European Commission – DG Regional Policy will concentrate substantial resources on investments supporting innovation, as a way to promote competitiveness and social, economic and territorial cohesion across the EU. Cohesion Policy potentially exhibits strong complementarities with the Research and Innovation (R&I) policy, aimed at achieving excellence in research and to contribute to make the EU the most competitive knowledge-based economy in the world. Existing synergies between R&I and Cohesion policies have been widely discussed in several policy reports and in the literature since the 1990s (including, among many others, European Commission 1993, Fritsch and Stephan 2005, Barca 2009 and European Commission 2012a). The process of regionalisation of innovation policy and the development of a place-based approach in the field of economic development and innovation may make the Cohesion Policy an important partner to pursue R&I objectives in the years to come.

A theme which has received less attention than it would deserve in both the academic literature and policy documents is the possible tension between the efficiency and excellence goals chased by the R&I policies, on the one hand, and the EU Cohesion Policy aims to equity purposes on the other one. While R&I policies generally tend to concentrate funds in core and well-endowed urban areas, in order to reach economies of scale and scope (see e.g. Rodríguez-Pose 1999), the intervention logic of Cohesion Policy favours less endowed, peripheral and economically weaker regions, which could be less prepared to achieve excellence in innovation and research.

A way to address the trade-off between innovation/excellence and cohesion/redistribution objectives has been proposed by the recent smart specialisation approach underpinning Cohesion Policy (European Commission 2012a). This approach admits the possibility for any region to generate innovation, by leveraging its own strengths and competitive advantages and selectively targeting its place-based R&I strategy on those economic activities in which the region can hope to excel. However, the conditions which could actually ensure a synergic relation between different policies aiming at enhancing European competitiveness, overcoming possible obstacles and tensions, still have to be explored.

This paper aims to provide some insights to understand how regional innovation policies can be effective in promoting both excellence and cohesion objectives in lagging behind EU regions. To this end, the case of the regional innovation system set up by the Apulia region (Southern Italy) over the past nearly ten years is presented. The elements of strengths and weaknesses of such a system are critically examined and discussed to produce lessons learned of more general relevance.

The case of the Apulia regional innovation system

Like other EU less developed regions, Apulia is characterised by important structural constraints on its innovation capacity, which are reflected in a low share of R&D expenditure and poorer research and innovation results compared to the most dynamic Italian and European regions. However, some important changes occurred in the past decade, as a consequence of the Italian devolution reform (2001). The reform assigned the regions a legislative power in a number of policy domains, including those for scientific and technological research and support to innovation. This reform set the motivation for Italian regions to reorganise their institutions in order to carry out the new tasks. Between 2005 and 2008 the Apulia Region set up a system of bodies with specific responsibilities over the implementation and evaluation of the regional policy for research and innovation. The system comprises the independent agency ARTI and two regional in-house companies, PugliaSviluppo and InnovaPuglia. The system has been enriched by a network of Industrial Liaison Offices within universities, aimed at promoting the born of spin-offs, and a number of Technological Clusters. Among the latter, the Mechatronics Technological Cluster in the province of Bari deserves special attention.

Bari is an area characterised by a long-standing industrial tradition in precision mechanics. Multinational companies having their plants in Bari (Fiat, Bosch and Getrag) have played a pivotal role for the development of the industrial district. Since the Nineties these large enterprises and a few local medium firms have started specialising in mechatronic technologies, which integrate mechanics with electronics, ICT and control science. Having identified mechatronics as a promising path to increase the competitiveness of Apulian firms, in 2007 ARTI strongly promoted the establishment of the Mechatronics Technological Cluster, a body named MEDIS. MEDIS involves private enterprises and universities which collaborate for the development of pre-competitive enabling technologies which could find application in a variety of industrial sectors, such as automotive, biomedical and others.

Even if an in-depth evaluation of the effects generated by the new regional innovation system (and particularly of MEDIS) in terms of innovation capacity and socio-economic cohesion is not yet available, field interviews and existing quantitative evidence, for example about the number of spin-offs generated, or the number of patents and utility models' applications, suggest that significant progresses have been made since 2005. The fairly good local industrial context, the strong regional commitment and institutional setting, the large volumes of Structural Funds allocated to R&I priorities, and effective mechanisms for public-private collaboration, such as Technological Clusters, are among the factors which could explain some improved innovation performance of Apulia.

However, more time and additional efforts are needed to allow excellence achieved by the small number of more innovative firms to generate a multiplying effect on other micro and small enterprises. In particular, appropriate mechanisms of knowledge transfer and diffusion still have to be envisaged by the local actors. In this regard, MEDIS acknowledges the importance of acquiring a stronger strategic role to achieve a wider socio-economic impact. The successful innovation pole MESAP (Mechatronics and Advanced Systems of Production), located in the northern region of Piedmont, is possibly a benchmark which MEDIS could look at, without disregarding the specificities of the Apulian industrial context.

Ingredients for a successful regional R&I policy

The case study on the Apulian innovation system confirms that while there is some scope for a place-based R&I policy, a balanced combination of pre-conditions and mechanisms have to be available in order to succeed at generating both R&I excellence and socio-economic development and cohesion in a lagging-behind context. These ingredients include:

1. Strong and well-established industrial vocation in a given sector and a good endowment of skilled human capital and public research tradition. These represent necessary preconditions for any place-based effective research and innovation policy.
2. A comprehensive and long-term development strategy focused on innovation. This should be defined by the regional government, taking into duly consideration potentialities and existing competitive advantages of the local context.
3. The regional strategy for development and innovation should be implemented by a well-functioning and multi-level administrative machine. The Region should retain responsibility for setting up the regional innovation system, while the national government should provide both timely financing and adequate coordination and guidelines to Regions.
4. A sufficient volume of financial resources targeted to research and innovation should be available to ensure the implementation of a minimum efficient scale of investments.
5. Local enterprises should have the possibility to access a sufficiently diversified set of financial instruments and to receive tailored support addressing their specific needs.
6. The regional innovation system should be open to wider networks. The system should ensure exchange of ideas and knowledge with other regions and countries in order to prevent the risk to incur in a lock-in situation.
7. The collaboration between public and private actors is particularly effective when research and innovation is focused on horizontal pre-competitive technologies, which in principle could be transferred and applied to a variety of industrial sectors.
8. Finally, in order to guarantee the diffusion of technological advancements and the transformation of R&I excellence into a driver of wider territorial development, appropriate mechanisms of knowledge transfer from the most innovative to the less (but potentially) innovative enterprises should be in place.

1. Introduction

The EU set in 2000 the goal to become the most competitive knowledge-based economy in the world (Lisbon Strategy[2], then restated in 2010 with the 'Europe 2020' Strategy[3]). European institutions took a leading role in the promotion of the conditions making it possible for European countries to compete with the research and innovation levels recorded in the USA and Japan. Indeed, research and innovation (R&I) are today recognised as drivers of all EU policies, from industrial policy, where technological improvements are instruments to ensure a strong, competitive and diversified manufacturing value chain, to environmental and energy policies and initiatives, where they are meant to provide sustainable solutions to tackle climate or energy challenges (European Commission 2010b and 2011a, European Union 2013a). R&I have become key ingredients also of the Cohesion Policy implemented by DG Regional and Urban Policy (DG Regio) of the European Commission (European Commission 2011b; European Union 2013b). Even more, Cohesion Policy has become a key instrument to effectively implement and enforce the principles of "Europe 2020". This in fact is the culmination of a process that took place over the past twenty years, when the European Union has been striving to promote an integration between research and innovation strategies with regional economic development (European Commission 1993, 1998, 2010a, European Council 2000, 2005).

A priori there are potential strong synergies between R&I and Cohesion policies since both are intended as growth enhancing policies; indeed complementarities between investments in R&I policy and economic and social cohesion policies have been continuously emphasised by the European authorities (European Commission 1993, 1998, European Commission 2006, EURAB 2007, European Commission 2012a). Already in 2000-2006, between 5.5% and 7.4%[4] of all Structural Funds expenditure were invested in research and innovation, while in 2007-14, the proportion earmarked to R&I increased to nearly 25%.[5] During the 2014-2020 programming period, even more emphasis is expected to be put on EU funding of investments for applied research and technological development, with the aim of boosting competitiveness of European micro, small, medium and large enterprises.

Yet, there might be tensions too between different policy goals, targeting of beneficiaries and implementation mechanisms. The excellence principle underlying research and innovation policies – which mainly stresses the potentialities of the most endowed areas – may seem to be at odd with the fundamental objective of Cohesion Policy in terms of economic social and territorial cohesion – which provides support especially to less well-off regions.

It is the objective of this paper to discuss some conditions under which the Cohesion Policy can effectively contribute to enhance R&I in Europe and the extent to which it offers a relevant framework for devising R&I policies at regional level overcoming possible tensions and maximising potentials for synergy. To do so, the paper mainly relies on an in-depth illustrative case study of an Italian Southern region, Apulia. The paper is structured as follows:

Section 2 provides a brief review of the issues at stake, clarifies some conceptual notions and very selectively reviews some of the relevant literature on the regionalisation of innovation policy;
Section 3 is the core of the paper, drafted on the basis of extensive desk documentary analysis and field semi-structured interviews with selected stakeholders: it describes the regional innovation system put in place by the Apulia Region and analyses the value added that can be attributed to such a system as far as innovation and economic development promotion are concerned;
On this basis, findings from the case study are generalised in a set of lessons learned with hopefully more general relevance: these are discussed in Section 4.

The paper is accompanied by two Annexes:

- Annex I synthesises the milestones which led to the development of the regional innovation system and the establishment of the Mechatronics Technological Cluster;
- Annex II includes the list of persons interviewed for the purpose of this study.

All the sources of documentary evidence are reported in the Bibliography.

[2] European Council (2000).
[3] European Commission (2010a).
[4] Respectively according to Technopolis (2006) and European Commission (2005).
[5] Amounting to approximately EUR 86 billion (European Commission 2014).

2. R&I in the context of Cohesion Policy – an analytical framework

Great expectations are currently placed on Cohesion Policy to reach the objectives of Europe 2020 and in particular to foster innovation as a decisive engine of growth. Hence it is important to clarify the way in which Cohesion Policy is expected to contribute to R&I and in particular how it is supposed to overcome possible obstacles and tensions between the different intervention logics underlying R&I and Cohesion policies.

2.1. Innovation and its regional dimension

What makes Cohesion Policy a natural candidate to foster the conditions upon which innovation is to develop is related to the intrinsic features characterising the process of innovation as recently conceptualised in the academic literature in this field. Indeed, the mix of assets, skills and ideas, upon which the comparative advantages that drive innovation is built, is often a regional or even local issue. In this respect, Box 1. recalls some basic concepts accounting for the territorial dimension of innovation

Box 1 Basic concepts from the literature on innovation

Various theoretical models exploring the mechanisms of generation of innovation and its links to socio-economic development have been developed.

- Overcoming a so called linear approach, the understanding of innovation has been tackled by systemic models, according to which innovation is not the simple result of a linear sequence (from fundamental research, to experimental development, and new or improved products), but rather the product of a system of interactions between numerous and various stakeholders. A famous way to represent it is the Triple Helix model (Etzkowitz 1996, Etzkowitz and Leydesdorff 1996), which recognises a prominent role in the generation and transfer knowledge to university, industry and government: from this perspective, innovation can arise both within each of these three spheres and through their interaction.[6] An alternative representation of the systemic approach is proposed in the "Open innovation" framework (Chesbrough 2003).[7]

- Different factors are acknowledged as important ingredients allowing the generation of interactions at the origin of innovation. For example, adequate absorptive capacity of firms is defined by Cohen and Levinthal (1990), as their ability to recognise the value of new information and to assimilate it and adapt to their specific ends. Absorptive capacity and innovative performance are favoured when there is a certain level of technological proximity between the knowledge producer and absorber (Perez and Soete 1988, Nesta and Saviotti 2005).

- Fundamentally, geographical proximity is indeed considered to play a crucial role in favouring intellectual, commercial and financial exchanges, thus heavily influencing the innovation process (see e.g. Sternberg 1990, Puga and Venables 1996, Baldwin and Martin 2004, Rosenthal and Strange 2004; Lehto 2007, Martin 2010). Evidence shows that research and innovation activities tend to physically and spatially agglomerate in defined geographical areas and this trend finds a theoretical argumentation in the Porter's theory of competitive advantage (1990, 2003).[8] Other theoretical foundations can be found in the literature on industrial districts (originating from Marshall, 1890), explaining how Small and Medium Enterprises (SMEs) with a coherent specialisation profile and vertically or horizontally integrated among each other spontaneously cluster in specific areas, often centred on one or few large catalysing enterprises. Even if this literature is more focused on industrial, rather than research and innovation

[6] Universities are the place where new knowledge is generated, but they can also contribute to technological development by promoting the establishment of incubators for start-ups and by joining public-private organizational mechanisms for knowledge creation and diffusion, such as science parks, networks, associations. Industry is the locus of production but enterprises also participate in the knowledge creation process within their own research laboratories and/or in collaboration with external research centres and academia. The government intervenes to define contractual relations among different actors, but also to finance fundamental and applied research and innovation diffusion, and to take part of the risks associated to innovation (as recently reaffirmed by Mazzucato, 2013).

[7] Chesbrough (2003) has conceptualised the Open Innovation framework. This paradigm points out that permeable boundaries between firms and the environment in which they are embedded allow them to obtain new ideas from the external environment in order to advance their business, rather than entirely relying on their own ideas and research efforts. Technological progress can benefit not only firms which directly generated it, but can also inspire others actors and spread outside the knowledge-producer firms, for example through the selling of licences or set up of joint ventures.

[8] According to Porter, different territories are endowed with a different set of attributes which prevent them from enjoying the same degree of socio-economic performance and to strictly compete against each other.

processes, similar aggregation patterns can be highlighted for R&D ventures. In the same vein, innovation potential is considered to be maximised in technological clusters, where strong interactions and good exchange of information among actors involved in scientific, technological and industrial activities take place, and which are generally characterised by high level human capital, strong entrepreneurial culture, availability of venture capital and demonstrated track record on research and innovativeness (a few references include Saxenian 1994, Jaffe 1989, Ibrahim and Hosein Fallah 2005).

- In more general terms, the notion of 'regional innovation system' was proposed by Cooke (1992, 2001) to indicate the regional place-based nature of the system of factors which can ensure knowledge based growth. A possible conceptualisation of regional innovation systems is made by Asheim and Coenen (2005), who identify different types of systems, depending on their degree of internal interactions and openness to the outside of the cluster. There could be territorially embedded regional innovation systems where innovation is mainly based on enterprises' learning-by-doing with limited interactions with knowledge generating organisations, like universities: the risk for these systems is to incur in a lock-in situation due to limited circulation of new ideas. There could also be systems where research organisations and firms actively interact and learn from each other, so that informal knowledge is supplemented by competences arisen from more systematic research. Each cluster can then be more or less integrated with other systems, and innovation can take place to more or less extent in cooperation with actors outside the region.[9]

As a reflection of conceptual developments that stress the importance of local patterns and proximity among key players of the innovation game (government, firms, universities and research centres), policy trends have evolved towards the regionalisation of innovation policy. As argued by Fritsch and Stephan (2005), today 'regionalization is not a whether or not-question but an issue of more or less and how'. The central government has often reduced its powers, but it generally keeps a legislative role in some themes of national-relevance, such as the research and university system, and coordination and monitoring role over regional policies (Technopolis, Fraunhofer and UNU-MERIT, 2011).

In the European Union , up to the early 2000s, innovation policy was mainly operated at national level (Fritsch and Stephan 2005). Measures supporting innovation were designed by the central government and usually applied to all the regions within the country, without significant differentiation. Recognising the intrinsic differences of one Technological Cluster from another and their specific comparative advantages, it later emerged the need for the government to design and implement region-specific modalities of support. All major European countries have been involved in a process of regionalisation of innovation policy, with no preferred model of decentralisation. Countries already characterised by a strong political decentralization, like Germany or Austria, redefined the competence spheres of regions; others have more recently started to devolve powers to regions (such as in Italy and France), identifying innovation as one of the policies for which regions have some decision-making powers; in some countries the regionalisation process has not been homogeneous across all regions, like in Spain where the devolution process to Catalonia and Basque country has been more marked than in other autonomous communities, or in the UK, where Scotland, Wales and Northern Ireland have been granted with a more significant political autonomy than England. Eastern European countries, traditionally characterised by centralistic policies, are also moving towards a more regional approach (Technopolis 2006, European Commission 2010c, Applica and Ismeri Europa 2010, ADE and LL&A 2010, Technopolis, Fraunhofer and UNU-MERIT 2011).

The redistribution of competencies has been accompanied by an adjustment and verticalisation in the governance structures. Regional authorities in the EU Member States have replaced or complemented central government authorities. The multi-level governance has been further accentuated by the creation of ad hoc agencies for regional innovation and development. These are intermediate bodies in charge of the actual implementation of regional policies. The OECD (2010) acknowledges that regional agencies could bring significant advantages to regional innovation policies. By being closer to final beneficiaries, they better know their needs, they are more able to coordinate and aggregate their clients and monitor their results, and they can provide important contributions to the policy setting. Yet, regional agencies can be affected by some constraints too. Lack of resources and skills can prevent them from playing a propulsive role for innovation, to ensure efficient coordination between the different actors of the regional innovation system, to effectively monitor and evaluate the effects of public policies. An unclear mandate and overlap of responsibilities with other regional public authorities or financing agencies can be detrimental to their capacity to provide an adequate mix of services and instruments and to properly valorise the competitive advantages of the region.

[9] For a more extensive discussion about the theory and empirical evidence about regional innovation system, see e.g. Asheim et al. (2011).

2.2. R&I and Cohesion Policy: tensions and synergies

If the recognition that innovation is spatially embedded speaks in favour of Cohesion Policy as an appropriate action framework to deal with it, it is apparent that the very spatial dimension of innovation might also be in contradiction with some of the basic guiding principles underlying the intervention logic of Cohesion Policy. As a matter of fact, research and innovation activities tend to show economies of scope and scale as well as agglomeration effects leading to geographical concentration, usually in core and well-endowed urban contexts or in nearby areas (Rodríguez-Pose 1999, Bilbao-Osorio and Rodríguez-Pose 2004, Rodríguez-Pose and Crescenzi 2008). It is indeed possible to identify specific areas and regions where innovation concentrates and reaches a critical mass. These are often large urban agglomerations, with higher potential for interaction among socio-economic agents, thus favouring the generation of positive synergies and spillovers.

On the face of it, Cohesion Policy aims at reducing disparities between the levels of development of regions and countries and to strengthen economic, social and territorial cohesion. Hence, it needs mostly to focus on regions lagging behind. In this perspective, a trade-off seems to be in place. On the one side, R&I policies pursue efficiency and possibly world-class excellence objectives, on the other one, the EU Cohesion Policy aims to (broadly defined) equity purposes across regions.

Some emphasis has been put by the literature to study this trade-off. A few studies (Danish Technological Institute 2005, Pellegrin 2008, Koschatzky and Stahlecker 2010) have explicitly discussed the potential difficulty that the European Commission and Member States authorities might face in ensuring a balance between cohesion/redistribution and innovation/excellence objectives. In general, to a certain extent congruence and synergies are emphasised in this literature, while the lack of evidence, the role of rhetoric, or specific weaknesses (e.g. related to the implementation of the Lisbon strategy) are also identified.

What has in fact been decisive in the policy discourse is the formal recognition of territorial cohesion as an explicit objective pursued by the EU (Lisbon Treaty 2007) and the development of a "place-based" approach to Cohesion Policy (Barca 2009[10]). Through these developments, equity and growth are no longer seen as conflicting priorities but rather complementary principles underlying Cohesion Policy. As a matter of fact, a place-based approach to Cohesion Policy implies:[11]

- a long-term development strategy whose objective is to reduce persistent inefficiency (underutilisation of the full potential) and inequality (share of people below a given standard of well-being and/or extent of interpersonal disparities) in specific places,
- the production of bundles of integrated, place-tailored public goods and services, designed and implemented by eliciting and aggregating local preferences and knowledge through participatory political institutions, and by establishing linkages with other places; and
- the promotion of the place[12] from outside through a system of multilevel governance where grants subject to conditionalities on both objectives and institutions are transferred from higher to lower levels of government".

The so called "Smart Specialisation" approach promoted by the European Commission applies the place-based approach in the field of innovation. Developed, among others, by Foray and Van Ark (2007) and Foray, David and Hall (2009), the approach aims at reinforcing the complementary dimensions of excellence and convergence objectives during the 2014-2020 period. The new European regional innovation strategy (European Commission 2012a) relies on the idea that competitive advantages are not concentrated in specific regions, but that any region can have a competitive advantage with regard to specific resources. In principle, any region can contribute to increase the EU knowledge-base, by focusing on a limited number of innovation and research priorities in those fields where the region 'can realistically hope to excel.' In this context, priority setting should ensure a 'match between a top-down process of identification of broad objective aligned with EU policies and a bottom-up process of emergence of candidate niches for smart specialisation, areas of experimentation and future development stemming from the discovery activity of entrepreneurial actors' (European Commission 2012a: 23).

Hence, through such a place-based approach, Cohesion Policy aims at promoting development potentials in all regions (or places) as against redistributing resources from richer to less developed regions or focusing on how to help the latter

[10] Barca (2009).
[11] Op. cit.
[12] Or to be precise: "places": as units of intervention, they are not necessarily congruent with regions defined administratively, nor are they necessarily synonymous with local territories; they "are defined though the policy process from a functional perspective as regions in which a set of conditions conducive to development apply more than they do in larger or smaller areas" (Barca 2009, p. ix).

to catch up with the former. The place-based approach also proposes a response to the "innovation paradox" (Landabaso et al. 2001 and 2002) according to which regions with an already above-average innovation capacity, usually localised in the most developed EU countries, have invested more in innovation compared with regions with lower innovation capacity, often localised in less developed countries and classified as 'Convergence' regions. The paradox of European innovation policy is that those regions which are most in need of innovation funding as a means to improve socio-economic development, are also those which invest the less in innovation, preferring to focus public expenditure on other priorities, such as infrastructure development.

Finally, another way to ease the potential tensions between R&I policies and Cohesion Policy on the grounds of an alleged trade-off between excellence and equity is to adopt a multi-level governance perspective: while research policy pursuing excellence is best dealt with at EU or national level, innovation is best promoted (also) at regional level by Cohesion Policy and its place-based approach. What is decisive is the effective articulation between the different relevant levels in a proper multi-level governance setting. As argued by the European Commission (2012b), it is also possible to distinguish between absolute and relative excellence. While absolute excellence is used as a criterion by Research Policy, regardless the country or region of origin, Cohesion Policy would rather consider the relative dimension of excellence, according to which excellence emerges considering the relative position of the research system in the international context and the respective competitive advantages. The way is thus paved at least at strategic level and in conceptual terms for a synergetic relation between different policies aiming at enhancing European competitiveness.

Overall, while some regions are a priori more prepared than others to compete and excel on the ground of innovation, and to exploit technological advancement as engine for growth with the risk that this brings about further territorial imbalance (concentration of activities in promising and endowed regions), the regionalisation of innovation policy in the context of the recently developed place-based approach to Cohesion Policy and an effective multi-level governance setting offer a solution at least in conceptual terms to mitigate such risk.

Whether this is effectively verified on the ground and under which conditions is the object of the rest of the paper, through a case-study which reveals some of the issues at stake. The aim is to understand the factors and mechanisms through which Structural Funds can actually help regions including those under relative poverty, low population density, peripherally and structural economic weaknesses, to increase their research and innovation capabilities and to achieve excellence in applied research, technological development and innovation. Different such factors are to varying extent identified by the literature as briefly sketched above (e.g. absorptive capacity, the regional system of governance of innovation, etc.) and/or have been studied in recent policy reports and evaluations (like those already mentioned by Technopolis 2006, European Commission 2010c, Applica and Ismeri Europa 2010, ADE and LL&A 2010, Technopolis, Fraunhofer and UNU-MERIT 2011).

In the next section, an attempt is made to weigh these different factors and mechanisms and assess their importance through an in-depth study of the regional innovation system of the Southern Italian region of Apulia. In particular, the focus is on the role that the governance of the regional innovation system of Apulia plays in fostering research and innovation at regional level.

3. The regional innovation policy of Apulia

3.1. Economic and innovation profile of Apulia: some stylized facts

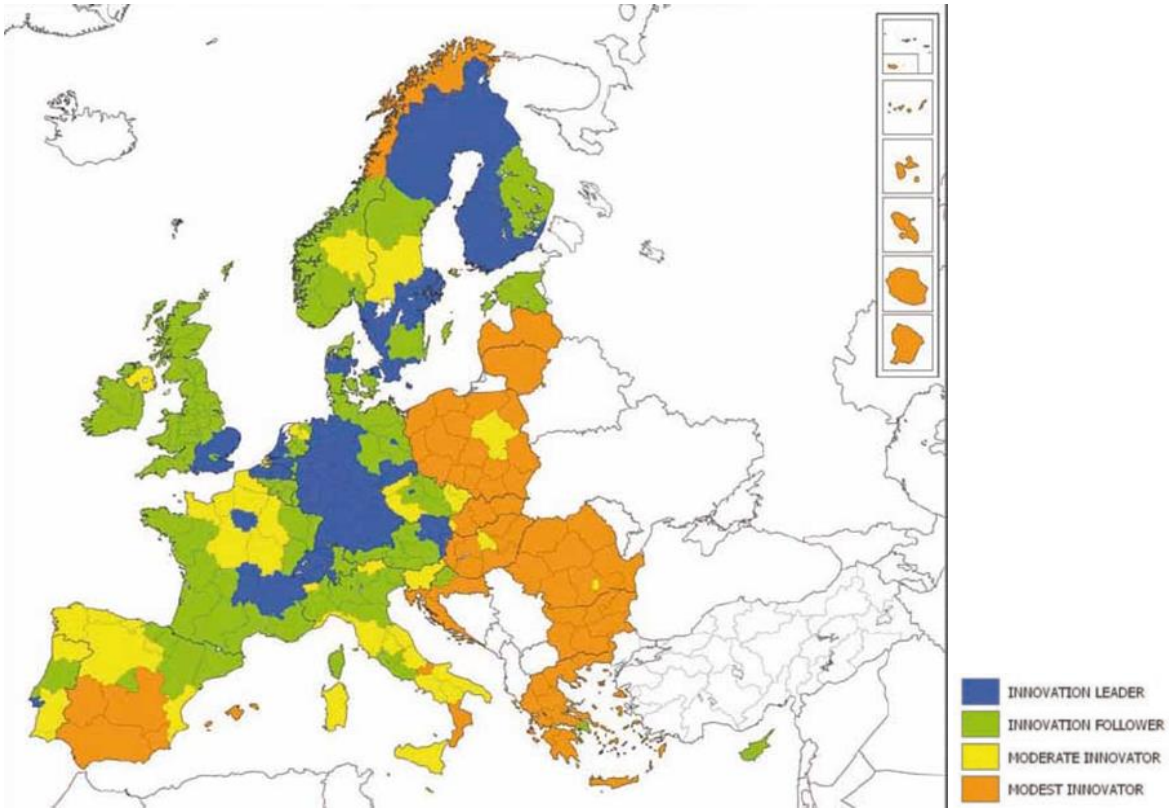
Classified as a 'Convergence' region during the 2007-2013 EU programming period, and as 'Less developed' region over the current 2014-2020 period, the Italian southern region of Apulia is characterised by socio-economic indicators generally below the EU average: per capita GDP has been lower than 70% of the EU-27 average in the latest years (2007-2012);[13] the regional total unemployment rate reached 15.7% in 2012, compared to 10.5% in the EU-27 and a 10.7% national average;[14][15] the so-called 'brain drain' phenomenon is particularly serious as shown by the negative net migration of university students (-6,720 in 2012), which is the most significant among Italian regions;[16] in terms of accessibility, the peripheral position of Apulia in the EU and the relatively lower infrastructure endowment for road, rail and airport transport, make the region poorly interconnected with the national and international transport networks, thus decreasing its attractiveness in people's decisions about where to work, live and invest (Espon 2009, Apulia Region 2005).

Indicators of innovation put Apulia among the moderately innovative regions of Europe, well behind regions of Central and Northern Europe (see Figure 1). The total intramural R&D expenditure of Apulia is 0.77% of GDP, against 1.26% and 2.01% for the entire Italy and the EU-27 respectively in 2010. Unlike the rest of Italy and Europe, where approximately half of the total R&D expenditure originates from the business enterprise sector, in Apulia 40% of R&D expenditure is imputable to higher education sector, while R&D produced by enterprises represents only 19% of total expenditure.[17] The large presence of micro family-owned enterprises with limited financial resources contributes at constraining the capacity to make research and realise technological product and process innovations.

Apulia performs worse than Italy and Europe also in terms of average share of R&D personnel over the active population[18] (0.46 in Apulia in 2011 compared with 0.91 in Italy and 1.09 in the EU-27) and the number of patent applications (13 EPO patents per million inhabitants versus an average of 72 in Italy and 85 in the EU-27 in 2009).

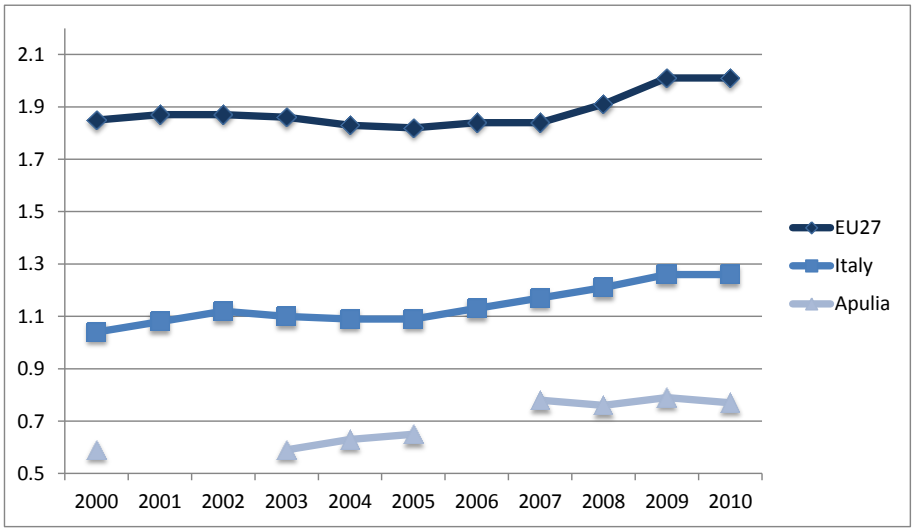
[13] Eurostat data.
[14] Eurostat data.
[15] Here and below data refer to the latest year for which regional, national and European figures are provided by Eurostat.
[16] Miur-Cnvsu (Comitato nazionale per la valutazione del sistema universitario) data, gathered from ISTAT –"Indicatori Territoriali per le politiche di sviluppo", http://www.istat.it/it/archivio/16777. The net migration is defined as the difference between the registered members in regional universities and the number of residents enrolled in the university system in the region. Neither foreign students enrolled in Italian universities nor Italians living abroad and enrolled at telematics universities are accounted for.
[17] 2010 data.
[18] Expressed in full time equivalents.

Figure 1 Clusters of EU regions by level of innovation – 2009



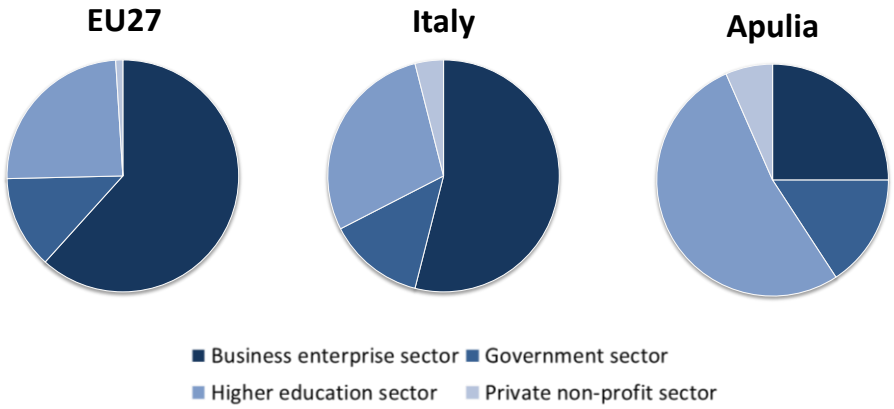
Source: European Commission (2012c)

Figure 2 Total intramural R&D expenditure as a percentage of GDP – 2000-2010



Source: Authors' elaboration based on Eurostat data

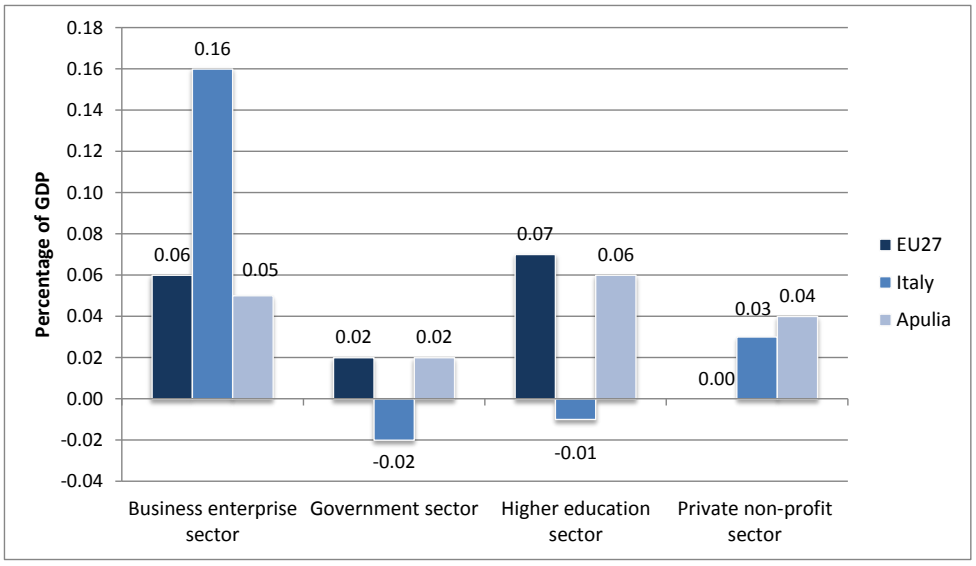
Figure 3 Total intramural R&D expenditure by sectors of performance – 2010



Source: Authors' elaboration based on Eurostat data

To sum up, Apulia appears as a region characterised by important structural constraints on its innovation capacity, similarly to several other EU less developed areas (see in Figure 1 EU regions classified as moderate and modest innovators). However, some important changes occurred in the past decade. According to Eurostat data and as shown in Figure 4, between 2003 and 2010, the level of regional intramural expenditure in R&D related to the business enterprise sector has increased by 0.05 percentage of GDP, very close to the EU average (0.06), even if lower than in the rest of Italy, where a 0.16 increase has been recorded. On the contrary, in the face of a reduction in the Italian R&D expenditure of the governmental and higher education sectors, an opposite pattern can be observed in Apulia, where R&D expenditure related to these sectors has increased at rates closed to the EU. The private non-profit sector (including non-market private institutions and individuals) has also recorded a positive variation between 2003 and 2010, higher than Italy and much higher than in the EU, where a nil average change occurred.

Figure 4 Percentage of GDP variation in intramural R&D expenditure by sector –2003-2010



Source: Authors' elaboration based on Eurostat data

But the growth in total R&D expenditure is only the surface of a deeper transformation which is slowly taking place in Apulia. Since 2005, an integrated and long-term strategy for innovation has been developed by the regional government, with the goal of fostering technological advancement for enterprise, public administration and citizens. This strategy,

formalised in April 2009,[19] has reshaped the regional innovation system and aims at a radical change in the pace of innovation and economic development. Since the programming period 2000-2006 and, more markedly, during 2007-2013, the Region has addressed a consistent share of EU Structural Funds towards research and innovation objectives: over the 2007-2013 period, Apulia has allocated almost EUR 1.3 billion of Structural Funds, representing 24.05% of total Structural Funds available, to the priority theme 'Research and technological development, innovation and entrepreneurship'.[20] Structural funds add to other EU funds made available under the framework programs for research, as well as other public national and regional financial contributions.

In the context here outlined, it is interesting to analyse, first, which mechanisms have been initiated by the Apulia Region aimed at triggering a change in the regional innovation system, and, second, to understand how such mechanisms are expected to produce tangible and sustainable results and to overcome the structural limits affecting Apulia.

3.2. The Apulia regional innovation system

Up to 2001, innovation policy in Italy was a prerogative of the national government. The reform of Title V of Italian Constitution marked a turning point, establishing concurrent legislative powers for the national government and regions in a number of policies, including those for scientific and technological research and support to innovation: regional administrations have been made responsible for policy making, provided they observe some fundamental principles set by national law. This reform set the motivation for Italian regions to reorganise their institutions in order to carry out the new tasks.

In this context, the regional government of Apulia in 2004 established ARTI, the Regional Agency for Technology and Development.21 Operational since 2005, ARTI was conceived as an independent agency to which outsource all the Region's activities concerning the implementation of the regional strategy for innovation. The real leap towards innovation occurred with the new regional government, taking office after elections in April 2005. The new region's president, supported by a team of experts, identified innovation as the fundamental leverage for economic development and, more in general, for quality of life improvement in Apulia. Considered as a crosscutting objective of all regional actions, the innovation was promoted starting from within the public administration itself, through the organisation of workshops addressed to officers dealing with core policies (education, labour, health, environment etc.).[22]

The mission of ARTI as it was originally envisaged by the previous regional government was revised by the new government. Rather than appointing one single and independent agency with all operational powers for technological research and innovation, it was decided to set up a system of agencies, including the newly born ARTI and other two bodies controlled by the Region's Department for Economic Development: InnovaPuglia S.p.A. and PugliaSviluppo S.p.A. The former was established by the Region in 2008 from the merger between the science and technology park Tecnopolis S.c.r.l. and the financial agency FinPuglia S.p.A.; the latter originates from the regional branch of Sviluppo Italia, the national agency for promotion of investments and enterprise development.[23] Up to 2008 the Sviluppo Italia regional branch served as a desk for local enterprises applying for national public financing but had few experiences in directly managing contracts under the 2000-2006 period. It was then transferred to the Apulia Region in compliance with Law n. 296 27/12/2006.

In 2008, the Region acquired the majority of shares of both InnovaPuglia and PugliaSviluppo and gave them a more strategic role as intermediate bodies for regional innovation policies. The division of responsibilities was clear: building on their respective traditions, InnovaPuglia is in charge of the implementation of e-government policies and ICT infrastructure investments; PugliaSviluppo is in charge of the promotion of business competitiveness, delivering Structural Funds' grants and engineering financial instruments to support entrepreneurship, innovation and internationalisation.

[19] 'Strategia Regionale per le Ricerca e l'Innovazione della regione Puglia 2009', by Regione Puglia, Assessorato allo Sviluppo Economico.
[20] DG Regio data.
[21] By regional law n°1/2004.
[22] Source: field interviews.
[23] Now Invitalia.

PugliaSviluppo works as one-stop shop for enterprises. The portfolio of instruments it makes available to firms is varied and designed to address the needs of different types of clients, distinguished by their size.[24] The regional company supports its clients during the whole process going from the project idea development, through the procedures to get administrative permits, up to the project final approval.[25] Funds are allocated on the basis of a negotiation procedure between the firm and PugliaSviluppo, aimed at exploring the specific investment need of the company and identifying the kind and volume of public support that could be provided to address that need. This procedure has been set up in order to provide more targeted support to enterprises and to avoid the bureaucratic complexity and slowness usually affecting open tenders (as experienced in the past with business support provided through national law 488/1992), where beneficiaries are selected on the basis of a number of qualitative and quantitative criteria.

PugliaSviluppo is currently the only regional intermediate body in Italy which disburses in advance up to 90% of the Structural Funds' grants (in two tranches), against a suitable bank guarantee by the beneficiary firm. In total, financing instruments initiated so far by PugliaSviluppo supported nearly EUR 2 billion of investments, of which EUR 1.04 billion related to 'programme agreements'[26] with some mechatronics and aerospace large companies; EUR 245 million for projects carried out by medium enterprises, EUR 90 million for small enterprises and EUR 450 million for micro enterprises. Investments specifically related to research and technological development activities represent less than 20% of the total, and are mainly implemented by large enterprises (receiving about EUR 200 million), followed by medium and small enterprises (EUR 20 million and EUR 10 million respectively).

PugliaSviluppo also operates as intermediary of other EU financing instruments specifically targeted to favour the access to credit of non-bankable SMEs. Furthermore, in 2013 PugliaSviluppo has been authorised by the Central Bank of Italy as financial agency which can deliver microcredit to SMEs drawing on its own capital.

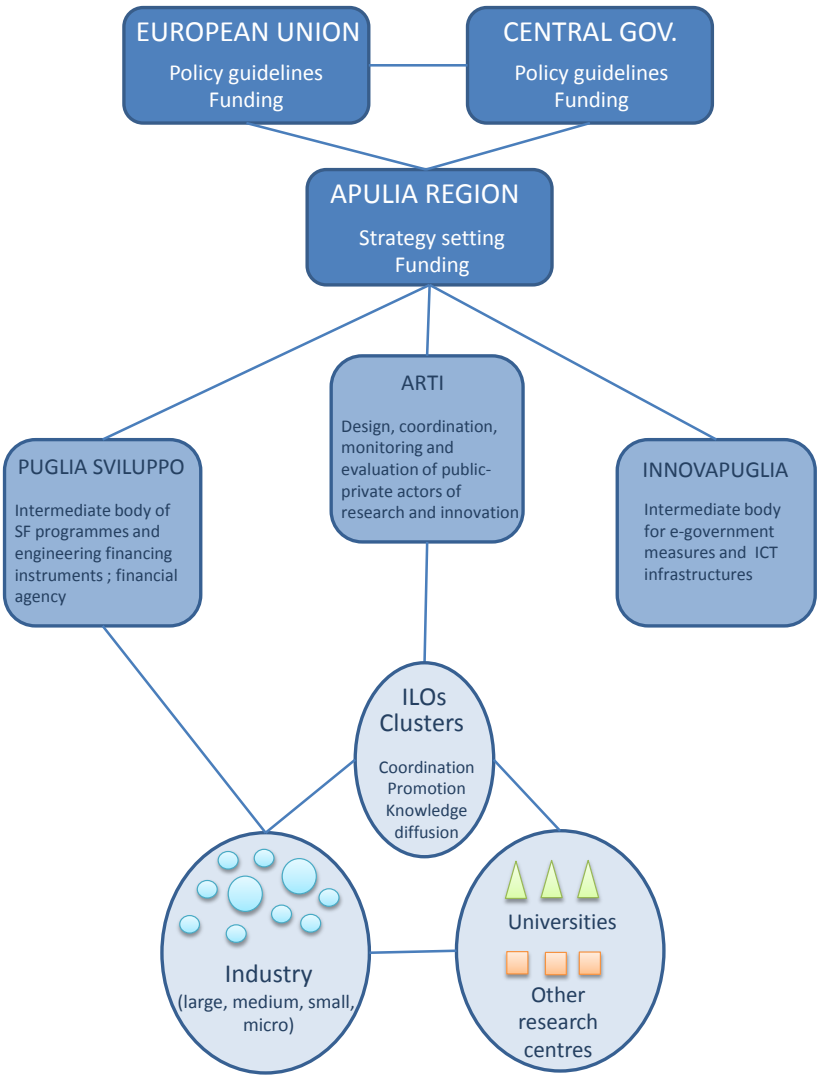
In turn, ARTI's remit was twofold: on the one side, ARTI has to support the regional administration in policy design, even with ex-ante and ex-post evaluation; on the other side, its mission is to link the public and private sector, to make their relationships smoother and more effective, and to improve their innovation capacity. ARTI pursues a better orientation of universities and the local research community towards the technological application needs of the business sector. To this end, the agency has created, within universities, a network of Industrial Liaison Offices (ILOs) aimed at promoting technological transfer and the generation of spin-offs, and at other public-private initiatives, such as Technological Clusters.

[24] Large enterprises are supported through 'programme agreements', according to which the firm and regional and/or national public authorities agree on the implementation of significant productive and research investments (up to EUR 50 million); medium and small enterprises can apply for integrated subsidy programmes for investments projects of EUR 10-20 million for medium and EUR 1-10 million for small enterprises; microenterprises can apply for a contribution on the interest of debts covering investment from EUR 30 thousand to 1 million.

[25] The definitive project is usually approved within 4-6 months from the application, mainly depending on the time needed to obtain the necessary permits.

[26] In the Italian administrative law, a 'programme agreement' is an agreement between local and regional authorities and other public administrations, through which the parties commit themselves to collaborate for the realization of works and interventions. It was introduced since the 1980s and it is regulated by Law 267/2000.

Figure 5 Simplified representation of the multi-level governance of the Apulian innovation system



Source: Authors

The support and organisation of Technological Clusters is, in fact, another major change that Apulia has faced in recent years. Technological Clusters (TCs) have been launched by the national government in 2003 as one of the building blocks of its scientific and technological policy. In line with the traditional Triple Helix model (see Box 1) TCs are consortia involving regional authorities (with financing, promotion and coordination roles), enterprises and universities committed to cooperate to produce technological innovation, with a view of becoming excellence centres at national and international level. The creation of a TC can be proposed by each region and, once approved by the Ministry of Education, Research and Universities, it can access to national public financing.

So far, four TCs have been set up and formally recognised by the Apulia regional government between 2005 and 2008. They are the cluster of High Technology (DHITECH),[27] the Agrofood Cluster (DARE),[28] the Cluster of Mechatronics of Bari (MEDIS) and the National Technological Cluster on Energy (DiTNE).[29] Other two clusters have been identified and

[27] Established by the national government nearby Lecce.
[28] Promoted by the Region which recognised the existing potential in this sector in the area of Foggia; DARE involves more than 90 enterprises, most of them SMEs, in addition to public research centres and universities.
[29] Established in 2008 by the Region with the purpose of encouraging the development of enterprises operating in the field of renewable energies around Brindisi, it was then transformed into a cluster of national interest, directly coordinated by the Ministry of Education, University and Research.

are waiting for being approved by the central government. They are the Aerospatial Technological Cluster (DTA)[30] and the Technological Cluster on human health and biotechnologies (HBIO).[31]

As shown in this brief overview, over the last nine years, the Region has put in place a system of different actors involved, to different degrees and with specific mandates, in the design and implementation of the regional strategy for innovation. Their actions are coordinated by the regional government towards the achievement of a common objective: the development of innovation in a number of strategic sectors, as a way to promote economic growth, competitiveness and reduce the gap with more developed regions of Europe.

In order to analyse the functioning mechanisms of such a system, in what follows we focus on one industrial sector in particular, mechatronics nearby the regional capital city of Bari.

3.3. The Apulian mechatronics cluster

Apulia has a long-standing industrial tradition in mechanical engineering and manufacturing, at first targeted to the agriculture sector, and then over the years more and more focused on precision mechanics for industry. During the late 1960s and beginning of 1970s, financial incentives granted by the national government to investors in Southern Italy attracted in Bari a number of large enterprises: among the first ones there was Nuovo Pignone, a company producing machinery and equipment mainly for the oil and gas industry controlled by ENI, a state-owned holding, and then sold to General Electric; Magneti Marelli Powertran and Fiat, both producing components for the automotive industry. Around the local plants of these firms, an industrial cluster of micro and small enterprises spontaneously arise and developed. In 2009, 184 local units operating in this productive system were identified (Invitalia 2012), with about 16,000 employees and contributing to about 25% of the regional exports.

Over the same years, both public and private centres for research and development have been founded. Today in Apulia there are more than twenty institutes belonging to the National Council of Research (CNR), including the National Laboratory for Nanotechnology, the Institute for Microelectronics and Microsystems, the Institute for Industrial and Automation Technologies and the Laser Innovation Technology Transfer and Training centre. The CNR manages the consortium Sintesi, a public-private research company in robotics and production systems. Another public-private research centre is Laser, focused on laser material processing, electrical-optical sensors and micro devices (ARTI 2007).

Other public actors of the regional public research system include universities. The University of Bari, founded in 1925, is the largest university of Apulia and the seventh one in Italy, with more than 50 thousands students in the academic year 2012/2013.32 With almost 20 thousands students in 2012/2013, the Salento University is the second largest one in Apulia; it was established in 2006 from the development of the previously existing University of Lecce, whose origins can be traced back to the late 1950s.[33] The Polytechnic University of Bari was set up more recently, in 1990, and in 2012/2013 it reached 10 thousand students.[34] These universities carry out applied research in the fields of Innovation Engineering (Salento University), Chemistry and Informatics (University of Bari), Electronics, Civil Engineering and Mechanical Engineering (Polytechnic University) and Physics (both the University of Bari and the Polytechnic University).

As to the private sector, the first important research centre that has been opened in the Apulian territory is the Fiat Research Centre (Centro Ricerche Fiat – CRF). In 1976 the CRF headquarters, based in Turin, decided to open a branch near Bari with the purpose of developing processes and products for the automotive injection systems for the Fiat group. Engineers originally came from the Turin CRF, but then the group enlarged hiring local professionals. It is now composed of around one hundred researchers. Other research centres arose in Apulia upon initiative of Fiat, such as another CRF branch in Foggia and the Elasis centre in Lecce. In the early Nineties a work group led by Mr. Mario Ricco at the Bari CRF developed the technology of Common Rail, a new injection system for diesel-powered engines, to which about 50 patents are associated. Lacking internal capacity to bring the technology onto the market, Fiat decided to sell it to Bosch, the German group producing automotive components for the world car industry.

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[30] It emerges from the industrial cluster based around Brindisi and involving 70 companies, 8 public and private research centres and 7 institutions and associations.

[31] The consortium has been set up in 2012 in Bari, comprising more than 40 associates among public research centres and companies, most of them SMEs.

[32] Source: http://anagrafe.miur.it/php5/home.php?&anni=2012-13&categorie=ateneo&status=iscritti&tipo_corso=TT&&order_by=i.

[33] Source: website http://www.unisalento.it/web/guest/storia_universita.

[34] Source: http://anagrafe.miur.it/php5/home.php?&anni=2012-13&categorie=ateneo&status=iscritti&tipo_corso=TT&&order_by=i.

This transaction explains the settlement of Bosch in Apulia in 1994 and the establishment of its own research centre, Centro Studi Componenti per Veicoli S.p.A., in 2000. Starting with a staff of less than seventy people, it has reached today 214 employees, including 160 engineers recruited from local universities. Bosch's presence was later consolidated through the acquisition of a company producing braking system (Allied Signal) with a plant in Bari. A 'programme agreement' with the Italian Government in 2000 provided co-financing for the implementation of two industrial projects and a research one, all in Bari. In the same years, another German multinational company chose to settle down in Bari, driven by the local mechanical engineering tradition but also by the significant public contributions granted by the Italian government: Getrag, world leader in the production of transmission systems for the automotive sector, which today in Bari has an industrial plant and a R&D unit with over thirty engineers and technicians.

The Nineties also witnessed the growth of some endogenous Apulian companies, such as Masmec, MerMec and Itel Telecomunicazioni. These reached the size of medium enterprises, thanks to international competitiveness and diversification of their product portfolio. The innovation capacity of these local firms has been recognised by some national and international awards.[35]

Masmec S.p.A was founded in 1979 by Michele Vinci, a former engineer at Nuovo Pignone. Masmec designs and manufactures complex and highly customised automated production systems for large companies producing car components, such as Bosch, Magneti Marelli, Continental USA and others. Before constituting its own R&D laboratory, for some years Masmec hosted in its premises the CNR Institute for Industrial and Automation Technologies,[36] which helped the company develop competences in parallel kinematic robotics systems with potential application in the automotive, but also other sectors, including biomedics. Understanding the potentialities of applying the same know-how and technology to different industrial sectors, Masmec has recently opened a division specialising in biomedical applications. Examples of products under development by the company currently include automated systems for the extraction and analysis of DNA, and sensor tools to help radiologists observe and analyse nodules or other masses in a human body. Its 30 researchers are well experienced in managing and participating to research projects financed by the public sector, either through the European research framework programmes, or national and regional operational programmes co-financed by Structural Funds.

MerMec S.p.A. develops and produces monitoring and diagnostic system for railway infrastructures and new generation railway signalling systems, based on innovative photonic sensor applications. Today MerMec is a world leader in this field. Its technologies are employed on the underground and railway lines of the most important cities. Like Masmec, MerMec is involved in a variety of European, national and regional research projects. In 2009 MerMec's president established a 6 million EUR equity fund to support or acquire start-ups operating in sectors for which there are synergy opportunities with MerMec. Among the targets there are Blackshape, today world leader in the production of high-speed light planes; Sitael, working in the aerospace industry;[37] Dreamslair, an enterprise producing applications for mobile and social gaming exploiting MerMec's experience with sensor technology.

Itel Telecomunicazioni S.r.l., with over thirty years of experience in the telecommunication sector, is among the premier companies worldwide in using, controlling, sheltering and measuring electromagnetic and magnetic fields. Its know-how is mainly applied to the telecommunication sector, but its division for research, development and engineering, established in 1997, is also working to the development of electromagnetic and mechatronic technologies for biomedical applications in the areas of radiopharmaceutical, to handle which special robotic systems are needed. Its division Itelpharma is the first reference centre in the region for the manufacture and quality control of pharmaceuticals marked with radionuclides used in the PET/CT diagnostic imaging.

Along with the increasing specialisation in mechatronics, through the integration of mechanics with electronics, ICT and control science, these companies have developed knowledge applicable to the realisation of high added-value and sophisticated products for niche markets. The opportunities brought by the mechatronic technologies for local socio-economic development were clearly identified by ARTI, but the limits of the regional research context were also acknowledged. On the one side, most of enterprises' research efforts were oriented towards the development of business ideas, to be brought onto the market in a short time span; moreover, enterprises generally tend to scarcely collaborate among themselves on R&D activities, not only due to different business sectors, but also to risks related to

[35] Such as the Italian Mechatronic Prize (granted to Masmec in 2013) and the Oscar of Photonics (awarded by the International Society for Optics and Photonics to MerMec in 2011).
[36] Now located in other offices, still in Bari.
[37] It is the only Italian company which has contributed to the development of the probe Curiosity, which is now exploring Mars.

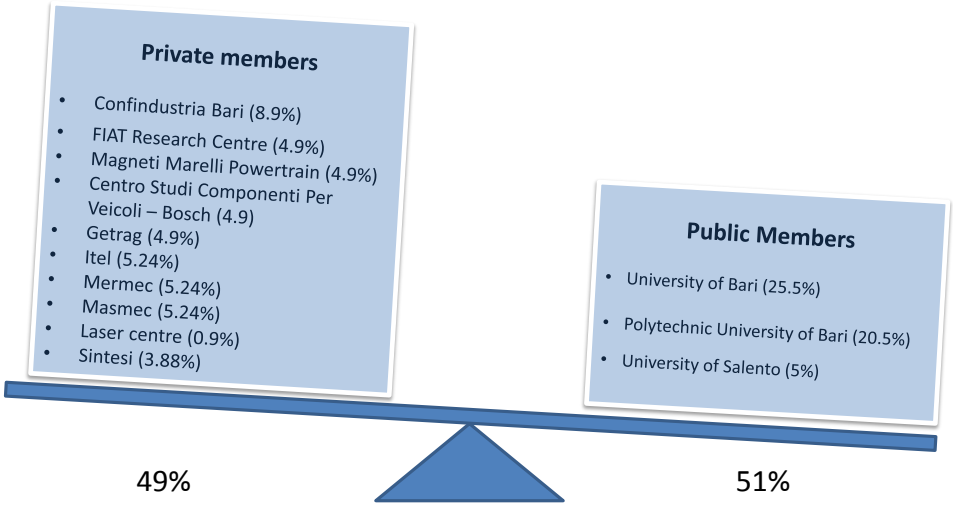
misappropriation of results.[38] On the other side, in spite of some existing collaborations among innovative enterprises and universities, according to interviewees (see Annex 2) most of high-quality research carried out by universities was not giving rise to sufficiently relevant technological transfer in Apulia.

Between 2006 and 2007 ARTI, in order to bridge the gap between university research and industrial technological development and to exploit synergies among innovative enterprises, explored the interest of stakeholders to establish a Technological Cluster of mechatronics. This was done in collaboration with the business representative association Confindustria Bari-BAT. The objective was not to institutionalise an already existing and well established business environment, but to indicate a possible evolutionary path for the wider regional system of mechanical engineering.[39] For several months, ARTI acted as incubator for the cluster. Representatives of the most innovative large and medium companies, who barely knew each other before, were invited to meetings, in order to discuss their current and future research interests and to understand how to combine their research efforts to reach common objectives. Some time was needed, in particular, to persuade larger companies to collaborate with smaller ones.

In 2007 ARTI drafted the cluster's Statute and the consortium MEDIS S.c.a.r.l. (Distretto Meccatronico Regionale della Puglia) was established. The consortium involves now all the main public and private actors belonging to the local productive and research system, with an overall governance equilibrium between the two components. Public-sector participants own 51% of the consortium shares, private ones (including two public-private research centres) 49%. All member enterprises have a fairly similar share of equity, regardless their size or turnover.

The balance between public and private interests is reflected in the composition of MEDIS board, with two representatives of public actors, i.e. university professors (one of which holds the presidency), and two representatives of private actors (one of which is appointed vice-president[40]). Unlike other Italian Technological Clusters, MEDIS lacks a scientific committee and a formal stakeholder assembly. According to interviewees, this light structure of MEDIS governance system enables a smooth and fast decision-making process.

Figure 6 MEDIS shareholders



Source: Authors' elaboration based on Invitalia (2012)

MEDIS's stated mission is to better focus university and private research on common research goals, which lay in the middle ground between purely academic and strictly business-oriented research. This mission is to be achieved by the collaboration of public and private parties for the pre-competitive development of key enabling technologies. In other terms, universities and enterprises are invited to work together on the development of new technologies which are

[38] The European Commission has recently proposed rules to better guarantee the protection of undisclosed know-how and business information (trade secrets) against the unlawful acquisition, use and disclosure (Proposal for a Directive, COM(2013) 813 final, 28.11.2013).
[39] As highlighted by Invitalia (2012).
[40] Current president is a professor of applied Physics of the University of Bari, prof. Gaetano Scamarcio, and vice-president is Mario Ricco, inventor of Common Rail.

sufficiently generic to find application in a variety of sectors (from automotive to biomedical, among others), and which do not directly lead to commercially exploitable results (MEDIS 2011). Once a new technology is developed, each enterprise can continue experimentation within its own research centre, in order to adjust the technology to its specific needs and commercial purposes. In this way, issues with appropriation of results obtained from R&D are supposedly avoided, while cooperation in the applied research phase are ensured.

For the period 2011-2015, MEDIS decided to focus its activities on three intervention areas, selected after a consultation process with its members and ensuring coverage of all their activities:

i. development of advanced minimally invasive diagnostic and radiation oncology systems;
ii. development of innovative mechatronic security systems (wired and wireless) for railway, aerospace and robotic applications;
iii. development of innovative technologies for the reduction of emissions, fuel consumption and operating costs of heavy-duty engines, in anticipation of the new Community rules in this field.

MEDIS does not own research laboratories. All research activities are carried out by its members with their own equipment and within their facilities. MEDIS is responsible for obtaining public financing and providing support mainly in terms of project management and coordination. Each research project is implemented by a group of MEDIS members, usually in collaboration with other actors (research centres, business associations, companies, other industrial and Technological Clusters, etc.) operating on a regional, national and international level. Also, MEDIS actively promotes the training of new generations of skilled researchers and technicians with expertise in the above mentioned fields of activities.

After its establishment, MEDIS faced some problems to get public financing to start operations. The high share of private members posed some difficulties to get public contributions by the government, due to concerns about 'state-aid' rules.41 The long delays of implementation of the National Operating Programme "Research and Competitiveness" also represented an issue.[42] MEDIS received, at first, a EUR 3 million grant by the government for university research only:[43] the project concerned the development of research on sensors and laser micro-production for automotive and manufacturing applications. When it was made clear that MEDIS is focused on research in cross-cutting and pre-competitive technologies, with no direct commercial and industrial aim, and that is up to its private members to apply the technology to their own products in a subsequent phase, in 2011 and 2012 the central government approved a EUR 50 million contribution. This is currently being used to finance three projects, each specifically targeted to one of MEDIS three priority fields. Projects started in 2012 and involve both public and private members. They are expected to be concluded by the end of 2015.

3.4. Some preliminary results

ARTI has the responsibility of monitoring activities carried out by MEDIS and other TCs and to evaluate socio-economic effects generated by research and innovation projects in the framework of the Apulian regional innovation system. To this purpose, over the past months ARTI has been collecting data about results (number of new patents, new employees, etc.) already achieved or expected by Apulian enterprises, but a comprehensive assessment is not available yet.

The Netval annual surveys on the valorisation of Italian public research show that the birth-rate of innovative enterprises in Apulia has significantly accelerated. In 2005 Apulia had the lowest number of spin-offs, while at the end of 2011 the region reached the fifth position in Italy (Netval 2012). This result can be linked to the Region's commitment to support research and innovation, and, particularly, to the network of ILOs set up by ARTI (Apulia Region 2012).

According to interviewees, MEDIS's positive results comprise the training of about sixty young researchers and technicians in the three priority technological fields covered by MEDIS. The two-year training courses, started in 2012, include teaching at universities and technical institutes and project-work in research laboratory, with the possibility for trainees to find employment in one of the cluster's enterprises.

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[41] In compliance with EU rules, public support for research and innovation within private enterprises is allowed, provided that the aid transaction takes place at the same time and under the same terms that would be acceptable to a private investor operating under normal market economy conditions (European Commission "Community framework for state aid for research and development and innovation", Official Journal of the European Union 2006/C 323/01).

[42] By 31 October 2011, five years after its launch, only 11.5% of resources planned under the National Operational Programme "Research and Competitiveness" had actually been disbursed (Barca 2011).

[43] Programme Agreement signed in November 2007.

The strengthening of collaborations between MEDIS members and other research centres, companies, industrial or Technological Clusters, business representative associations, universities on a regional, national or European scale[44] is a further result that can be imputed to MEDIS. Even before the creation of MEDIS, its members had cooperative relations with other research institutes, mainly established for implementing projects financed by the EU Research Framework Programmes. MEDIS is contributing to reinforce these relations and to search new complementary and synergic competences outside the cluster, though collaboration agreements directly involving external actors in its research projects.[45]

In terms of outputs from research projects, a few illustrative data can be provided. The know-how that has been produced over the 2008-2010 period by some of MEDIS members (as reported in MEDIS 2011) includes:

- 21 new products developed by MerMec, Itel, Masmec and the research centre Sintesi[46];
- 19 applications realised by MerMec, Itel, Sintesi, the Polytechnic Institute of Bari and the University of Bari[47];
- 12 patents, most of which European and international, obtained by the three Apulian companies, Sintesi and the two universities;
- 69 new permanent employees and more than 100 fix-term employees in the three Apulian companies Itel, Masmec and MerMec.

Research outputs achieved by Apulian research centres belonging to multinational companies are more difficult to be quantified. Actually, research on such companies is usually carried out by their own research centres acting as an internal network, so that it is often difficult to assess the contribution of each team to any new invention.[48]

At a more aggregate level, one may look at the dynamics of knowledge creation in the local context, i.e. the number of patent applications made by residents in the province of Bari to Italian patent offices during the last 20 years. This figure has increased in Bari by 174%, higher than a 146% in Apulia and 14% all over Italy (Figure 7). In the 2008-2013 period only, i.e. the years in which the new regional innovation system and MEDIS have started working, patent applications surged by 49% in Bari, versus a 12% in Apulia and in contrast to a -3% reduction in Italy. Today, 72% of all Apulian patent applications are ascribable to the province of Bari only.

The trend is even more pronounced when considering utility models, expressing not new inventions, but changes in the functionalities of already existing processes or products (Figure 8). The number of utility models applications in the province of Bari has undergone a 193% increase during the 2008-2013 period, higher than the 92% increase recorded in the whole region and much higher than the 21% Italian increase. According to Kim et al. (2012) and Capriati (2013), who study the relationship between different forms of intellectual property rights and economic development, patent protections more properly reflect innovation growth in developed countries. On the contrary, utility models, which are based on adaptation and imitation capabilities, are better representations of incremental innovation in less developed countries. Hence, utility models can be seen as the first step towards an increase of the autonomous ability of innovation, achieved thanks to the gradual strengthening of the scientific and technological base.

[44] Including, among others, various CNR institutes, the European and Italian platforms MANUFACTURE, Fraunhofer Institute of Jena, Instituto de Desenvolvimento de Novas Tecnologia of Lisbon, Royal Institute of Technology of Stockholm, Institute for Production of Cologne Fachhoschscule, several Italian and European universities.

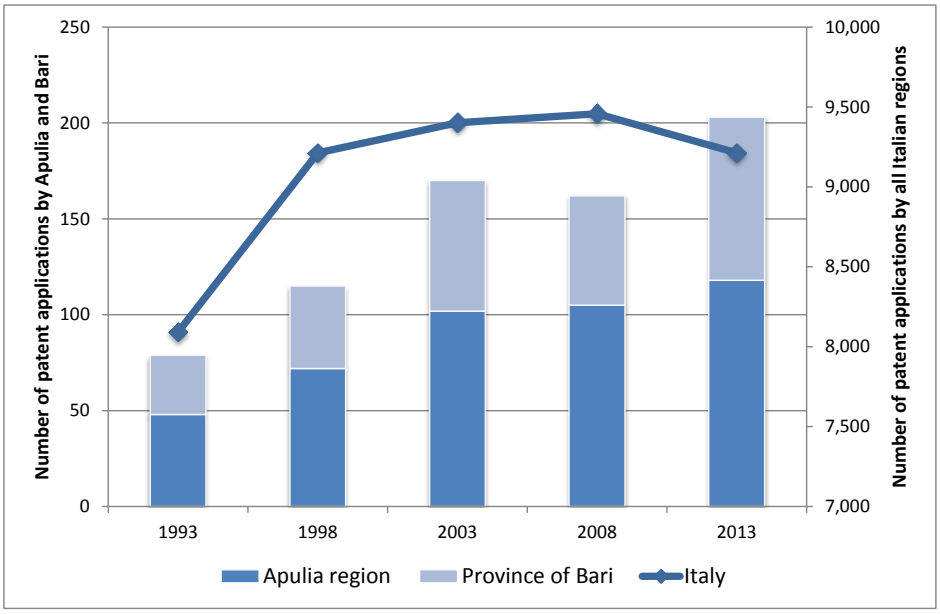
[45] For example, the main project related to the second intervention area of MEDIS, 'Development of innovative mechatronic security systems (wired and wireless) for railway, aerospace and robotic applications', is involving other 9 regional companies, 3 Italian companies, the Apulian productive Mechanics cluster, the Apulian Aerospatial Productive and Technological clusters, the European association of Railway companies (UIC) and the European Association of railway system manufacturers (UNIFE).

[46] Just to mention some of them: MerMec has developed led optical system for railway use, Masmec a biomedical liquid handling workstation for molecular diagnostics, Itel a robotic system for placing the patient in radiotherapy, the research centre Sintesi an encoder laser for measuring mechanical and structural deformation.

[47] Examples are a new software modular platform for ex-ante monitoring of railway assets (MarMec), a new laser sensor for NOx emissions monitoring (University of Bari), and a software for automatic design of electrical machines with permanent magnets (Polytechnic institute of Bari).

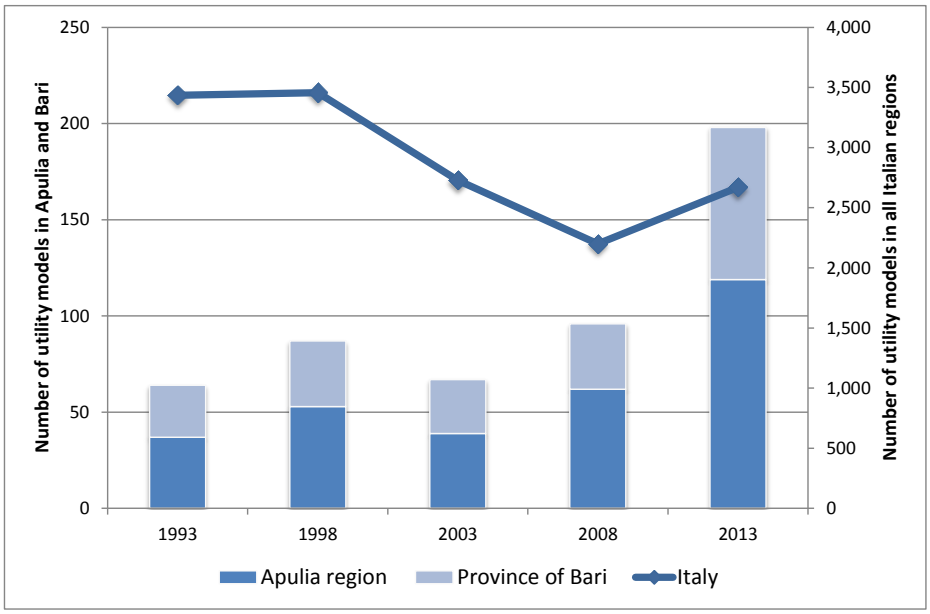
[48] For example, according to field interviews, Bosch produces every year between 20 and 30 patents (32 in 2013), but they refer to results obtained from research carried out by all its research centres.

Figure 7 Number of patent applications in Italy, Apulia region and the province of Bari – 1993-2013



Source: Authors' elaboration based on the Italian Patent and Trademark Office data

Figure 8 Number of applications for utility models in Italy, Apulia region and the province of Bari – 1993-2013



Source: Authors' elaboration based on the Italian Patent and Trademark Office data

In short, even if in absolute numbers Apulia still produces a minor share of Italian patent applications (in 2013 it was 1.28%, 0.92% for the province of Bari) and utility models (4.46% for Apulia and 2.96% for Bari), the growth trends seem to indicate an on-going convergence process. Whether these positive developments can be directly imputed to the changes of the regional strategy and governance system occurred in the past 5-8 years still should be inquired by an in-depth evaluation, which is beyond the scope of this paper. While we are unable with available data to claim a causal link between the activities of ARTI, MEDIS and other bodies, and the positive performance of some innovation indicators, we suggest that something has been moving in the right direction in our case history, and it deserves further inquiry.

In the next section we provide additional qualitative insights about the contribution that the regional innovation system is giving to the increase of the innovation capacity in Apulia. The main strengths and weaknesses of the system, as reported by interviewees, are hereby discussed.

3.5. Strengths and weaknesses of the regional innovation system

As mentioned, Apulia relies on a fairly good local context, with some innovation potential in specific industrial sectors. With reference to our case study, the Apulian mechatronics industrial cluster can benefit from high enterprise density, a deep-rooted industrial culture and precision mechanics tradition, local supply networks, a good international exposure,[49] specialised niches of manufacture. The companies' focus on high added-value products allowed most of them to record a positive economic trend over the last years, in spite of the world financial and economic crisis. In line with Florio (1991, 1996), Florio and Giunta (2002) and Bacchiocchi et al. (2012) on the pivotal role played by large enterprises in a number of industrial clusters in Southern Italy, the presence of large firms as Nuovo Pignone, Fiat, Bosch and Getrag, has been a driving force for local development. All these factors make the local productive system particularly suitable to generate technological innovation. The existence of well-established universities and public research centres carrying out research in mechatronics-related fields is another important asset of the region. External firms were attracted in Apulia by significant public subsidies, but also by such local environment.

The regional political-institutional setting is overall supporting knowledge generation. Since 2005, as mentioned, the regional government has put innovation at the centre of its long-term strategy for socio-economic development, affecting all regional sectoral policies, from industrial to education and labour policies. Direct investments to research and innovation in enterprises have been complemented by measures favouring the diffusion of ICT technologies and infrastructures, training to increase of skills of human capital, and support to SMEs' internationalisation (Apulia Region, 2009). The outcome of 2010 regional elections has guaranteed continuity to the strategy and stability of financing since nine years.

In implementing its research and innovation strategy, the Region has operated in almost full autonomy from the central government. According to some interviewees, this behaviour has been motivated by the need to ensure more rapidity of intervention and better responsiveness to local specific needs. As a matter of fact, the main role that has been played by the national Government was to co-finance investments applying for resources of the National Operational Programme.

The Regions' decision to allocate a large share of Structural Funds to innovation objectives, along with the high public co-financing rate granted to EU convergence regions for investments in research projects – spanning from 50% for large companies to 70% to small ones – makes attractive to enterprises to pursue their innovation activities in Apulia. It also represents a strong incentive for extra-regional and multinational companies to conduct research and develop new products in Apulia, compared to EU 'Competitiveness' regions where co-financing rates are lower.

The creation of PugliaSviluppo has considerably eased enterprise' access to fund compared to the previous situation, when EU Structural Funds were managed at central level. The proximity to the intermediary allows firms to receive continuous support over all the phases of the project cycle. Also, PugliaSviluppo's knowledge of local context has been crucial to elaborate specific measures that effectively meet enterprise's needs. Liquidity problems of firms have been addressed by ensuring advance payment of 90% of public contribution. Funds are allocated through negotiation procedures rather than open tenders, as a way to reduce bureaucracy and further speed the funds' disbursement. The large amount of available financial support forms has been rationalised, by proposing enterprises only those instruments which are considered more appropriate to their size and financial needs.

In order to ensure that business support actually determines a positive effect on employment (see Florio and Moretti 2013, for evidence in seventy EU regions), and more sustainable job opportunities than what has been achieved by other national measures (e.g. law 488/1992), PugliaSviluppo has set as a condition for funding the commitment by the enterprise to increase the number of employees and to maintain the same number for at least three years after the period of investment, otherwise the public subsidy is repealed.

Finally, the importance of the Region's and ARTI efforts to ensure a better alignment between university research and industrial innovation cannot be disregarded. The identification of promising patterns of economic development focused

[49] The Apulian mechatronic cluster has recorded the highest export growth of all Italian clusters during the second three months of 2013 (+40.7% compared to the previous year, according to Intesa San Paolo 2014).

on a limited number of industrial sectors, such as mechatronics, is fully in line with the European 'smart specialisation' approach. The establishment of Technological Clusters and a network of ILOs helped academic interests and industrial objectives to converge. In particular, MEDIS's decision to focus public and private efforts on a small number of pre-competitive key enabling technologies seems to have been effective to stimulate enterprises' collaboration, along with the development of cross-cutting transferable technologies. In spite of the late start of activities, due to delays in obtaining financing from the central government, MEDIS is now carrying out three research projects on highly innovative technologies.

However, in the face of these strengths, the regional innovation system is characterised by some weaknesses too. ARTI, after playing a crucial role over its first years of activity in guiding the political strategy and facilitating the born of Technological Clusters such as MEDIS, shows now some difficulties in providing a continued contribution. According to interviewees, such difficulties are reflected in the still lack of a functioning and effective monitoring system and of a comprehensive ex-post evaluation. A more prompt availability of data about innovation outputs obtained by enterprises, and information about their degree of satisfaction with the overall regional innovation system, would help different stakeholders (primarily Technological Clusters and PugliaSviluppo) to adjust their current and future actions to evidence of outcomes of previous actions, as well as new emerging needs.

ARTI's delay in monitoring and evaluation is unlikely to be explained only by a shortage of staff (ARTI currently employs ten people). Instead, interviewees have highlighted that ARTI may have some difficulties in setting up an effective monitoring system and in interpreting the collected evidence due to the lack of internal skills in this area and limited ongoing dialogue with research and innovation actors. There are some expectations now that the newly appointed president of ARTI will be able to give a new stimulus to the agency, by virtue of her former personal experience in managing a Technological Cluster (in the Campania region) and several industrial research projects. However, as argued by some interviewees, it is also important that the Region expresses firm political interest in obtaining information about the impact of its policy, particularly considering the high volume of funds already disbursed.

Interviews suggest the existence of another weakness in the regional innovation system. As mentioned, overall the region's technological level is still far from the most advanced industrial systems in Europe and the USA. This is because the capacity to innovate is concentrated among few enterprises, mainly belonging to large corporations, even if some medium-sized firms are also benefitting of the progressive environment. The micro or small size of the large majority of local firms is also associated to higher difficulties in accessing the credit or equity for investing in research and innovation. Notwithstanding more than 3,000 small enterprises all over Apulia have already benefitted from financing instruments offered by PugliaSviluppo, still sustained efforts are needed to increase their innovation capacity.

A further critical element preventing many micro and small enterprises from innovating is the limited availability of transfer mechanisms of knowledge spurring from the most dynamic enterprises. This can be clearly observed in relation to the mechatronics cluster. Up to now, research projects promoted by MEDIS have involved its members with the purpose of producing new key and horizontal knowledge, which will be eventually exploited mainly by the consortium's enterprises. The promotion of excellence among a handful of firms can be beneficial to the regional socio-economic development not only because of the additional employment created, but also, and most importantly, through the generation of a multiplying effect on other companies which are part of the local/regional network of collaboration and supply. In principle, once new knowledge is created, it should not be used by MEDIS business members only, but it should spread outside the consortium and be made available to other enterprises, according to an 'Open Innovation' logic. The training of new researchers and engineers in mechatronics sciences promoted by MEDIS and their employment in regional enterprises or research centres can be a way to favour such spread of knowledge. However, additional mechanisms favouring firms' absorption of new knowledge and their innovation capacity are needed. We discuss more extensively about this issue in the following section.

3.6. Opportunities of future development: the Piedmont benchmark

MEDIS, according to interviews and documentary evidence we have collected, admits that, for the cluster's potentialities to fully show themselves and produce wider effects, the model of the Mechatronics Technological Cluster needs to evolve. In particular, MEDIS should become a promoter of innovation not only among its members, but for the local productive system in general.

In its 2011-2015 strategic plan, MEDIS acknowledges the importance for the consortium to acquire a stronger strategic role for socio-economic development, primarily by giving itself an Industrial Liaison Office (ILO). Following the example of

several ILOs already existing in Europe, and integrating itself in the network of regional ILOs established by ARTI within the main universities, ILO-MEDIS will be entrusted to increase the overall commercial and economic impact of research activities. This objective will be pursued by providing services to the creation of spin-offs, information to enterprises about existing technological opportunities and support for patenting.

Moreover, MEDIS is currently reconsidering the number of companies to be involved in the consortium and the modalities of involvement. MEDIS is in principle open to new members, but, since its foundation, its memberships has been limited to a small number of medium-large well established private-sector players, thus excluding all small companies lacking a noteworthy research laboratory. While it is true that over the past few years some companies have been growing and have equipped themselves with a dedicated R&D division or laboratory, so that they could now strive for being admitted in the consortium,[50] these still represent a very limited number.

The decision of limiting MEDIS membership to highly innovative firms and R&D centres aimed at putting excellence in the foreground, but in fact could risk to constrain the achievement of economic convergence objectives. An adequate process of knowledge diffusion can favour the establishment of new start-ups and the increase of innovation within other smaller enterprises. The reinforcement of the entire cluster, rather than of few companies belonging to it, would be beneficial not only to the majority of small companies having less capacity to carry out significant research projects on their own, but also to the most innovative enterprises, which would then rely on a stronger local supply chain, able to provide improved technological applications and solutions. PugliaSviluppo usually asks large companies benefitting from a 'programme agreement' to involve in their activities local SMEs, but this is not a binding condition for funding. Hence there is no guarantee that collaborations actually take place and that knowledge is transferred.

Is there experience elsewhere of a more open and flexible system for the development of technology transfer? A possible benchmark has already been identified by MEDIS itself: it is MESAP, acronym for Mechatronics and Advanced Systems of Production, an innovation pole promoted in 2009 by the Piedmont Region, in Northern Italy. As the region where Fiat was born and developed, Piedmont shows deep-rooted industrial and innovation traditions, thanks to is world class excellence in specific sectors or highly skilled niches. MESAP is the body chosen by the Piedmont Region to link public and private actors and stimulate their collaboration on applied research projects focused on technological development.[51] Hence MESAP and MEDIS broadly share the same mission. Like MEDIS, MESAP has identified a small number of horizontal technological domains on which focus research activities, which are relevant to different industrial sectors (automotive, aerospace, biomedicine, railway, chemical, etc.).

Looking at their membership, however, the Apulian consortium and the Piedmont innovation pole greatly differ: MESAP has 205 members, of which 2 universities, 9 research centres, 31 large companies and 162 SMEs, and the number is still growing.[52] Among its members there is a core, made of large and medium-size companies but there are also many small high-tech enterprises and start-ups. The former and the latter collaborate on regional/national/European-funded research projects. MESAP facilitates the knowledge transfer by organising workshops at the completion of each research project in order to disseminate results, or 'technology days', i.e. events with educational purposes, specifically aimed at explaining new technologies to MESAP members. Piedmont's business community expresses great satisfaction with the services provided by MESAP. According to interviewees, the large number of associates does not hinder the smooth implementation of activities and achievement of objectives. It is important, however, that – first – all associates share a certain technological capacity or at least an interest about the key enabling technologies developed and – second – that MESAP is able to highlight the synergies and maintain close and direct relationships with all involved actors.

At present, MEDIS is lacking such a wide membership, but it is looking at MESAP as a model to understand the way how even smaller enterprises could be involved in the knowledge generation and diffusion process. Considering the differences between Apulia and Piedomont's industrial fabric, in particular the much more limited innovation capacity of Apulian small companies, MEDIS considers more appropriate to maintain its membership limited to the few most innovative medium and large enterprises. These will be in charge of producing new transferable knowledge. In parallel, following MESAP's example, MEDIS will identify a group of small and less innovative companies which will not be directly involved in research projects, but will benefit from technological transfer, absorbing, rather than directly producing, new knowledge.

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[50] An example is Icam S.r.l., which designs and manufactures intelligent automatic storage and filing systems, allowing to efficiently exploit available space and better organise the working environment. In 2007 when MEDIS was set up, Icam was too small and did not have enough capacity to produce research, but over the past years it has significantly grown.

[51] MESAP is not defined as a technological cluster *strictu sensu*, but it is an independent association managed by Unione Industriale, the Turin business representative association.

[52] Partners are admitted against the payments of a small fee.

The increase of mechanisms for knowledge transfer to local SMEs, the strengthening of ARTI's monitoring and evaluation capacity, along with the continuation of financial support provided by PugliaSviluppo and further development of human capital, are possibly the key means to improve the effectiveness of the regional innovation system in Apulia. Until now, however, it is not entirely clear if the current experience will stabilise and eventually help to close the gap with the Piedmont benchmark.

4. Lessons learned

The case of the Apulian regional innovation system confirms some of the findings of previous innovation literature: there is some scope for a place-based research and innovation policy, but provided that some specific conditions are met. In this final section we highlight these conditions, which, even if drawn from one single case study, are sufficiently general to be of interest for other less developed EU regions.

As a first lesson, the Apulia case study highlights that innovation cannot occur in the middle of nowhere. Strong industrial vocation in a certain sector and an already well-established productive system, often developed in connection to a few large enterprises, are preconditions for a successful Technological Cluster to develop. The territory should also be endowed with universities producing skilled human capital and an adequate level of applied research, both of which could then be suitably employed to satisfy industrial technological needs. These ingredients are rather a pre-condition than part of the place-based innovation policy, as it takes often decades to establish an industrial fabric and a fairly good academic tradition in any region. Thus, selectivity is needed in establishing an ambitious place-based innovation strategy. Not all context are suitable, and a careful opportunity study should identify the appropriate places where to experiment such strategies.

1. The regional or local government should define a clear, comprehensive and long-term development strategy focused on innovation. The importance of innovation for socio-economic development and convergence should be explicitly recognised, stated in policy papers, and pursued at all levels of government. This implies coordination of different agendas and departments. For example, measures in support of industrial technological advancement should be accompanied by a simultaneous effort to sustain human capital, able to generating technological change and exploiting the potentialities of the already existing comparative advantages. Political stability and continuity are crucial to guarantee such a long-term commitment and to ensure a smooth implementation of the strategy. This condition, in the last around ten years, was apparent in the Apulia case study.

2. Besides a widespread policy vision about the role of innovation within government, there must be a well-functioning and structured administrative machine. The place-based dimension of innovation can be more effectively dealt by authorities operating at the regional or local level, which may have better knowledge of the characteristics and potentialities of the local research and industrial sectors. Regional governments can be more effective than national governments in detecting the needs arising bottom-up and in involving and coordinating the relevant stakeholders. The national government should sustain the regional innovation system, by retaining some power of coordination and stimulus over research and innovation policies, but also by contributing to finance innovation and attract foreign direct investments in relatively less developed regions. The division of roles between the decision-making process, performed by national and regional authorities, and the execution tasks, performed by intermediate innovation agencies, would ensure a better exploitation of comparative advantages of different layers of government. Knowledge of the local context and more responsiveness to changing needs is typically place-based, while the overall funding strategy for long-term research and innovation is better managed by high-profile national bodies. Multilevel governance of the regional innovation system can work well provided that all actors have clear and not overlapping mandate, commitment and enough financial and technical resources to carry out their tasks. The Apulia case-history shows that the combination of national programs and regional policies were synergic in attracting and retaining large innovative firms, but also that occasionally there were difficulties in coordination between the national and the regional government.

3. A sufficient volume of financial resources should be available to ensure the implementation of a minimum efficient scale of investments in research, industrial innovation, education and training. The combination of regional, national and European financing can help attain a critical mass to trigger a change in the development and innovation pattern. The significant volume of public contribution helps to reduce sunk costs of research and innovation, thus also favouring the attraction of extra-regional and multinational enterprises within the regional innovation system. This happened in Apulia occasionally since the 1960s, and particularly with the ‘programme agreements’ in the 1990s and it shows the long-term resilience of such policy when the context is adequate.

4. The set of financial support instruments should be sufficiently diversified, so as to include grants and various financial engineering instruments, but also tailored to the specific needs of different types of beneficiaries. In particular, SMEs’ difficulties in accessing capital for risky investments should be properly addressed. Access to

funds is facilitated by the availability of a regional intermediate agency for public financing support, which can establish a more direct relationship and provide more tailored support to potential beneficiaries than a centralised authority. Apulia Region had had some good experience in this area, but not yet enough to fully match the needs of SMEs. Binding conditionality in providing research grants should be foreseen to enhance their spillover effects.

5. The regional innovation system should be open to other regions and countries, in order to favour the exchange of ideas and knowledge. This can be achieved through the establishment of collaboration relationships with partners outside the regional territory and it can have a twofold effect: on the one side, Technological Clusters open to receive and absorb the new knowledge generated elsewhere are less likely to incur the risk of a lock-in situation; on the other side, the exchange of research and innovation results with other territories can produce positive spillover effects to other regions. In Apulia it was a positive ingredient that some of the major players gave access to the more advanced research and technology context of Piedmont or Germany, and that local private research centres already had some contacts with foreign research institutes. Elsewhere the wider network should be built as part of the strategy.

6. The regional innovation system should promote mainly the development of key enabling technologies. Developing cross-cutting pre-competitive technologies, which in principle could be applied to a variety of sectors, favours the diversification of the industrial basis and maximises the utility of generated knowledge. The types of technologies on which focusing the research and innovation efforts should be driven by the local industrial tradition, and selected through a participatory approach. This happened in the case of the Apulian mechatronics cluster, thanks to the initial important facilitator role played by the regional agency ARTI.

7. The existence of appropriate mechanisms of knowledge transfer from the most innovative to less innovative enterprises is crucial to guarantee the diffusion of technological advancements and ideas to a wider number of actors, besides those which actually produce new knowledge in the first place. This process can transform technological excellence, which is typically highly idiosyncratic, into a driver of wider territorial socio-economic development. The existence of a common industrial vocation (as from point 1 above) increases the firm's capacity to absorb knowledge and to give it a practical application. The Apulia case study shows some difficulties in establishing knowledge transfer from the core players to the local SMEs.

The case study presented in this paper suggests that in principle several ingredients should simultaneously occur to sustain an effective innovation policy decentralised at regional level. We guess that this combination of ingredients is not frequent in lagging-behind local contexts in the EU Member States. Any regional innovation strategy significantly lacking one of the core pre-conditions and ingredients we have identified is risky. Policy-makers should carefully study the opportunities and challenges arising from local contexts before embarking in ambitious place-based innovation strategies. The Apulia case history on mechatronics, despite some fairly good results, shows that ten years of efforts are not enough to achieve long-term success when some, but not all, ingredients are available. On a more positive vein, however, the case-study also shows that a place-based innovation policy in lagging behind regions is feasible, and has a potential to pay a growth-dividend to its stakeholders.

Annexes

Annex I. Milestones of the development of the Mechatronics Technological Cluster in Apulia and the regional innovation system

1960s-1970s	- Establishment in Apulia of the first large enterprises operating in the mechanics industry (Nuovo Pignone and Fiat), also thanks to government incentives.
1976	- Establishment of Fiat Research Centre in Bari.
1994	- Bosch buys the Common Rail technology developed by Fiat Research Centre and establishes a plant in Bari.
1995	- Getrag establishes a productive plant in Bari.
1996	- Bosch enlarges its presence in Apulia by taking over Allied Signal.
2000	- Bosch establishes a research centre in Bari, the Centro Studi Componenti per Veicoli S.p.A.
2001	- Reform of Title V of Italian Constitution, which foresees the devolution of legislative powers to regions concerning policies for territorial development and innovation.
2004	- Creation of ARTI, the Regional Agency for Technology and Innovation.
2005	- On January 1st, ARTI becomes operational.
2005	- In April, following the regional political elections, the new regional government led by Nichi Vendola settles down. - Establishment of DHITECH, regional cluster of high technology.
2006-2007	- Law 296/2007 and the subsequent Directive of the Minister of Economic Development dated 27/03/12007 foresees the institutional reorganisation of Sviluppo Italia S.p.a., the national agency for business promotion and the transfer of its regional offices to regional public administrations. - ARTI starts promoting the establishment of a Mechatronics Technological Cluster.
2007	- Establishment of the regional Mechatronics Technological Cluster MEDIS.
2008	- The Region merges the science and technology park Tecnopolis and the regional financial agency FinPuglia establishing the new in-house company InnovaPuglia. - The regional office of Sviluppo Italia is transformed into the in-house company PugliaSViluppo. - Establishment of the regional technological agro food cluster DARE. - Establishment of the national Technological Cluster on energy DiTNE. - MEDIS receives a first grant (EUR 3 million) by the central government, following which a research project is carried out by its public members.
2010	- In March, following the regional political elections, Nichi Vendola is reconfirmed president of the regional government.
- 2011	- MEDIS drafts it first strategic plan, covering the period 2011-2015.
- 2012	- Establishment of the Aerospatial Technological Cluster DTA and the Technological Cluster on human health and biotechnologies HBIO, still to be approved by the central government. - MEDIS receives a EUR 50 million grant by the central government, following which three research projects on mechatronics key enabling technologies have been started by MEDIS's public and private members. - MEDIS starts the training of 60 researchers and technicians in mechatronics. - The Apulia Region starts discussions with stakeholders in view of drafting the regional Smart Specialisation strategy.
- 2013	- PugliaSviluppo becomes an accredited financial body for microcredit to enterprises.
- 2014	- Start of the new EU programming cycle 2014-2020. The Apulia Region confirms its focus on innovation support.

-	2015	- Expected end of MEDIS currently ongoing research projects. - Establishment of ILO-MEDIS and setting up of other mechanisms for technological transfer.

Annex II. List of interviewees

Ms. Adriana Agrimi	Director Directorate – Economic development, employment and innovation policies – industrial research and innovation Regional Government of Apulia Bari
Ms. Eva Milella	President ARTI – Regional Agency for Technology and Innovation Bari
Mr. Antonio De Vito	General Director Puglia Sviluppo S.p.A. Bari
Prof. Gaetano Scamarcio	President of MEDIS, Apulian Mechatronics Technological Cluster Professor of Experimental Physics at the University of Bari
Mr. Antonio Arvizzigno	CEO Centro Studi Componenti Per Veicoli S.p.A. (Bosch private research centre) Modugno – Bari
Ms. Daniela Vinci	CEO MASMEC S.p.A Modugno – Bari
Mr. Vittorio Colangiuli	Confindustria Puglia (Business representative association of Apulia) Bari
Mr. Nevio Di Giusto	CEO Fiat Research Centre Turin (Piedmont)
Mr. Dario Scapaticci	Technology manager MESAP – Piedmont's Cluster of Mechatronics and Advanced Production Systems Turin
Prof. Michele Capriati	Professor of Economics University of Bari
Prof. Gianfranco Viesti	Professor of Economics University of Bari; President of ARTI from 2006 to 2009

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