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INNOVATION & ENVIRONMENT
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ERMIS
Effective Reproducible
Model of Innovation System

LITERATURE REVIEW

A BASIS FOR THE ERMIS MODEL

13 September 2012

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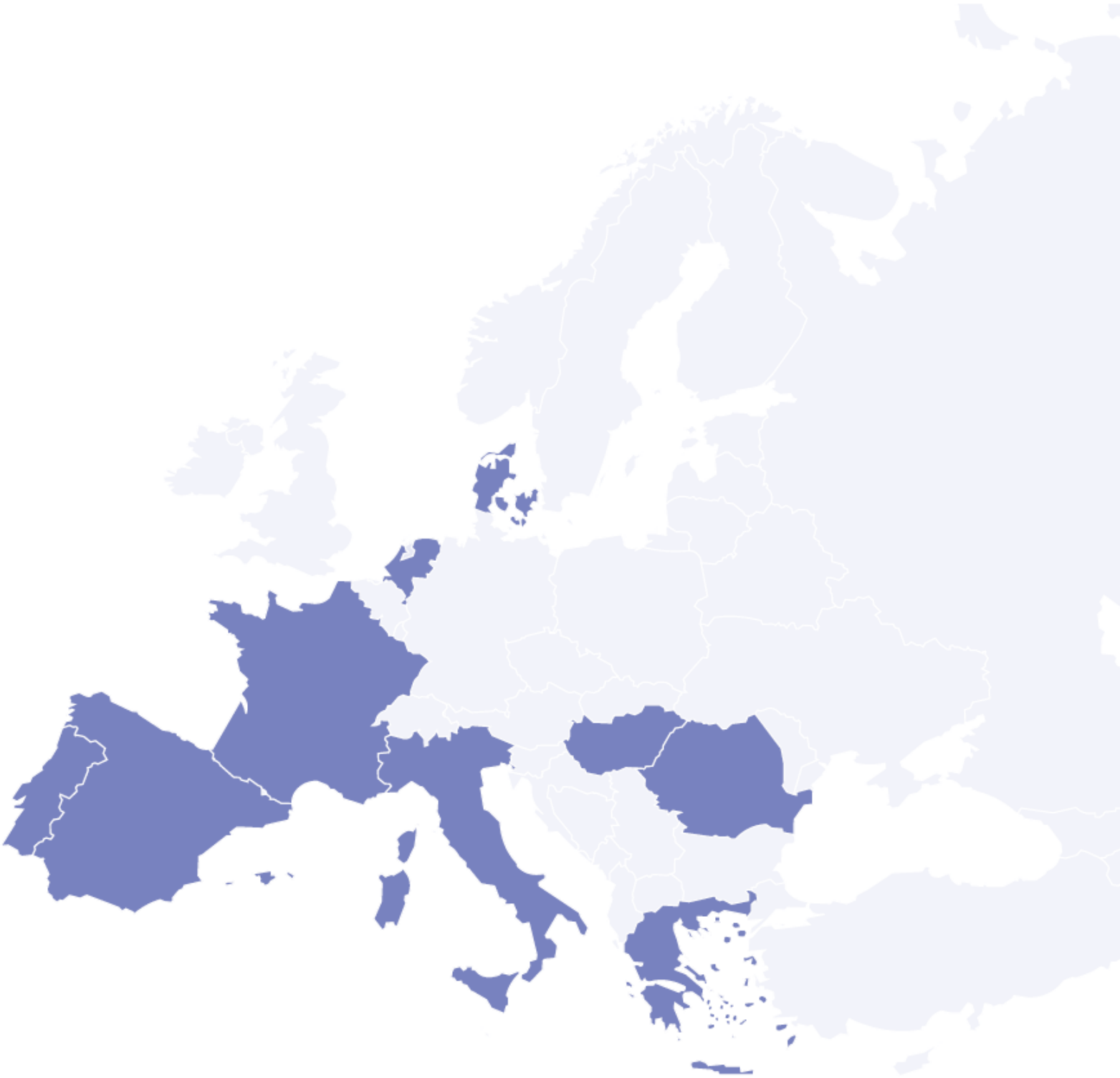

The ERMIS project has been made possible by the INTERREG IVC and Co-financed by the European Regional Development Fund.
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Executive Summary

1. Small and young firms matter. They provide the necessary dynamics of an economy both at the national and regional level

2. SMEs suffer from market inefficiencies and even the most productive (and thus promising) ones may not manage to grow and survive.

3. Innovation (not only technological innovation) is the main source of growth of SMEs. It is therefore critical to enable those promising firms to access resources to accomplish their innovative endeavor.

4. Region is the best level to implement policies –and in particular innovation policies- orientated to SMEs. This is explained because SMEs learn essentially from knowledge developed by others (firms, universities, research institutions etc.). Knowledge is best transferred when relations are established between close players.

5. Proximity matters not only because of (free) spillovers –that indeed are more intense between firms located in the same region- but also because of contractual relations and people mobility that reveal the best means to transfer knowledge.

6. The needs of innovative SMEs prove significantly different depending on their age, experience and industrial context.

7. Further, the structural conditions (in terms of population, research and innovative culture, geographic, political or industrial centrality of regions strongly affect the ability of SMEs to seize opportunities and thus to innovate and grow.

8. Therefore, the industrial and innovative contexts of regions should determine their policy orientation

9. The regional innovation system framework proves useful to describe the innovative context of a region but proves limited in providing regions an analytical tool to design an effective innovation policy.

Introduction

1. In recent years, despite the globalization of economic activity dominated by giant multinational companies, regional policy targeted to SMEs have become a priority in the policy agenda of most developed and developing countries. This evolution is triggered by the understanding that innovation is key to increase firms' competitiveness in a knowledge-based economy.

2. SMEs account for a small share of total R&D, but it is well established that SMEs, and more specifically young firms with high growth potential, play an important role in innovative activity, productivity gains and on economic growth and generate a disproportionate share of new jobs.

3. However, evidences also show that SMEs experience problems related to size that often limit growth and survival likelihood. Of course, all new firms are not necessarily competitive enough to survive and it is generally understood that market mechanisms naturally select the most productive ones and push the less efficient ones to exit. Although several empirical studies have evidenced the effectiveness of this selection process, when looking with more scrutiny at the conditions of entry and exit, it appears that market does not always sanction the less efficient firms. More prosaically, SMEs may be prevented to grow and survive not because of a lack of efficiency but because of their size… In fact, the literature often underlies that the most damaging problems are the obstacle SMEs encounter to innovate. Young small firms, when interviewed, report systematic problems to access strategic resources such as finance or equity and human resources, which are critical, particularly when growth –most often related to innovation- is a survival condition. These facts have intensified the academic debate –which dates back to Schumpeter (1934, 1942)- on whether small firms disproportionately suffer problems of market failures, and explain the recent intensification of policies directed towards SMEs innovation and competitiveness.

4. However, the focus on access to resources may not be enough to solve SMEs innovation problems. Innovation is the outcome of complex processes underlying systemic relations between different actors from policy makers to companies, whose main objective is to produce, share and better exploit knowledge and create value.

5. The complementarity of all those dimension has been well documented by the literature on innovation system, emphasising the role of regions and local territories as the best level of action to activate synergies among institutions and private players.

6. One of the main reasons for the resurgence of the interest in regions is the common belief that knowledge spreading bounded in space, thus requiring proximity between individuals, firms, research and academic institutions, policy makers. The properties of knowledge (tacitness in particular) are considered as the main explanation for the increasing co-location of companies trying to establish a learning environment favourable to learning and idea generation.

7. Thus, regions or local areas are viewed as the right level to foster innovation systems, through interactive learning networks, supported by local authorities and civil servants, directly involved in the dynamics of the system.

8. This literature review first reports the main challenges and obstacles limiting SMEs innovative performance and explain theoretical and empirical justification of the emphasis of Regional Innovation systems as an analytical framework and as a policy guide line. Then, it tries to account for the most recent results provided by empirical tests on the effectiveness of the mechanisms often questioning the effectiveness of the mechanisms.

Why do SMEs matter?

9. Although empirical studies testing the so-called Schumpeterian hypothesis have proven inconclusive (see Symeonidis, 1996 for a critical survey), scholars generally agree that the relationship between size and R&D is weak. Inter-sectoral studies (e.g. Pavitt et al., 1987) find that innovation intensity tends to be greater for large firms and small firms and smaller for medium-sized and very small firms. But more importantly, the size-R&D intensity relation seems to exhibit important sectoral differences. Breschi et al. (2000) have suggested that this phenomenon relies on different technological conditions and knowledge base properties giving rise to different success factors in innovative activities. This view is supported by empirical works suggesting that R&D intensity and market structure are jointly determined by technology, the characteristics of demand, the institutional framework, strategic interaction and chance (Symeonidis, 1996).

10. The role of new small firms on innovation and productivity growth is probably more rigorously evidenced by empirical studies trying to test the efficiency of market selection process. While new small firms, potentially endowed with better technologies and products, enter and try to challenge incumbent firms, efficient markets tend to push the less efficient firms to exit, and select the best performer. It follows that this selection mechanism is supposed to positively contribute to the average productivity and thus to aggregate economic growth (e.g. Baily et al., 1992, Haltiwanger, 1997, Bartelsman et al., 2003). Most studies conclude that market selection works pretty well in all countries1.

11. However, when looking with more scrutiny at the conditions of entry and exit, it appears that the selection mechanism does not work similarly in every country, in all industries and seems to affect differently small and large firms. Bartelsman et al., (2003, 2004, 2005), for instance, undertake comparative studies between ten OECD countries and evidence that about 20 to 40 per cent of entrants fail within the first two years of life and only about 40-50 per cent survive beyond the seventh year. Although quite common to all categories of firms, this selection process proves less harsh to larger and fast growing firms.

12. They further argue that different regulatory frameworks induce different performance levels and that European markets have been less efficient than the one in the United States at promoting the growth of new firms. More precisely, barriers to entry and the likelihood of failure in early years are lower in the United

[1] Specific circumstances may limit the effectiveness of the market. For instance, Nishimura et al. (2005) argue that selection mechanisms may not work in recession periods.

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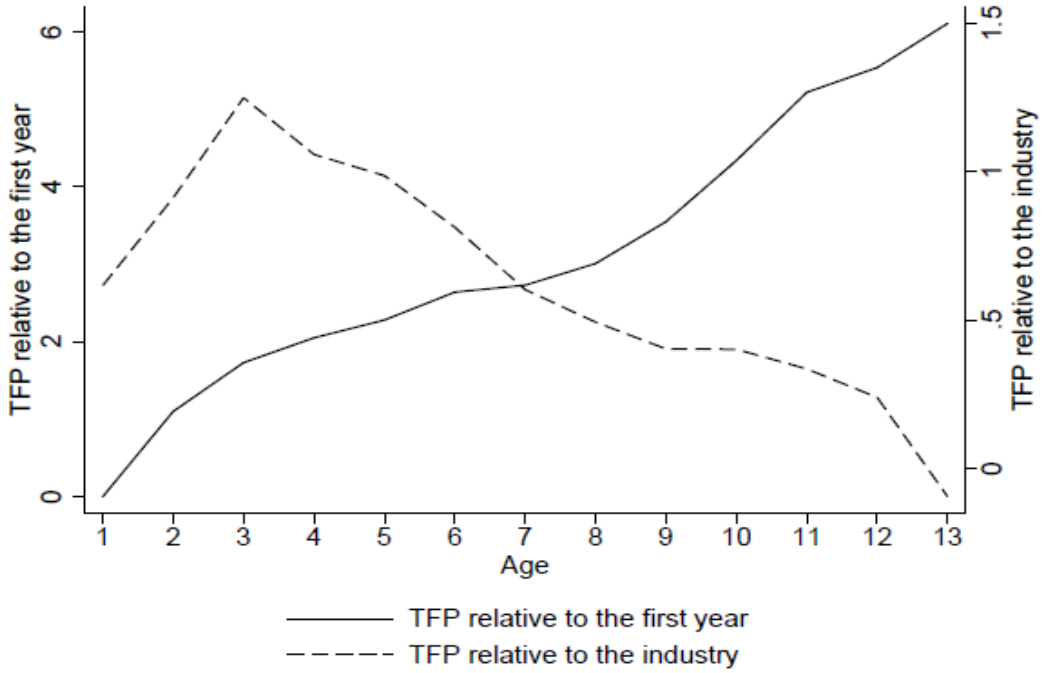
States than in most other countries, with the exception of Italy and Germany. In addition, on average new entrants are smaller in the United States than their counterparts in Europe, but, if successful, grow faster and reach a higher average size. In other words, the market selection process tends to be more radical in Europe. Thus, the US market seems to allow more experimentation while European markets tend to sanction the smallest firms (rather than the less efficient ones) earlier.

13. That new firms grow faster in the U.S. than in the E.U. is confirmed by several observations (e.g. Ortega-Argiés and Voigt, 2009). For instance, looking at successful new ventures, only 16% of the EU15's current largest companies were established more recently than 1980 (among which only 37% were created from scratch and not resulting from mergers and acquisitions), compared with 30% of the largest companies (among which 82% where real start-ups) in the US (Cohen and Lorenzi, 2005, European Commission, 2005a). This observation has attracted attention since successful growing firms are shown to be the main contributors to aggregate productivity gains.

14. This observation is of prime importance if we accept that growth is a condition to survive. Following the selection mechanism argument, only the most productive entrants should survive: size differences induce a lack of competitiveness of young and small firms that cannot enjoy scale economies. Therefore, they prove more fragile than incumbent firms and are more likely to fail. Thus, overtime, only the most performing entrants (typically those firms that are more productive than their incumbent counterparts) are likely to grow and survive, while the less performing ones are likely to exit.

15. A recent study on French manufacturing firms by Bellone et al. (2008) reports that conditional on survival, new firms continuously increase their level of productivity (figure 1). More interestingly, young firms exhibit higher productivity level than incumbent firm, and increasingly so until the third year and then converges towards the industry average. This phenomenon could be the result of the selection process, as anticipated by theory: since only the most productive entrants, the average level of productivity may increase as the selection process operates. However, it rather proves to be essentially the result of a learning effect: entering firms have opportunities to increase their productivity advantage in the first years of existence. They find, nonetheless, that the selection process dominates after some time when indeed the less efficient firms tend to exit. It follows that not only successful entrants enjoy higher performance, but the survivors also tend to increase their productivity level compared with incumbent firms in early stages of their life. As a consequence, innovation –expressed by the productivity gains of young firms- is the way to compensate for the size disadvantage.



Source: Bellone et al. (2008), p.760

Figure 1: Post-entry TFP performance (%)

16. Notice that innovation is not necessarily a technical change resulting from an R&D investment. Innovation covers all sources of productivity gains such as technical advances to existing products and processes, the development of new products, but also organisational or marketing innovations. The European Community Innovation Survey (CIS), distinguishing between R&D and non-R&D based innovation has reported that SME's innovation is mostly non-R&D investment based. Rather, capital equipment and design innovation seems to be more important.

17. A companion study (Bellone et al. 2006) also emphasizes clear signs of market failures at the expense of young firms: the authors show that despite the decrease of the productivity advantage of young firms after three years of existence, the likelihood of survival does not increase at the same rate. In other words, age matters: for the same level of performance, the hazard rate decreases with firm's age, a clear sign of market failures.

18. Thus, while exiting firms tend to be less productive than surviving ones, market failure (and not only performance differences) impacts on the hazard rate. For instance, high entry sunk costs, limited access to finance or to foreign markets give an advantage to low-productivity incumbents over high potential new firms, which then experience more difficulties to grow and achieve the minimum efficiency size to survive.

19. The ability of those small SMEs to exhibit higher innovative performance than incumbent firms is generally assumed to result from flexibility advantages and

adaptive capacities, particularly in unstable environments. However, innovative SMEs generally face specific constraints that tend to hinder their performance. In particular, globalization has increased the scope of the competitive landscape directed by new customer needs inducing increasing technological complexity of products and requiring shorter product and innovation cycles (OMC Expert Group, 2004). Thus, both scale economies and research and development may have gain importance. It follows that obstacles to innovate due to size disadvantage should be underlined and possibly compensated by specific innovation policy.

As long as the market selection process works well, young firms are the main source of productivity gains in the economy. However, empirical evidences show that market failures generate obstacle to innovation and growth, thus reducing their positive economic effect.

Barriers to innovation

20. Although most empirical studies conclude a proportional relation between firm size and R&D growth, suggesting no clear advantage to size in innovative activities (e.g. Symeonidis, 1996; Cohen, 1995; Cohen and Levin,1989), this result does not seem to hold if technological intensity is taken into account. Lee and Sung (2005) for instance, show that while the size-R&D relationship is less than proportional for firms in low-tech sectors, it becomes more than proportional for rapidly changing technology sectors. More broadly, size tends to matter differently depending on sectoral conditions and in particular on the fixed costs required to invest (in capital or R&D for instance).

21. This does not mean that size never matters, whatever the specific conditions of the industry: in the presence of large fixed costs to innovative activity (e.g. in pharmaceuticals), large firms will have an advantage; when it comes to flexibility and the ability to exploit niches, small firms are likely to emerge as innovators. Thus, while size does play a role for different types of innovation processes, the relationship can go different ways and it is difficult to establish a-priori whether entrepreneurial activity is negatively or positively related to firm size.

22. There are intensive debates about what the most important barriers to SMEs innovation might be. The most common well-known barriers to growth are linked to access to market, financial resources, knowledge, human capital and management competences (European Commission, 2003c). However, very few studies make a clear distinction between barriers to growth and barriers to innovation. Barriers to innovation, as barriers to growth, are generally attributed to market failures and/or structural barriers (table 1). Market failures express conditions that prevent the market to operate efficiently and therefore tend to disadvantage specific agents. Structural barriers are local conditions –most often

resulting from choices (or from the absence of choice) of policy makers- that negatively affect SMEs' innovation capacities.

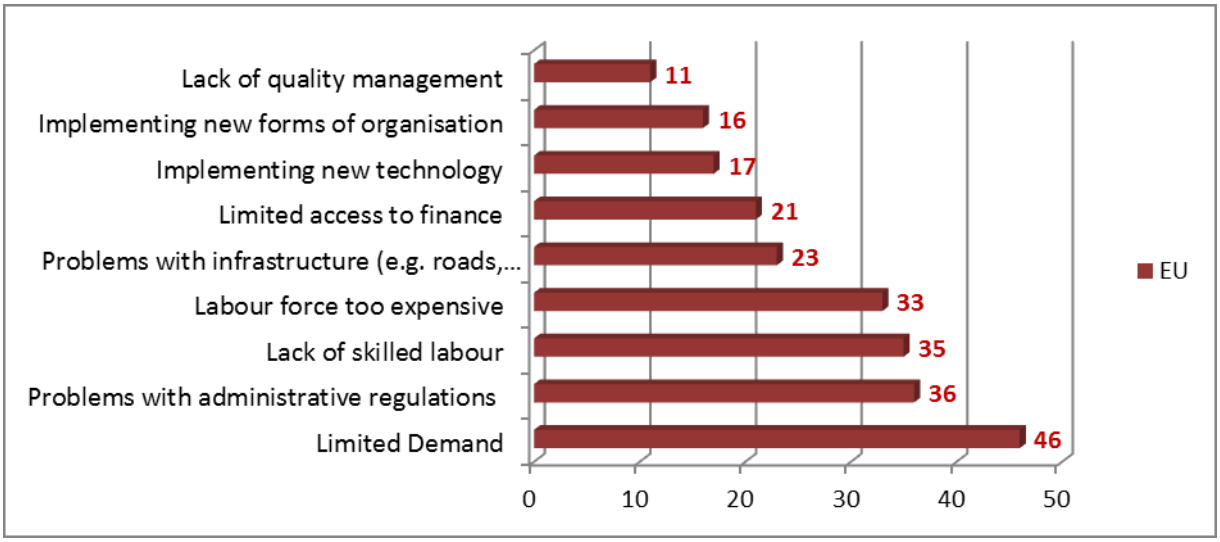
Barriers to SMEs' innovation	Description
Market failures	
Information failures	Access to information is not free, limiting awareness and knowledge of innovation and market opportunities, cooperation and partnership opportunities, etc.
Public goods	limited access to public resources such as public research
Externalities	Limited access to resources produced by others such as highly skilled labour
Sunk costs	Sunk costs generate barriers to entry such as marketing investment (branding, distribution channels etc.), R&D investment, IPR costs (e.g. patenting), cost of participating in public call for projects and to using public procurement and funding
Structural barriers	
Infrastructure	Underinvestment in local infrastructure (communication, transport, etc.)
Administrative burdens	Time to create a company, costs of failure, time required to fulfil administrative requirements
Access to human capital	lacks of top level universities and other companies developing similar competencies
Cost of human capital	Level of salary in the region (related to the cost of living) and administrative labour cost in the country
Regulatory and legal framework	competition laws, efficiency of the IPR system, etc.
Complementarities failures	Lack of appropriate complementary resources or services in the local area

Table 1: Barriers to innovation

23. The Gallup Organization (2006) undertook a dedicated survey in the European Union for the Observatory of European SMEs. Interviewing managers of European SMEs, they tested nine potential constraints often mentioned as limitations to growth (table 1). Beyond limited demand (and in particular the limited purchasing power of their customers) administrative burdens and human resources (both access to and the cost of labour force) were mentioned first, more than the traditional financial gap usually highlighted (table 2). The study also reports that, interviewees perceive further deterioration in these areas.

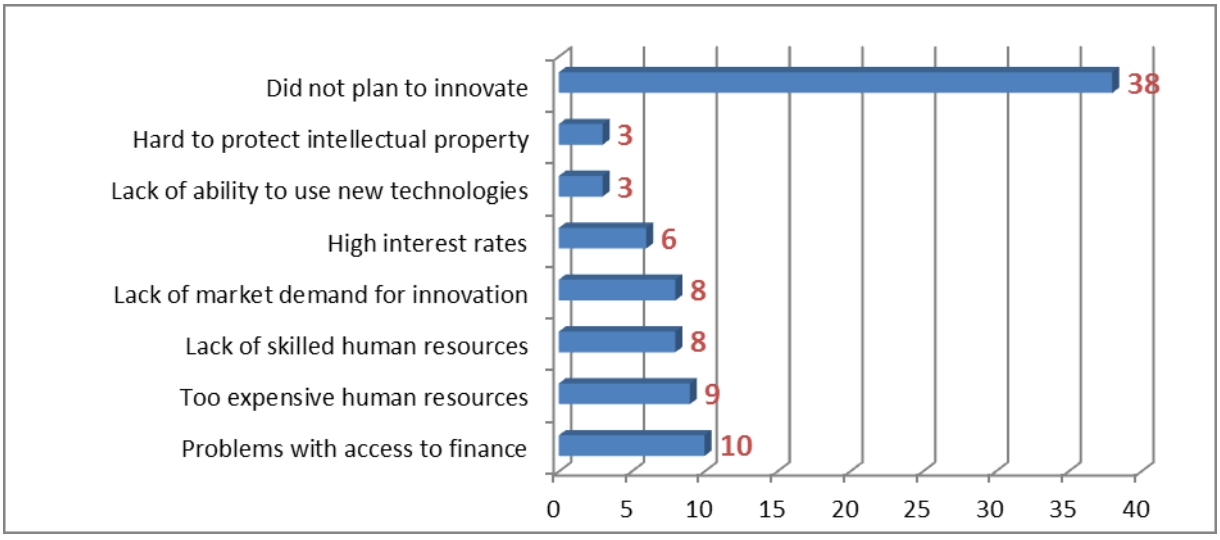
24. Focusing on innovation constraints (table 3), the Gallup Organization study (2006) reports that it is not relevant to underline one specific difficulty. Access to finance, access to human capital, market demand, and the cost of human resources are equally mentioned as the main problems encountered by SMEs in innovative

activities, with an emphasis on human resources (when adding the lack and the cost of skilled labour). These results are confirmed by the Observatory of SMEs (2006/2007) survey, which reports access to finance, scarcity of skilled labour, a lack of market demand and expensive human resources as the four main barriers to innovation.



Source: Gallup Organisation (2006)

Table 2: Difficulties & constraints to growth encountered in the last two years (%)



Source: Gallup Organisation (2006)

Table 3: Main constraint for innovation activities (%)

25. Interestingly, Ortega Argilés and Peter Voigt (2009) suggest considering barriers to innovation depending on the firm's development stage. The basic argument is that firms' innovative performance does not rely on the same conditions depending on whether the company is small because of its immature life stage or because it is a strategic choice such as being a niche player. Then whatever the study, it is easy to recognize that the critical stage is the development phase since the faster the growth of the firm, the more likely it is to report problems in finding the necessary human resources, and the less likely it is to report difficulties in getting the financial resources that are necessary for innovative activity.

26. Probably the most studied and reported constraint is the so called equity/finance gap, which expresses the financing constraint experienced by SMEs compared with large firms (e.g. Fazzari, Hubbard and Petersen, 1988). This constraint proves to impact significantly on the likelihood of survival and growth (Musso and Schiavo, 2008). Fazzari, Petersen, 1993) and seems to hold particularly for financing R&D projects with more uncertain and risky outcomes (Ortega Argilés and Voigt, 2009). In other words, financial constraints are particularly problematic for innovative firms in the development stage when personal funds should be substituted by external sources. Then, investment -while still risky and thus requiring higher rates of return- increases dramatically. At this stage, banks and business angels should fill the gap between personal funds and institutional venture capital funds (European Commission, 2006a; OECD, 2004a).

27. However, the EU experiences a lack of venture capital and of business angels supply compared to the US (OMC-SME Expert Group, 2006), revealing a strong market failure in Europe, which is not only damaging for fulfilling finance constraints but also for compensating for the limited management competences and social networks of firms at early phases of their life (Ortega Argilés and Voigt, 2009).

28. In a broader study, Hall and Lerner (2009) stress that R&D investments (of SMEs in particular) suffer a higher cost of external funding than internal capital, essentially because of information asymmetry (in risky project). Thus, limited cash-flow may reduce R&D spending and compromise survival if innovation is critical to competitiveness. This statistical study confirms surveys showing that the main cause of failure is the lack of liquidity due to payment defaults or an increase of payment delays.

29. This phenomenon, reported by all surveys interviewing SMEs, is confirmed by quantitative data base studies. For instance, according to Carpenter and Petersen (2002), most SMEs' growth is limited by the lack of internal funding while Audretsch and Elston (2002) report that the finance gap is higher for Medium sized firms than for the smallest or largest firms (see Ortega Argilés and Voigt, 2009).

30. Although heavily cited, financial constraint may not be the major problem encountered by SMEs willing to innovate. There are clear evidences that startups success is strongly related to technological, managerial and entrepreneurial skills of the founders.

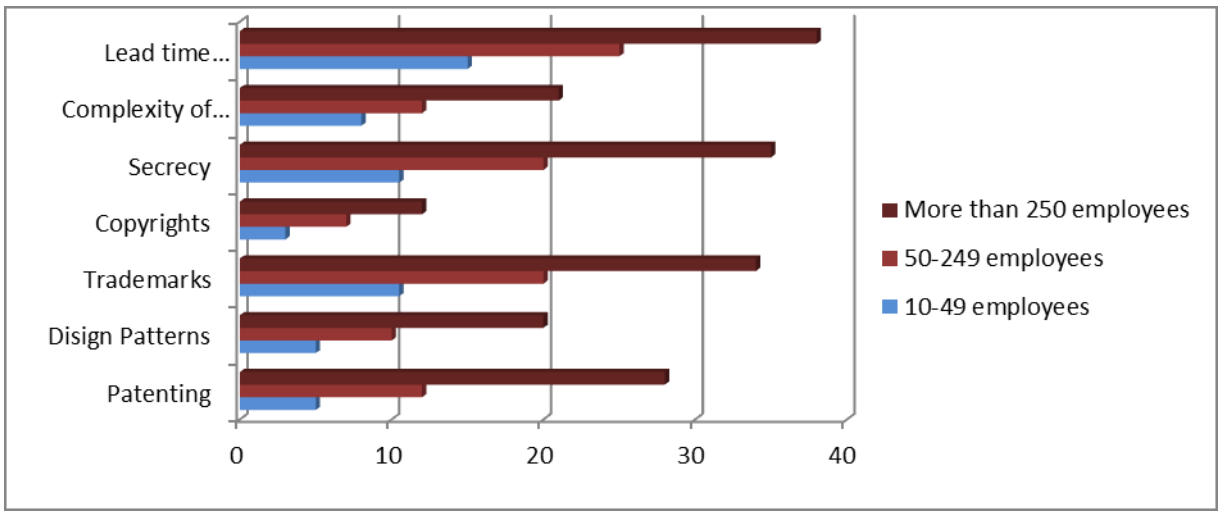
31. This recruitment problem is particularly stringent for growing firms and larger SMEs in all EU countries. It is reported by more than 50% of SMEs in Lithuania (72%), Turkey (60%), Estonia (60%), Greece (54%) Romania (53%), and Finland (51%), and seems to be less problematic in Germany (26%), Hungary (22%) and in the Netherland (20%) (Observatory of European SMEs 2006-2007).

32. According to the OMC-SME expert group (2006), the justification for the lack of management skills in particular is due to the tendency of (research-intensive) SMEs to under-invest in new and necessary competence. The report suggests potential reasons for this:
    - Lack of capital for investments in competence development (high risk, no mortgage).[2]
    - Little awareness or recognition of competence as a competitive edge.
    - Lack of information and knowledge about how to acquire necessary competence, and from whom.
    - Most suppliers in the competence market find larger enterprises and the public sector more attractive as clients than SMEs (who entail higher transition costs).
    - Suppliers have often a poor understanding of the real competence need of the SMEs.

33. Another often mentioned reason is the lack of interaction between key players: link with large firms, with universities and public research institutions and with appropriate services, essentially knowledge intensive business services. But in some countries, insufficient education system and inability to produce sufficiently high skilled labour are the main concern.

34. As reported in table 3, inability to use or difficulty to protect intellectual property is also mentioned as one of the major institutional issue that makes a difference between Europe and the US on the one hand and between European countries on the other. Recent studies (essentially based on the Community Innovation Surveys) show the disadvantage of SMEs in protecting intellectual property. Beyond the lack of information and the opacity of the European IP systems, the costs of patenting are generally perceived the main reason to deter SMEs from using IP systems (Derwent, 2001), including the fees, the advisory costs and the potential litigation costs.

[2] Notice that growing SMEs are significantly more likely to increase their capital than others (Mani and Bartzokas, 2002, Gallup Organization, 2006), meaning that they suffer human capital access and an equity gap barriers at the same time.



Source OECD (2005) based on Eurostat, CIS Survey (2004)

Table 4: Use of intellectual property protection by EU firms (%)

35. Another reason explaining the limited use of the IPR system by SMEs is the time required for an application to be granted. Thus, SMEs often prefer to protect their IP through secrecy or exploitation of lead-time advantages for instance. Table 4 evidences that size matters in exploiting IP tools at their disposal. It further shows that the smaller the firm the less likely the use of IP systems.

Although not similar in all European countries, recruiting skilled labour and access to finance are the main barriers to innovation, while access to market demand is the main difficulty to grow. However, constraints are different depending on the firm's life cycle and on the market structures of the industry. The lack of venture capitalists and business angels is particularly damaging in Europe. SMEs are also suffering from a lack of awareness on the impact of management competences on success.

Regional Innovation Systems

The rationale for agglomeration

36. Over the past decade, there has been a growing interest in the spatial concentration of economic activities by economists, geographers, sociologists, management scientists but also (and above all) by policy-makers. The essential part of the work has focused on the geographic distribution of firms resulting from the forces that make economic actors decide their location. This interest has

pushed scholars to use a myriad of concepts (such as clusters, industrial districts, innovative milieu, local innovation system, etc) to express that globalization has actually increased the importance of location of economic activities and that regional competitiveness becomes and essential means to boost firms' productivity. Thus, it is not surprising that current national industrial policies in all industrialized countries and in Europe in particular concentrate on the promotion of regional innovation policy, now considered as an essential step to achieve the Lisbon objectives.

37. The existence of a large variety of concepts to account for industrial agglomeration is due to different schools of thought in different academic disciplines. It further results from the trial of researchers to characterize specific contexts that standard frameworks have imperfectly characterized through generic criteria. Then, authors tend to extend the concept or create new ones, while relying on the same basic principles.

38. Economic geography traditionally analyses the pattern of the spatial distribution of activities by estimating external effects resulting in agglomerations economies (e.g. Krugman, 1991). The standard framework lies in estimating the optimal level of concentration depending on increasing returns to concentration (and in particular scale and scope economies) on the one hand and transaction costs or congestion costs on the other.

39. This view has not dramatically changed since Marshall (1920)'s who defined the concept of industrial district to emphasize on the benefits of external economies that compensate for the lack of scale economies when (small) firms co-locate in a specific region. The sources of these benefits generating agglomeration are described as a result of a cumulative causation process engendered by the co-location of firms. Marshall suggests three main reasons for industrial agglomeration:

    - Localisation of specialized intermediaries, triggering cost advantages associated with externalities arising from the use of specialized and productive machinery
    - labor specialization reducing hiring costs and competence uncertainty.
    - spillovers facilitating improvements in machinery, organization and management.

    For instance, the raise of the number of firms in a particular region increases the attractiveness of the region to suppliers of intermediary goods, which in turn by locating close to their customers tend to increase their incentive to locate in the region and reduce transportation costs for instance.

    Beyond specialization, agglomeration can also arise from the so called Jacobs' externalities, or diversity externalities, whereby new ideas and knowledge creation across sectors are favoured by diversity.

    Meanwhile, agglomeration, concentration and growth will boost demand in housing, resulting in an increase of price of housing if construction capacities are

limited. Such transaction costs are congestion costs, which naturally limit the size of agglomeration.

Eventually, localization economies arising from agglomeration always lead to a reduced cost of production factors (thus to lower unit cost) and of better market access through scale or scope economies, since knowledge developed for one application could be used in others. According to Henderson et al. (1995), the effects described by Marshall are static externalities. Dynamic externalities are the learning effects and the accumulation of knowledge that impact innovation and productivity gains. Indeed, the idea is that unlike the standard view of knowledge as a public good, knowledge is partly tacit and remains costly and difficult to transmit across areas (Jaffe et al., 1993). Consequently, local collective learning processes are easier and more effective than distant ones.

Clusters

40. The cluster framework explicitly builds on the same basic principles to explain spatial concentration of industries. It is probably the most popular framework and underlies most of current regional industrial policies. A cluster can be defined as a group of interconnected firms and related institutions in a specific field, operating in the same geographical area and exhibiting similar attributes or complementarities (Porter, 2000).

41. Although not very clear about the meaning of similar attributes and of complementarities, this definition of a cluster rely on the idea that proximity generates benefits based on synergies and scope economies generated by the relations between firms. The notion of "field" is also vague. While clusters generally relate to a single industry, some clusters cut across a wide range of activities with more or less complementary characteristics. The automobile manufacturing for instance uses a vast a set of intermediary inputs such as plastics, glass, steel, textiles electronic goods etc. The fuzziness of the concept of cluster and the analytical weakness of the framework[3] justify sharp critics by academics (e.g; Martin et Sunley, 2003, Desrocher and Sautet, 2004) but also an extensive use as a tool to study industrial agglomeration in general and as a support for local industrial and innovation policy.

42. Thus, agglomeration is analysed as an outcome of a combination of industry and regional characteristics. For instance, the likeliness of clustering is not the same in the perfume and in the biotech industries, and in any case, it is very unlikely that perfume firms extracting essences from flowers will locate in a desert area.

43. In addition to 'Marshallian engines of agglomeration' (labor market pooling, supplier specialization, and knowledge spillovers), cluster analysis also considers

[3] The main problem of cluster approach is the inability to estimate the positive and negative impact of each element on the others. For instance, in the Porter's diamond, any dimension in one box (factors, demand conditions, competition and rivalry, and related industries) will positively affect all other dimensions (Duranton et al. 2007).

entrepreneurship, competition intensity, path dependency and lock-in, culture and local demand. Competition intensity can be understood as a level of barrier to entry and exit: The higher the competition, the better the selection process pushing the lower productive firms to leave the industry and thus increase the average performance of the remaining firms (Porter, 1990).

44. The increasing role of innovation as a source of competitive advantage has pushed analysts to better understand innovation processes and in particular the conditions for knowledge creation and diffusion in cluster and the subsequent knowledge external effects of proximity, that is spillovers. The work of Jaffe et al. (1993) showing the significant impact of localisation on the effect of knowledge spillovers on innovative productivity has dramatically orientated the focus on knowledge and learning mechanisms in industrial agglomeration studies. Spillovers exist when innovation undertaken by one firm (partly) benefit on innovation of other firms at no cost.

Learning regions

45. However, as previously underlined, knowledge is not necessarily freely accessible at any condition. Knowledge creation, distribution and use depend on cognitive and social dimensions, which constraint innovation processes. In particular, because knowledge is partly tacit, proximity matters. Learning from others is more effective through direct interactions. Further, learning and information diffusion relies on social dimensions that Storper (1997) calls "untraded interdependencies" (such as trust), which results from the embeddedness of actors in social networks and their geographical proximity.

46. Several studies have then tried to exploit the increasing availability of data to make econometric tests estimating the impact of the relations between players of a cluster on innovative or economic performance. The relation between universities and firms (Baptista, 1998), public and private R&D (Mohen, 1996) have thus been extensively analysed, often within the standard economic geography framework. All studies seem to conclude that knowledge spillovers are important and bounded in space, thus requiring proximity to enjoy the effects of this external effect.

47. Other scholars have intended to better understand the process of knowledge formation and diffusion by integrating social and institutional dimensions. Rather than only accounting for individual firms, worker, consumer behaviour, they focused on social relations and network formation, and on the role of institutions, conventions and routines in industrial agglomeration phenomena. Becattini and his colleagues (see Becattini, 1990) for instance, have extended the industrial district framework to social dimensions to analyse Italian industrial districts. In particular, they underscore external economies resulting from socio-economic structures, interactions and locally bounded resources.

48. The French GREMI-study (see Camagni, 1995) has pushed further the focus on inter-relations by looking at regions as innovation system more than as an aggregation of individual firms. Regions are evaluated on the basis of innovativeness and synergies in called 'district economies' and 'proximity economies' relying on the human capital created by local education systems, informal contacts between firms, the flow of information within the region, and a common cultural, psychological and often political background.

49. The system view has then increasingly been focused on learning and knowledge spillover as the source of innovative performance of regions. Michael Storper (1997) describes systems of production as systems exploiting the synergies that arise from co-operation and competition. Then, the economic dynamics of the regions, as in previous frameworks, is based on external economies of scope that complement internal economies of scale. But regions become 'learning regions' (Storper, 1993, Florida, 1995, Asheim, 1996, Morgan, 1997) that is learning adaptive systems based on cooperation, trust and stability facilitating the effectiveness of external effects. Innovation is considered as an outcome of interactive learning process, socially embedded and strongly dependent on local institutional and cultural contexts, repositioning regions as relevant analytical and political levels in industry development.

50. The rediscovery of the regional level suggests that regional policy should be aimed at providing local firms with a competitive advantage based on localized competencies such as specialized resources, supportive institutions and share of common cultural values (Maskell and Malmberg, 1999, Maillat and Kébir, 2001, Andersson and Karlsson, 2002).

51. It is also worth noticing that the study of agglomeration with regions in mind provides a better account of other external effects than localization economies (resulting from the co-location of firms within the same industries), an in particular urbanization economies (based on population density) and *Jacobs* economies (arising from the industrial diversity within the region).

Regional Innovation Systems

52. The concept of Regional Innovation System (RIS) is at the confluence of these approaches, understanding innovation as the outcome of a learning system. However, regions are viewed as an institution with clear strategic intents which may have a significant impact on the governance of industries between national and local levels (Cooke, 2001). As such, RIS is more a policy-orientated framework than a consistent analytical one. Regional governance is expressed by "both private representative organisations such as branches of industry association and chambers of commerce, and public organisations, such as regional ministries with devolved powers concerning enterprise and innovation support, particularly for SMEs" (ibid. p. 33).

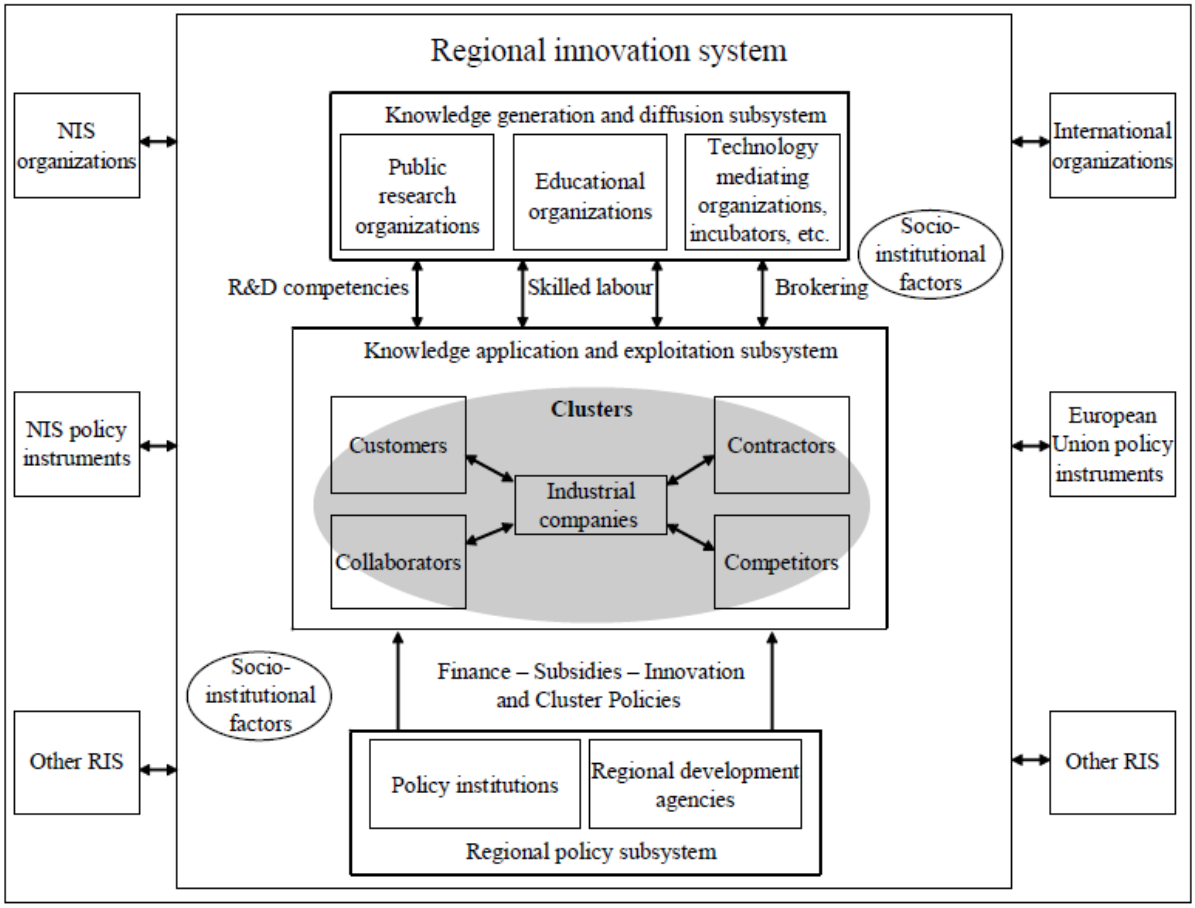
53. Although very helpful to describe the innovative mechanisms in a region, the RIS framework hardly provides us with analytical tools for empirical validation

(Doloreux and Parto, 2005). The very wide variety of use and of application contexts makes the concept difficult to define and to study. The main problem, from a practical point of view, is that "it is not possible to explain how one 'knows' a regional innovation system when one sees one" (Doloreux and Parto, ibid. p. 143 quoting Markusen 1999). Even more disturbing, strictly speaking, as Cooke and Morgan (1998) put it, only Silicon Valley, Emilia-Romagna, and Baden Würtetenberg actually fulfil all the criteria of RIS as described in the literature. Or, to see it differently, all regions have some characteristics of a RIS, but saying whether it is effective is far from straightforward. These lacks of common understanding and of normative rationale limit the reach of both comparative studies and policy reports. Several problems are pointed in the literature:

- First, unlike clusters, focusing on regions rather than on industries regional innovation systems can be seen as a "constellation of industrial clusters surrounded by innovation supporting organizations" (Asheim and Coenen, 2005).

- Second, the definition of region boundaries remains unclear. Should we look at regions as administrative entities (e.g. Maskell, 1998, Wolfe and Gertler, 1998) or as a subjective representation of what is close enough to exhibit the relevant systemic properties (e.g. Asheim and Isaken, 2002)?

- Finally, from an analytical point of view, the ambiguity of the unit of analysis (actors, institutions, instruments, routines) and the complexity of relations between elements prevents the validation of any causation in the dynamics.



Source Cooke et al. (2007, p. 54)

Figure 2: Regional Innovation System

54. A simple definition that could probably been used as a starting point describes RIS as a 'production structure' embedded in an 'institutional structure' in which firms and other organizations are systematically engaged in interactive learning" (Asheim & Isaksen, 1997; Cooke, Uranga, & Etxebarria, 1998). As shown in figure 2, this definition enables RIS to comprise the standard cluster view, generally focused on actors directly involved in the considered industry, and integrate regional institutions and services providers as intermediary elements between local companies and national and international dimensions. RIS further considers the regional production structure (the 'knowledge exploitation subsystem') and the regional support infrastructure (the 'knowledge generation subsystem') should be systematically involved in interactive learning (Cooke 2001).

55. As suggested by this definition, RIS strongly draws on the work of Lundvall (1992) on National Innovation Systems describing innovation not as an outcome of inputs such as R&D but as an *interactive learning* process relying on social interactions between suppliers, customers and national institutions. As a consequence, innovation is often studied by mixing cluster analysis tools (measuring the frequency and the intensity of relations between actors) and social dimension such as regional social capital and culture as affecting relations between actors and/or between institutions.

56. The foundation of RIS approaches is also influenced by the evolutionary economics framework (Cooke et al. 1997, Uyarra (2009), emphasising technology as a prime determinant of the evolution of socio-economic structures (Freeman, 1987, Nelson, 1993, Patel and Pavitt (1994). Following this view, innovation policies are targeted at affecting relations in order to support the system dynamics along specific technological trajectories determined by national patterns of knowledge accumulation. This path is country specific since it is determined by national institutional factors, but it is also region specific since it is influenced by industrial history and of local choices in technological and educational specialisation.

57. The last aspect to mention is the underdeveloped impact of governance on innovative performance in general and on RIS effectiveness in particular. While generally used in the context of political activity, there is no unifying definition for the concept of governance. It can be viewed as a "binding decision making in the public sphere" Marks and Hooghe (2000) or "a change in the meaning of government, referring to a new process of governing; or a changed condition of ordered rule; or the new method by which society is governed" (Rhodes, 1996)

58. Within the RIS framework, 'governance' include all processes contributing to the coordination, the incentives and the control of innovative activities "Hierarchy, markets, networks and culture are seen as the most important types of governance" (Cooke and Memedovic, 2003, p. 8). However, focusing on regional authorities the objective is to interplay in the learning process by offering services and other mechanisms that favour interactions between actors.

59. Probably the most important impact of governance mechanisms is the put in place a multi-level policy coordination (Uyarra, 2010). Policies at different territorial ties must be articulated in order to facilitate the diffusion of knowledge through local and regional channels, alongside national and international channels. It follows that regional governance mechanisms must be specific to the context of the region, trying to target coherence and consistency at each stage of the innovation value chain.

The concept of ***Regional Innovation System*** intends to integrate previous works (such as industrial districts, cluster analysis, innovative milieu) in order to account for both traditional Marshallian externalities and systemic relations between actors. The RIS framework focuses on learning dynamics as an outcome of interactions between actors and institutions. It further emphasises the role of regional governance structures as a central coordination, incentive and control device. Recent trends underline the necessity to work on the coherence and the of different policy actions enforced at different levels and on the specificity of the local historical, cultural and socio-economic context.

What works, what doesn't?

60. To start out, all studies testing the impact of regional concentration on firms' innovation (e.g. Baptista and Sawan, 1998) and productivity (e.g. Hederson, 2003, Duranton et al., 2007) and on growth and survival of new entrepreneurial firms (Wennberg and Lindqvist, 2008, Maine et al. 2010) find positive results. Henderson (2003), for instance, finds that in the United States, for each doubling of the level of concentration, the productivity level of each establishment of the considered county in high-tech sectors increases by 8%. Interestingly, the author also finds that independent firms benefit more from localization externalities than establishments affiliated to large groups. Cingano and Schivardi (2004) also find increasing returns to specialization in Italy. These results are consistent with other studies testing the impact of concentration/specialization on the choice of firms' location (Crozet et al., 2004, Head et al., 1999).

61. Duranton et al. (2007) try to distinguish localization economies (intra industry or cluster effects) from urbanization economies or Jacobs' externalities (inter industry effects) in France. They find a positive effect of clustering: doubling the number of workers in a given sectors, all else being equal, increases total factor productivity by 5%, which confirms other similar studies in other European countries. They also find a very strong heterogeneity of cluster effects between industries with negative effects in plastics and machinery for instance and very positive in others (such as chemicals).
    Interestingly, the authors neither find any significant effect of regional diversification nor any positive impact of the competitive intensity, unlike Porter's assumptions.

62. The first hypothesis to be tested to assess the effectiveness of regional innovation systems (here understood as a set of clusters)[4], is labour mobility on the one hand, and the mobility of firms on the other. Indeed, agglomeration may occur only if better conditions will attract workers and companies. This is in fact the first –and may be the most-problematic- issue. First, unlike their US counterparts, European workers are quite reluctant to move and salary changes do not significantly affect mobility (Obstfeld and Peri, 1998). Spatial rigidity is also true for companies' mobility. In fact, when firms decide to move, they tend to relocate in close areas (Pellenbarg, 2005). Duranton and Puga (2000) further show that every year only 1.5 % of French establishment change location and that 75% re-locate in clusters. More interestingly, Devereux et al. (2007) show that, in the UK, 100 000 £ subsidies only increase by 3% the probability of relocation in the region. In fact, weak mobility is probably the first cause of limited size.

63. Based on the analysis of 256,985 workplaces in Sweden, Eriksson and Lindgren (2008) find that localized mobility clusters (job mobility between local firms)

[4] Clusters are embedded in the RIS framework and can be understood as the business basis of RIS

significantly outperform other similar firms within the local labour market, while other clusters externalities prove insignificant.

64. Duranton et al. even suggest that increasing the number of clusters and trying to artificially concentrate activity in specific locations may be counterproductive. Several cases show that leading regions are not necessarily successful because they tried to keep their leadership in one technology or one industry, but rather because they developed dynamic adaptation capacities (e.g. Glaeser, 2005). Limiting mobility (by trying to keep firms inside) may prevent potential redeployments of activities towards more promising fields.

65. However, other studies explain that although it may not be wise to erect barriers to exit, successful regions have managed to be attractive enough to encourage mobility from the outside but also to put in place conditions that reduce mobility towards other regions. This may be due to access to specific resources (e.g. sunshine, culture, etc.), infrastructures (airport, large band, schools, university, etc.) or an attractive tax system for instance.

66. The second hypothesis explaining a positive impact on firms' innovative performance and competitiveness is knowledge externalities or spillovers. Spillovers are unintended transfers of (technological) knowledge that supposedly occur at no cost or at least through untraded relations. The problem is that how and via which medium knowledge is actually transferred remains an open question. Thus, two complementary questions have motivated academic research dedicated to spillovers. First the question of the impact of spillovers on firms' innovative performance and second the means and conditions for those spillovers actually occur.

67. The seminal work of Jaffe and his colleagues (Jaffe 1989; Jaffe et al 1993) has been the first to set a rigorous analytical framework to measure the effectiveness of spillovers in innovative activities. Using patent database, a series of works has not only shown that spillovers exist and have a positive impact on performance, but also that spillovers are geographically bounded, thus confirming that proximity matters.

68. The main theoretical justification for spatial boundary, as previously explained, is that knowledge is (partly) tacit, embodied and often embedded in social networks or organisations. Thus, knowledge spillovers result from different intended or unintended media such as informal contacts (Feldman 2000) or social networks, observation and monitoring of competitors (Malmberg and Maskell 2002), spin-offs (Keeble and Wilkinson 2000, Tödtling et al. 2006) or labor mobility.

69. However, the problem with econometric studies essentially based on patents and with broad classification of industries, is that they test the effects of spillovers but cannot ascertain whether these effects result from spillovers or other types of knowledge transfer between co-located actors. As Breschi and Lissoni (2000) suggest, it may well be that we are talking about pecuniary externalities.

70. These remarks suggest more caution in the interpretation of the results. In fact the authors suggest that "the reason for this localization [of innovation networks] has less to do with knowledge spillovers mediated by social and physical proximity, than with the need to access a pool of skilled workers and to establish transaction-intensive relationships with suppliers and customers" (p. 27).

71. Empirical results confirm that labour mobility, or rather the mobility of human capital (or the mobility of talent as flagged by Florida 2000) and cross-firm inventors are the main reasons to justify for innovation network localization (Breschi and Lissoni, 2006, Eriksson and Lingren, 2008). Some considers spinoffs as a source of labour mobility, parent firms providing the required competencies to start ups (Klepper, 2002). Wenting (2006) and Boshma and Wenting (2007) confirm that spinoff companies managed by entrepreneurs with strong experience in the same or related industry had much more chance to survive than others. Others rather focus on employee mobility as a means to disseminate tacit knowledge across firms (Almeida and Kogut, 1999, Maskell and Malmberg, 1999, Power and Lundmark, 2004).

72. However, recent empirical studies tend to deepen this investigation and show that indeed the most effective mechanism of knowledge transfer is the mobility of highly skilled personnel but this is especially true for intra-industry (or related industry) labour markets (Eriksson et al. 2008). But it may be that more than skilled personnel, what really matters is the type of knowledge or competences brought in the firm. A series of recent studies consider knowledge relatedness as a complement to labour mobility. In a recent article, Boshma and his colleagues (Boshma et al., 2008), working at the plant level, show that labour mobility per se has no impact on performance. However, bringing in related competencies contributes to productivity growth. Interestingly, they found that unrelated skills inflow has a positive impact when recruited in the same region, while labour mobility across region has a positive impact when it concerns unrelated skills.

73. A more specific look at different types of spillovers confirms that knowledge transfer is rarely free. Rather than collecting knowledge in the air, knowledge transfer is more effective when arising from a contractual relationship. In the case of inter-firms relationship with the support of knowledge creation entities, learning from others is eased through joint ventures or contract based partnerships. Thus the question is whether region should promote intra-technology cooperation.

74. The positive role of R&D cooperation in innovative performance at firm level is well established (Becker & Dietz, 2004). However, judging on its significance at regional level is subject of debate (Fritsch, 2004). Results of European Regional Innovation Survey (ERIS) put emphasis on the type of partners and on the size of partnership for highlighting the role of innovative linkages at regional level. It shows that intraregional technology cooperation is particularly fruitful to high tech sectors. (Koschatzky & Sternberg, 2000). Some authors question this view and believe that the role of R&D cooperation in regional innovation system efficiency remains unclear since they find that spillovers arising from R&D partnership between co-located firms is minor (Fritsch & Franke, 2004).

75. Finally, a commonly agreed mechanism that justify agglomeration in general and the effectiveness of RIS in particular is the significant contribution of university as a knowledge provider to the all system. A very wide number of studies document the existence and motives of university-industry relationships. Recent works found, however, that all of university-industry relations are not valuable. Giuliani and Arza (2009), for instance, show that the role of the firms' knowledge base in the formation of valuable university-industry relation is considerable. Indeed, "the stronger the knowledge base of the firms that establish links with universities, the more likely that those linkages will be 'valuable' in the sense of increased potential for diffusing university-produced knowledge" (p. 915).

76. In the same spirit, close location may not be enough to benefit from University knowledge. And sourcing knowledge from the university may not be free either. In fact, all seems to demonstrate that university-industry knowledge transfer works pretty well when supported by contractual and pecuniary relations, confirming the success and the effectiveness of markets for technological knowledge (Arora and Gambardella, 2004).

77. This does not mean that firms with low level of R&D investment cannot benefit from knowledge produced in the region. A recent stream of the literature has proposed that promoting open innovation may increase local firms' performance (Laursen & Salter, 2006), and then counter-balance the weakness of SMEs knowledge base. This approach considers firms as knowledge integrators, which need not necessarily produce knowledge internally (Chesbrough, 2003). Thus, innovation can be achieved and sustained based on a range of actors and sources which are external to firms, therefore increasing the potential scope of application.

78. This suggestion is consistent with Rondé & Hussler (2005)'s results that demonstrate that building external interactions is of greater importance than developing internal technology competences for firm of a regional scale. The role of regional R&D cooperation is confirmed when estimating the regional innovation performance (Simonen & McCann, 2008).

79. Results are not all consistent unfortunately. Martin and Salter (2001) argue that even in open innovation contexts firms are more likely than others to benefit from relations with universities if they invest in R&D. In other words, open innovation strategies could be a means to increase opportunities to access external knowledge but firms must have strong knowledge base to improve absorptive capacities and better capture useful knowledge (Cohen & Levinthal, 1990). A promising direction is to better understand knowledge integration mechanisms and the effectiveness of knowledge platforms. No doubt that more work needs to be done in this direction since we have more suggestions and hypotheses than convictions so far…

Recent patent and firm level data bases have enabled scholars to deepen investigations into the mechanisms of knowledge production and to test the impact of the determinants of innovative performance. Results have induced researchers to question the effectiveness of spillovers and the tacitness of knowledge as an essential justification for localisation choices. Knowledge is best acquired through contract relations and if directly related to existing knowledge base.

A promising alternative (or complement for knowledge sourcing) is the promotion of open innovation strategy. It may not permit to completely compensate for the weakness of the firm's knowledge base, but it could enable SMEs to concentrate on R&D investments in specific knowledge domains directly related to the expertise of partners.

This conclusion works for relations with other firms as well as with university. In the same spirit, labour mobility, and the acquisition of highly skilled personnel, is the most valuable source of knowledge acquisition and therefore appears as one of the most critical determinant of innovative performance. However, recent studies suggest that the type of knowledge and competences of these talented workers matter. Again, knowledge relatedness between existing knowledge and acquired knowledge conditions the firms' ability to leverage the acquisition of external expertise.

80. From a policy perspective, recent results emphasise the need to consider specificities. When analysing what works and what doesn't, innovation policies do not apply systematically and universally. OECD (2010), for instance has recognised the diversity of regional development and suggest to go beyond the triple helix idea (taking into account the related roles of government, business sector, and knowledge production organisations in innovation policies).

81. In order to highlight the diversity of regions, Marsan and Maguire (2011) propose a regional typology based on basic economic and innovation variables. This grouping leads to the recognition of 3 types of regions and 8 sub-groups of European and US regions. This study evidences the specificity of regions that may differ more within countries than across countries.

82. Although limited to a static analysis of regions, this work emphasises the specificities of regions and the necessity to consider innovation policy mix that fit with the situation of the region.

83. More work is needed to analyse specific knowledge production and diffusion characteristics depending on the specificity of regions.

84. Further, studies dedicated to understand the needs of innovative SMEs depending on the economic or industrial specificity of the region is lacking.

CONCLUSION

85. Small, young and growing firms have an abnormal impact on productivity gain and economic growth both at national and regional levels. However, there is high heterogeneity of firm's growth between Europe and other parts of the world and across European regions. In other words firms with a high growth potential experience are limited in their expansion due to an unfavorable environment. Studies show that regional policies are best suited to facilitate access to critical resources. In particular, beyond traditional Marhallian economies, regions are more than other levels able to create the necessary complementarities between companies, universities and public research centers and local political institutions and increase learning capabilities required to boost innovative capacities of local companies. The regional innovation system framework seems particularly useful to account for the specificities of regional contexts and thus to design policy orientations dedicated to innovative SMEs. Recent studies show that further analytical tools are needed to better adapt local innovation policies to regional innovative contexts.

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