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Developing and implementing a smart specialisation strategy at regional level: some open questions*

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ABSTRACT

The smart specialisation strategy (S3) requires the identification in each region of one or more thematic areas where R&D and innovation policy should be focused on to create and sustain a competitive advantage. Not necessarily the chosen areas will belong to the core, general purpose technology that are generally identified as high-tech sectors (ICT, biotech, etc.). For most of the (peripheral) regions the application of the S3 will involve the identification of production domains in which general purpose technology can be applied and adapted. The aim of this paper is to discuss the theoretical underpinning of the S3, focusing the analysis on three concepts: embeddedness, relatedness and connectivity. The analysis is carried out by reviewing the available documents about the definition and implementation of the smart specialisation strategy and the early proposals developed by some European regions. S3 is an important advancement in the design of regional innovation policy. A better clarification of its theoretical basis and implementation problems can improve its effectiveness.

Keywords: smart specialisation; regional innovation policy; low and medium tech-industries.

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1 Introduction

The concept of *smart specialisation* has been highlighted by the European Commission as a central pillar of the Europe 2020 Strategy (European Commission, 2010). The concept emerged within the "Knowledge for Growth" expert group established in 2005 by Commissioner Janez Potočnik to reinvigorate the Lisbon Strategy.[1] According to its proponents, S3 addresses "the issue of specialisation in the R&D and innovation" (Foray et al., 2009, p. 1).

The application of the smart specialisation strategy (S3 from now on) requires regions to identify the sectors and technological domains in which they are more likely to reach or maintain a competitive advantage, and then focus their investment and innovation policy in these fields. In particular, the application of S3 is crucial for the regions which are not leaders in any of the major scientific or technological domains.

The concept of S3 is based on two fundamental ideas: a) that a region should avoid the spreading of knowledge investment (high education and vocational training, public and private R&D spending, etc.) on many different fields, but concentrate them in a few technological domains in which they can have a significant impact (specialisation); b) that those domains are not to be chosen because of their general technological appeal but because they enhance or complement the research and productive assets already present in the region (smart).

From a theoretical point of view, these ideas rely on two assumptions: a) that reaching a critical mass of resources is fundamental for obtaining results in R&D investment and productivity in their application; b) that regional specialisation shows a high degree of path dependence and that successful diversification can be achieved only in areas that are closely linked to the existing knowledge base (Asheim et al., 2011; Neffke et al., 2011).

To underline the latter aspect, the proposers of the smart specialisation concept have emphasized that its application to regional policy should not imply a top-down approach (i.e. a strategy designed and implemented by regional government) but 'an entrepreneurial process of discovery' (Foray et al., 2009, p. 2) in which the entrepreneurial actors (i.e. firms, research institutions, clusters, etc.) are expected to play a leading role in discovering the promising areas of specialisation. In this context, the role of policy makers is to 'select' the

[1] http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

most promising areas among those suggested by leading actors rather than imposing a set piece strategy.

Another concept used to emphasize the 'smart' nature of S3 implementation is the difference between general purpose technology (GTP), i.e. those that are at the frontier of knowledge, and its applications. It leads to the difference between leading regions, i.e. those that can reach critical mass of R&D investment in GTP, and follower regions that specialize in the applications of GPT to specific domains.

A platform for helping regions to develop and implement S3 has been recently created (http://s3platform.jrc.ec.europa.eu). Several European regions have registered on the platform and some of them have presented their S3 at peer review meetings organized by the S3platform.[2] Besides the documents in which the S3 is developed and explained, the S3platform recently issued a document explaining the methodology to be followed for the implementation of the S3 (Foray et al., 2012).[3]

The analysis of the S3 proposed by the regions that participated at the above mentioned meetings reveals that some of them are just a declaration of the intention to apply the methodology rather than an actual plan for its application (see Table 1)[4]. In general, the S3 proposed at those meeting reveal some common weaknesses: a) some of them identify very broad areas of specialisation (ICT, life sciences, …) which can hardly serve as an effective base for the selective allocation of funds; b) there is little of no analysis of inter-domains or inter-industry links within the region; c) most of them focus on the implementation of innovation policies (for example, measures to promote entrepreneurship) rather than the identification of specialisation domains; d) only in one case there is an attempt to identify complementarity with other European regions. These weaknesses are mostly explained by the fact that these presentations must be regarded as first attempts at applying the methodology. However, I suggest that they can also be the result of some ambiguities that are present in the S3 concept and in the methodology proposed for its implementation.

Specifically, the following questions should be more clearly discussed at theoretical level and more clearly specified in their practical applications.

1. *The scope of the S3*: i.e. whether it refers to the "specialisation in the R&D and innovation" - as was in its initial formulation - or to a broader regional development

[2] Up to August 2012, three such meetings were organized with 4 regions presenting in each meeting.
[3] The guide is available on the S3 platform at the following link:
http://s3platform.jrc.ec.europa.eu/c/document_library/get_file?uuid=a39fd20b-9fbc-402b-be8c-b51d03450946&groupId=10157
[4] The documents and presentations of the S3 of the above mentioned region are available on the website of the S3 platform: http://s3platform.jrc.ec.europa.eu/peer-review

strategy. At the beginning the S3 emphasized the identification of knowledge based sectors and R&D-based innovation. However, S3 is implemented also by 'follower' regions that are characterized by the presence of low and medium-tech industries in which R&D spending is of low or little importance.

2. *Variety versus specialisation*. A recent literature has highlighted the importance of industry variety in promoting innovations. At the same time the S3 approach requires to concentrate R&D efforts in a few domains, especially in the case of smaller regions. At the implementation level it is unclear how to define and identify the relations between different domains so that they can be potentially useful in enhancing the innovation capacity of the region. The same questions arise when identifying complementary relations between different European regions.
3. *Top down versus bottom-up approach*. The definition and implementation of a strategy requires the definition of a vision, the setting of specific objectives and a long term commitment of resources to achieve them. This process is normally implemented with a top-down approach. It is unclear how this process can be achieved through the suggested 'entrepreneurial discovery' approach.

The aim of this paper is to discuss these questions by identifying the theoretical underpinnings of the S3 methodology and the most likely implementation problems. The development and implementation of S3 is an important chance for European regions to improve their innovation policy. The aim of this paper is not that of questioning the S3 approach but rather that of contributing to its effective application.

The paper is organized as follows. Section 2 discusses the issue of R&D specialisation as opposed to a broad innovation perspective. Section 3 discusses the problems associated with the definition and empirical identification of useful links between actors (related variety). Section 4 discusses the implementation problems stemming from the bottom-up approach suggested by the S3 and proposes a modification of this approach. Section 5 draws the main conclusions.

2 R&D versus innovation and production specialisation

In its original formulation S3 emphasised the association between research and innovation. Indeed, S3 was conceived as addressing "the issue of specialisation in the R&D and innovation" (Foray et al., 2009, p. 1). However, in later formulations it has lost the emphasis on R&D to "…embracing a broader concept of innovation, not only investment in research or the manufacturing sector, but also building regional competitiveness through design and creative industries, social and service innovation, new business models and practice-based innovation" (Foray et al., 2012, p. 7).

The consideration of all types of innovation and sectors responds to the necessity to extend the S3 approach to all the regions, also those with little or no of high-tech activities. However it has several risks.

The 'practice-based innovation' which is typical of the low and medium tech industries is based on a model of innovation that entails little investment in R&D and does not require relations with research centres. It is mainly based on learning by doing and learning by interacting, i.e. the exchange of information between firms along the production chain. Most of the innovations developed within this model are process rather than product innovations. It is the innovation model that is specifically relevant for the competitiveness of industrial clusters of small firms (such as the Italian industrial districts). This innovation model is no more able to ensure the competitiveness of industrial productions of most European regions[5]. It is the model that the S3 strategy was supposed to change by emphasizing the need for research-based innovations.

An associated risk of shifting the balance from research to innovation is that it will be more difficult to select the domains in which to concentrate public resources. All sectors are likely to incorporate innovations by applying the knowledge developed in other domains. This poses a challenge to the 'selection' process and give strength to the sectors that are already strong in a region to appropriate most of the public resources.

All sectors have the potential for innovation but not all for developing useful links with research institutions at local level[6]. Promoting innovation in these sectors simply means facilitating the acquisition of new technology from other sectors (for example the application of ICT). It is questionable whether the same 'strategy' and the same instruments can be applied for promoting R&D based innovations and innovation in traditional sectors.

A possible solution of this problem would be that of identifying the technological domains from which traditional sectors are more dependent for their innovation and promote their development within the region; in the hope that the proximity of suppliers and acquirers of new technology will produce benefits to both. However, this strategy has several implementation problems. The first is how to identify the sectorial links that are more profitable in developing new technology and promoting innovations[7]. The second problem is that the knowledge domains from which a production sector can profit when acquiring new knowledge are quite diverse. In the case of the footwear industry, for example, they could be R&D on new synthetic

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[5] This model has been labeled as a model of 'innovation without research' (Cowan and van de Paal, 2000).
[6] For most of their process and product innovations, traditional sectors depends on technology produced in other sectors. For this reason, in terms in innovation model they are referred to as 'supplier dominated' (Pavitt, 1984).
[7] This question will be discussed in more general terms in the next section.

materials, or process automation to save labour input, the application of ICT in marketing and distribution, etc. It is likely that firms in the same sector will stress different aspects of innovation, depending on their competitive strategy, thus making it difficult to select the most promising domains to develop within the region.

A major emphasis on innovation rather than R&D poses two other questions within the S3 approach.

The first question is that the justification for the selection process (i.e. the specialisation) is the need to reach a critical mass of resources when investing in R&D. It is unclear whether this is also the case when the focus is on promoting innovation.

The second question is that in the case of R&D there is a rationale for the public intervention, based on the idea that firms will under invest in the production of new knowledge because of appropriability problems and spill-overs. In the case of innovation, firms have direct incentives to adopt them, given their more immediate market results.

3 Identifying infra-regional and inter-regional links

The emphasis on the intra-regional links between sectors is theoretically justified by the recent literature on the importance of 'related variety' for fostering innovation, especially radical product innovation as opposed to incremental innovation in existing production domains (Asheim et al., 2011; Frenken et al., 2007).

The concept of 'related variety' relies on the observation that the 'cross fertilization' of ideas between different technological domains is better than specialisation when the aim is promoting innovation rather than efficiency in existing production. The literature on related variety has demonstrated that a more diverse production base can be preferable to specialisation, especially when the aim is that of fostering radical (product) innovation rather than efficiency (Boschma and Iammarino, 2009; Boschma et al., 2010).

The adoption of the concept of 'related variety' within the S3 approach poses several questions at theoretical and practical level.

At a theoretical level the related variety approach could be in contradiction with the 'critical mass principle' which is the justification for the specialisation strategy. This problem is specifically relevant in the case of small regions that may have difficulties in promoting several technological domains at the same time. In fact, the related variety approach is based on the consideration of 'jacobian' agglomeration advantages, which are mostly observed in rich (and large) urban contexts (Jacobs, 1969). A possible solution for this question (i.e. specialisation versus variety) could be the idea of focusing on a few domains within the same region between which there are potential knowledge links.

This in turn raises two implementation questions.

The first is related to the size of the local system. Jacobian agglomeration economies are observed in large urban areas were diversity (i.e. the presence of multiple specialisations) is associated with critical mass in each specialisation. The size of the region (in terms of population and firms) is critical for deciding whether a strategy of related variety in R&D can be implemented.

The second question is how to define and empirically detect the links between different sectors so that they would produce the highest potential in promoting research and innovation in the involved technological domains.

There are two basic ways of defining and empirically detect the degree of relatedness between industry sectors. The first is that of indirectly detect them on the basis of observed (revealed) associations between different productions: if within the same geographical area it is more likely to observe the same associations between sectors, we can deduce that there are advantages in their spatial proximity. These advantages may depend on the presence of vertical relations (input-output exchanges) or on the existence of overlapping areas in the knowledge base used by those sectors (Hidalgo et al., 2007; Boschma and Iammarino, 2009).

The second way of defining and detecting the degree of relatedness between sectors is to identify an 'a priori' criteria that define the relations between them. In the case of vertical relations the best indicator is the coefficients of the input-output tables, that measure the relevance of input-output exchanges between sectors (Cainelli and Iacobucci, 2012). However, the implementation of the S3 requires to focus on knowledge relations rather than input-output exchanges. The former are more difficult to define and to empirically detect. The empirical tool most commonly used to measure knowledge proximity is the association of IPC (International Patent Classification) codes observed in patents. This technique also allows to detect the associations between technological domains and industry productions. This is done by further associating patents to the SIC codes of companies that own them (Patel and Pavitt, 1997).

One of the main problems in the application of this technique is that not all industry sectors and firms rely on patents when producing and applying new knowledge. This is especially the case of low and medium tech sectors that are supposed to be of major importance on the peripheral regions that are the specific object of S3. Moreover, in all sectors the distribution of patents by firms is highly concentrated, with a few large companies owning much of the patents.

Given the above mentioned problems, it is necessary to find other ways of defining and measuring the potential relatedness in terms of knowledge exchanges between sectors.

A possible solution is to rely on the increasing adoption of the open innovation model, which requires firms to develop collaborative relations with other firms and research institutions when implementing their R&D strategy. One of the ways of detecting such relations could be that of analysing the collaborations developed by firms when participating to national and regional programs that promote research and innovation. There are some attempts at building comprehensive databases of R&D collaboration at regional level.[8] The implementation of such databases will allow researchers not only to detect the most likely associations between firms and research institutions in R&D projects but also the industries and firms that are more active at regional level in R&D investment.

The design of the S3 should aim at developing cross sectorial links not only within the same region but also between different, complementary, EU regions (Foray et al., 2012, p. 6); these relations are labelled as 'connectivity'. In the original formulation, the inter-regional links were supposed to develop between 'core' regions, that are at the frontier of GPT, and peripheral regions, that would specialize in the applications of these technology to specific production domains. It is a vertical relation between producers and users of new knowledge rather than horizontal relations of the type implied by related variety. Moreover, the benefits of related variety (as well as of specialisation) is based on the advantages of spatial proximity. On a theoretical level, it is unclear on what economic mechanisms rely the advantages of linking different (distant) regions.

Besides the theoretical justification for such collaborations, there is again the practical question of how to detect the regions that show the highest potential in terms of possible knowledge exchanges.

The difficulty in finding such relations is evident if we consider that of the twelve regions that presented their strategies at the S3 platform meetings, only two mentioned the possible collaborations with other EU regions (Table 1).

4 Bottom up versus top down approach

The proponents of the S3 approach stress that it should be the result of a bottom up process that involve all the main private and public stakeholders, and that rely on firms 'entrepreneurial discovery'. This is not only to ensure consensus in the implementation of the strategy but also to single out the most promising domains where public investments will be concentrated.

The suggestion is "…to let "entrepreneurs" discover the future domains of specialisation through a relatively complex entrepreneurial process of discovery" (Foray et al., 2012, p. 11). It is also clarified that "… entrepreneurs must be understood in a broad sense (firms, higher education institutions, public research institutes, independent inventors and innovators) and include

[8] One of these examples is the innovation portal developed by the Marche Region, which is publicly accessible at the following link: www.marcheinnovazione.it

whoever is in the best position to discover the domains (for R&D and innovation) in which a region is likely to excel given its existing capabilities and productive assets" (Foray et al., 2012, p. 12).

The only 'clue' which is provided to solve the 'complexity' process it that it "… follows a complex and iterative logic that cannot be described as essentially top down or essentially bottom up. This is a process in which the principle of entrepreneurial discovery plays an essential role and yet does not minimize the importance of policy intervention" (Foray et al., 2012, p. 12).

This is the most controversial question for the implementation of the S3. It is true that entrepreneurs (or researchers) are in a better position than policy maker to identify research and innovation opportunities; however, it is also clear that the knowledge of entrepreneurs and researchers is limited to their area of expertise. This means that the domains that would appear more promising will depend on the entrepreneurs (or researchers) whom the question is asked. Whoever entrepreneur or researcher is asked to single out the more promising domains in terms of R&D investment he/she will invariably indicate the domain in which he/she is involved in.

It is difficult to understand how to carried out the selection process (i.e. the identification of the most promising domains) by a process of entrepreneurial discovery. The bottom-up approach is in contradiction with the idea of identifying a "strategy", which is one of the most promising novelty of the S3. The involvement of the main regional stakeholders (not necessarily all of them) is assured by the participation in the process and the communication of its results. However, the process is best described (and implemented) as a top-down approach. Even when some of the stakeholders (such as leading research centres or firms) are asked to contribute, the top-down approach is evident from two aspects: a) the choice of the stakeholders to be involved in the process; b) the final choice of the domains in which to concentrate resources.

The importance attributed to the bottom-up approach by the proponents of the S3 is justified by the aim of avoiding that policy maker will develop an R&D strategy without taking into consideration the actual weaknesses and strengths of their regions. However, this aim is better achieved not by shifting to a bottom-up approach but by requesting regions to justify their choices on the basis of quantitative and qualitative data about the technological domains they have identified. The identification and selection of promising domains must be based on indicators that demonstrate the effective strength of regional actors in R&D and innovation: number of researchers in university departments; number of people involved in R&D in firms; number of R&D projects developed; number of patents; etc.

The strength of the technological domains should be assessed not only on the basis of their absolute quantitative relevance (critical mass property) but also for its quality on the basis of a national and international comparison.

The quantitative and qualitative evaluation is easier for public research structure, such as universities. Data on the number of researchers by scientific domains are easily available. Moreover, the quality of their research can be assessed by referring to publication metrics. Data and information about the research infrastructure and output can be supplemented by other information about the technology transfer activity: collaborations with firms, presence of ILO, number of spin-offs, etc.

The assessment of the R&D capability of firms is more difficult. Data on the number of people employed and on R&D investment are normally available only at an aggregate level but not for individual firms. Usually the degree of aggregation is too high for a meaningful analysis of specific technological domains. In the case of firms it is also more difficult to assess the output of their R&D activity, which are supposed to be primarily in terms of product and process innovation. The most easy indicator is the number of patents; however, as explained in the previous section, this is a very partial and distorted measure when traditional sectors and small firms are prevailing.

Also in this case the implementation of a database of R&D projects developed by firms and sustained by regional, national and EU funds will be a useful tool to verify whether in the technological domains that have been chosen there is a critical mass of R&D activity by regional firms.

The process of 'entrepreneurial discovery', i.e. the bottom up approach, is more appropriate as a second step; i.e. when identifying the specific projects to be sustained, once the technological domains were identified.

One of the weaknesses of the S3 already proposed by EU regions (see the presentations on the S3 platform) is that the specialisation domains are identified in very broad terms: for example biotech, life science, energy saving, etc. In this case, the bottom up approach could help in single out specific projects that could be carried out within the chosen domains.

5 Conclusions

This paper discusses some of the questions arising when considering the theoretical underpinning and the practical implementation of the S3. It also proposes ways of addressing such questions. The starting point of the analysis is the recognition that the S3 is an important advance in the design of regional innovation policy. The aim is to provide a contribution to a more effective definition and application of the S3.

The first question is that the S3 approach has progressively shifted from a strategy for R&D-based innovation to a broader concept of innovation. This poses several problems at theoretical and practical level. On the theoretical side the shift to a broader concept of innovation would reduce the emphasis on specialisation as innovation policy can be addressed to almost all sectors. Moreover, while there are justification for a public intervention in sustaining investment in R&D, it is questionable to what extent public resources should be invested in promoting innovation. On the practical level, this will give strength to the sectors that are already strong in a region to appropriate most of the public resources, given that all sectors are likely to incorporate innovations by applying knowledge developed in other sectors.

The second question highlighted in the paper is the relation between specialisation and variety at regional level. Also in this case there are theoretical and implementation problems. Specialisation and resource concentration is a way of gaining scale economies and effectiveness in R&D investment; at the same time, recent literature has emphasised the role of variety at local level when the aim is that of promoting radical innovation rather than incremental innovation and efficiency. This means that in selecting the specialisation domains a specific emphasis should be given in assessing whether and to what extent these domains are able to promote knowledge exchanges and cross fertilization of ideas and technological knowledge. This poses several challenges at practical level because the literature does not clearly indicate how these potential linkages can be defined and empirically detected. The paper suggests the importance of developing datasets about firm to firm and firm to research centres relations at regional level.

The third question refers to the balance between the top down and the bottom up approach in the design and implementation of the S3. The proponents of the S3 emphasize the bottom up approach and advocate a process of entrepreneurial discovery in which firms and research institutions should play a key role in the identification of the promising domains. The paper questions this idea by emphasising that the identification of a 'vision' and the design of a 'strategy' at regional level must necessarily rely, at least at the beginning, on a top down approach. The bottom up approach can be used in a second phase, once the strategy has already been defined. The involvement of firms and researchers could help in identifying the specific projects that could be carried out within the chosen domains.

The starting point of this paper is that the S3 represents a significant step in improving innovation policy at regional level and the effectiveness of the resource allocation fund at European level. The paper underlines the importance of maintaining the focus the S3 on R&D based innovation, thus avoiding the risk of overlapping (and confusion) with the much broader innovation and development policy that can be designed and implemented at regional level.

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Table 1 – Synthesis of the S3 presentations

Region	Country	Population (thousands)	Main sectors	Proposed areas of specialisation	Relatedness at regional level	Connectivity at European level	Note	Presentation
Azores	Portugal	247	Tourism Services	Not identified	Not analysed	Not analysed	Mostly methodological	June 2012
Basque	Spain	2.163	Industry	Target markets: Ageing Society, Digital world, Transport and mobility, Energy (renewable), Science Industry Cross-technology domains: Biosciences, Nanosciences, Advanced Manufacturing	Analysed	Mentioned but not analysed	Analysis of the present situation	January 2012
Canary Islands	Spain	2.127	Tourism	Astrophysics and astronomy, Marine environment, Biotech, Renewable energies and water , Sustainable tourism	Mentioned	Not analysed	Analysis of the present situation	June 2012
Cornwall	United Kingdom	535	Services	Smart grid development, marine energy, floating wind and bio fuels Future knowledge sectors: creative, biomedical, health & well being and digital	Not analysed	Not analysed	Mostly methodological	June 2012
Friesland	Netherland	630	Agriculture	Water technology, Life sciences, Sustainable energy, Agriculture, Tourism	Not analysed	Not analysed	Mostly methodological	January 2012
Nord Pas de Calais	France	4.000	Industry	Railway transport; Health-Nutrition-Food; Commerce of the future; Automotive; Buildings and eco-construction; Mechanical engineering; Advanced materials (green chemistry, textiles, composites); Energy and power electronics; Waste treatment, sediments, polluted sites and soils; Images and digital creation; E-health	Not analysed	Mentioned but not analysed	Analysis of the present situation	January 2012
Northern Ireland	United Kingdom	1.800	Services	Advanced Manufacturing; Advanced Materials; Sustainable Production & Consumption; Life & Health Sciences; ICT; Electronics & Photonics	Analysed	Analysed	Identification of broad technology specializations	May 2012
Puglia	Italy	4.090	Agriculture Manufacturing	Aerospace, Agro industry, Cultural heritage, Biotechnology and life science, Energy and Environment, Logistics and Production technology, Mechanics and Mechatronics, New materials and nanotechnology, ICT	Mentioned but not analysed	Analysed	Mostly analysis of the recent policy on innovation and R&D	May 2012
Reunion	France	840	Public sector	Biotech, Life science, Sea (fishing, aquaculture), Energy, ICT, Tourism, Environment	Mentioned but not analysed	Mentioned but not analysed	Analysis of the present situation	June 2012
Skane	Sweden	1.251	Industry	Sustainable cities, Personal health	Not analysed	Not analysed	Mostly methodological	May 2012
Vest	Romania	1.920	Industry	Not identified	Not analysed	Not analysed	Mostly methodological	May 2012