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Exploring Current Trends in Scientific Research on Smart Specialisation

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Exploring Current Trends in Scientific Research on Smart Specialisation

This paper describes current trends in scientific research on Smart Specialisation by answering the following questions: (1) How many scientific publications on Smart Specialisation have been produced since this concept emerged and what are their characteristics in terms of type and influence?; (2) How large is the community of researchers, organisations and countries working in this field?; (3) What is their influence and productivity?; (4) What are the main regional knowledge hubs and the key knowledge producers?; and (5) What are the highly-cited knowledge objects published by the research community? The answers are sourced from a bibliometric analysis of the scientific publications produced during the first 12 years of research on Smart Specialisation.

Keywords: Smart Specialisation; Research Trends; Core Literature; Knowledge Producers

JEL classification codes: O31, O33, R11, R58

1. Introduction

In March 2000, the European Council set a new strategic goal: to make Europe *"the most dynamic and competitive knowledge-based economy in the world [by 2010], capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment"* (Rodriguez et al. 2010: 11). This goal represents the core of the Lisbon Strategy, which affirms the European Union's political ambitions and the determination of its Member States to undertake the structural improvements required to harness the full benefits offered by *"the transition to a knowledge-based economy and society"* (European Council 2000: 3). With this strategy, the European Union started to recognize the driving force of knowledge creation, diffusion and exploitation in supporting the resolution of the social, economic and environmental challenges that its regions are facing and generating sustainable growth and prosperity (European Commission 2010a).

To accelerate this transition and support the achievement of the Lisbon Strategy's objectives, in 2005 the European Commission set up the Knowledge for Growth (K4G)

Expert Group[1]. This group of European economists was tasked with operating as an independent advisory body and providing high-level recommendations on how to develop research and innovation policies able to move Europe towards a competitive knowledge-based economy (Deakin et al. 2017; 2018; European Commission - Directorate-General for Research 2008; Komninos et al. 2018; Knowledge for Growth Expert Group 2009). The high-level recommendations proposed by the Expert Group were published between 2005 and 2009 as a series of reports and policy briefs (see Foray 2006; David and Metcalfe 2007; Foray and Van Ark 2007; Knowledge for Growth Expert Group 2007; O'Sullivan 2007; Marimon and Carvalho 2008; Foray et al. 2009; Giannitsis and Kager 2009; Hall and Mairesse 2009; Veugelers and Mrak 2009).

These publications offer advice on the policy challenges that the European Union needs to address in order to pave the way for a competitive knowledge economy: the deficit in R&D and innovation; the governance of science and technology systems; the globalisation of R&D; the interrelation between technology production and diffusion; and the relationship between higher education institutions and industry. In addition, these advisory documents introduce the concept of Smart Specialisation, which emerges as a leading idea of the K4G Expert Group and is presented in the policy briefs by Foray and Van Ark (2007) and Foray et al. (2009).

According to the K4G Expert Group, *"Europe is losing ground as a centre for research and innovation"* (European Commission - Directorate-General for Research 2008: 13), because its *"companies are increasingly looking outside Europe for their R&D, and overseas companies are less and less inclined to base their R&D in Europe"* (Foray and Van Ark 2007: 1). The Expert Group suggests that the solution to this problem is to create European-based *"global R&D hubs which can compete with foreign hubs to attract more research capacities and other knowledge resources"* (European Commission - Directorate-General for Research 2008: 13). This requires countries and regions across Europe to engage in the so-called 'Smart Specialisation process', which entails the identification and subsequent development of the most promising research and innovation domains by means of a prioritization logic. These research and innovation

[1] The Knowledge for Growth (K4G) Expert Group is no longer active. Its activities were completed in June 2009 and then presented during the final conference "S&T policy in times of crisis: Prospects for the knowledge-based economy". The conference documentation can be found on the European Union's website: http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm.

domains are considered as areas of specialisation, and their identification is based on a process of entrepreneurial discovery: a bottom-up and place-based collaborative learning process, during which local entrepreneurs form mutually reinforcing connections and pool their knowledge in order to identify and explore the specialisation areas that can best support the growth of the regional economy (Foray et al. 2009).

As McCann and Ortega-Argilés (2015), Capello (2014) and Kroll (2015) highlight, after the publication of the first policy briefs, the concept of Smart Specialisation started to move out from the grey literature[2] produced by the K4G Expert Group and enter the scientific publishing system, opening up a new research field and marking the beginning of an international debate. This paper aims to capture the effects of this transition by reporting on the results of an exploratory study on current trends in Smart Specialisation research.[3] In doing so, the paper addresses the following questions:

(1) How many scientific publications dealing with Smart Specialisation have been produced since 2005 and what are their characteristics in terms of type and influence?
(2) How large is the community of researchers, organisations and countries working in this research field?
(3) What is the influence and productivity of the entities belonging to this community?
(4) What are the main regional knowledge hubs and the key knowledge producers in the field of Smart Specialisation?
(5) What are the highly-cited knowledge objects published by the research community?

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[2] Grey literature consists of those publications that are *"produced on all levels of government, academics, business and industry in print and electronic formats, but [are] not controlled by commercial publishers, […] i.e., where publishing is not the primary activity of the producing body"* (Schopfel 2010). This type of literature is therefore published without being subject to the traditional academic peer-review process (Adams et al. 2016).

[3] This analysis does not map the topics and subject areas emerging in the field of Smart Specialization. Additional research focusing on this knowledge gap would be very beneficial and would help the community of researchers working in this field to acquire an improved understanding of its overall organization, extending the findings of the bibliometric study that this paper reports.

To answer these questions, a bibliometric analysis was conducted in which the count of publications, authors, organisations and citations was combined with network analysis in order to examine: (1) the scientific literature dealing with Smart Specialisation published between 2005 and 2016, a period corresponding to the first decade of research on this subject; and (2) the community of researchers who produced such literature.

The paper is divided into three main sections. Section 2 describes the methodology used to conduct the bibliometric analysis, in particular, the data collection and processing approach and the metrics adopted during the analytical process. Section 3 is organized into four sub-sections, each reporting the results of the analysis, which provide researchers investigating Smart Specialisation with a comprehensive picture of their research field and a better understanding of how its intellectual structure is being shaped. Section 4 concludes the paper by summarizing the results and discussing their significance in the broader debate on Smart Specialisation.

2. Methodology

This section of the paper describes in more detail the methodology used to conduct the bibliometric analysis. The analysis began with a search phase designed to build an accurate representation of the research field under investigation by collecting a large sample of scientific publications on Smart Specialisation. This literature search was conducted in February 2017 using Web of Science and Scopus, which are two of the main databases supporting the development of bibliometric analyses (Bakkalbasi et al. 2006; Komninos and Mora 2018; Mongeon and Paul-Hus 2016; Mora et al. 2017). The decision to adopt a multi-database approach was based on research undertaken by De Groote and Raszewski (2012), Jacobsen et al. (2013), Levine-Clark and Gil (2008) and Zhao et al. (2009), who all suggest using a single search tool brings data reliability into question.

To set up the search, a timespan of twelve years was selected, from 2005 to 2016, and a search query was run to identify all the publications in which the keyword 'Smart Specialisation' was included in their titles, abstracts, keyword lists or full texts.[4] Both

[4] Considering the specific interest of this study in research focused on the concept of Smart Specialisation, a decision was taken to design the literature search so that only publications containing the term 'Smart Specialisation' were captured. No varying or related terms were considered during the search. This made it possible to avoid the risk of adversely affecting the bibliometric analysis by including publications that did not explicitly relate to what Smart Specialisation means as a knowledge object.

American and English spellings of the keyword were considered. In addition, no restrictions for languages and document types were imposed to filter the results. The search initially produced 274 results, which were subsequently transferred into a single dataset. However, after eliminating duplicate publications indexed by both Web of Science and Scopus, 205 documents remained, which were grouped into the following five categories: Books (4); Book chapters (8); Conference papers (58); Articles published in scholarly journals (128); Other (7).[5] This last category includes book reviews, editorials and books' forewords. The raw data necessary to perform the analysis was extracted from this group of publications, which can be considered as the source documents of this bibliometric analysis (Small and Crane 1979; Shiau and Dwivedi 2013).

The data obtained from the source documents made it possible to compute the following group of metrics, which provide insights into the research questions and support the identification of current trends in research on Smart Specialisation.[6] A full description of each metric is provided by Colledge and Verlinde (2014), in the SciVal Metrics Guidebook[7].

Metric 1: Author and organization count

Authors' full names were extracted in each source document, along with the information related to their affiliations[8], which were grouped into four categories: (1) University; (2) Business; (3) Government; and (4) Other. This process made it possible to reconstruct the

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[5] The number of publications belonging to each category is shown in brackets. To be noted is that only peer-reviewed publications are considered in this study. Grey literature, which is not indexed by either Scopus or Web of Science, was excluded from the search process.

[6] Considering that bibliometric data extracted from scholarly databases often contain errors (Adam 2002; Bar-Ilan 2008), all data was checked for accuracy and changes were made when necessary by cross-referencing the information obtained from four different sources: Web of Science; Scopus; the full texts of the source documents; and the publishers' repositories in which each source document is stored.

[7] SciVal is one of the Elsevier's Research Intelligence digital tools. It is designed to support researchers and research managers in gathering bibliometric data and analyzing research trends. Additional information describing the functioning and features of Scival can be found on its official website: https://www.elsevier.com/solutions/scival.

[8] In the case of authors with a double affiliation, only the one that they positioned first was considered. This choice simplified management of data related to a small percentage of the analysis sample: 3.8% of the total 395 authors.

community of researchers and organisations working in the field of Smart Specialisation, analyse its overall structure and compare the distribution of authors and organisations in different geographic regions.

Metric 2: Publication count

This productivity metric was used to measure and compare the scientific output at any level of aggregation (author, organisation and country). During the count, publications produced by multiple entities were split and each entity was assigned an equal part. This means that a publication was only counted once even when it was co-authored.[9] The counting process is explained in Table 1.

SOURCE DOCUMENT	ENTITY 1: AUTHORS	ENTITY 2: ORGANISATIONS	ENTITY 3: COUNTRIES
SD1	A1	O1	C1
SD1	A2	O1	C1
SD1	A3	O2	C2
SD1	A4	O3	C3
COUNTING PROCESS	**A1 = 0.25** **A2 = 0.25** **A3 = 0.25** **A4 = 0.25**	**O1 = 0.50** **O2 = 0.25** **O3 = 0.25**	**C1 = 0.50** **C2 = 0.25** **C3 = 0.25**

Table 1. Methodology for publication count

Metric 3: Citation count[10]

This impact metric was used to compare the influence of authors, organisations and countries actively involved in scientific research on Smart Specialisation. The influence of each entity was measured by counting the number of citations that its source documents received from other source documents. Citation data was extracted manually by analysing

[9] When available, the online publication date was considered for the classification of the source documents.

[10] Despite focusing on twelve years of scientific production, it is important to note that the bibliometric study reported in this paper was conducted by considering a short-time citation window because all the scientific literature dealing with Smart Specialisation was published between 2011 and 2016. A comprehensive analysis of this issue and a discussion of the error rate that this condition can generate is provided by Wang (2012).

the reference section of each source document. As in the case of the publication count, when a source document was authored by two or more entities, the total number of citations that it had received was divided equally, and each entity was assigned an equal share.

The citation count was also used to identify the core literature on Smart Specialisation. In a group of publications belonging to the same research field, core documents are those publications with the highest centrality, which is expressed by the number of citations they have obtained from other publications in the group (Glanzel and Thijs 2011; Glanzel and Czerwon 1996; Meyer et al. 2014; Mora et al. 2018a; 2018b). Since core documents are highly-cited publications, they can be considered as the most representative literature and *"are expected to form the […] cognitive nodes of the [research field] they represent"* (Meyer et al. 2014: 477).

3. Results

The results of the analysis are discussed in the following sub-sections, which set out current trends in research on Smart Specialisation.

3.1. Knowledge production

Data related to both the annual count and cumulative growth of source documents shows that research on Smart Specialisation began in 2011 (see Figure 1), with three publications introducing this new science-related topic. The first is a conference paper describing the user-driven and open innovation model promoted by TestLab, i.e. a living lab created in 2007 by the Italian Province of Trento, in collaboration with ENoLL (European Network of Living Labs). In light of this experience, the paper suggests that the living lab methodology generates *"a mechanism of bottom-up Smart Specialisation, whereby regional priorities can be determined by the willingness of local actors to join forces and strive for common goals"* (Ferrari et al. 2011: 332). The second publication is a journal article by Di Anselmo and Lo Cascio (2011), which discusses the challenges that the recent economic crisis has generated in Europe, highlighting the need for smarter forms of policymaking able to support innovation at the regional level by deploying public investments. According to the article, the Smart Specialisation process is a means to fulfil this aim because it can support the establishment of new and sustainable regional development paths that provide for *"a selective use of resources"* and concentration of investments *"in a narrower range of measures which offer better returns"*, moving away from a deregulated provision (Di Anselmo and Lo Cascio 2011: 468). Finally, the third

publication reports on a study aimed at supporting the Smart Specialisation process in Cape Town by explaining how this European concept can be exported to South Africa (Lorentzen et al. 2011).

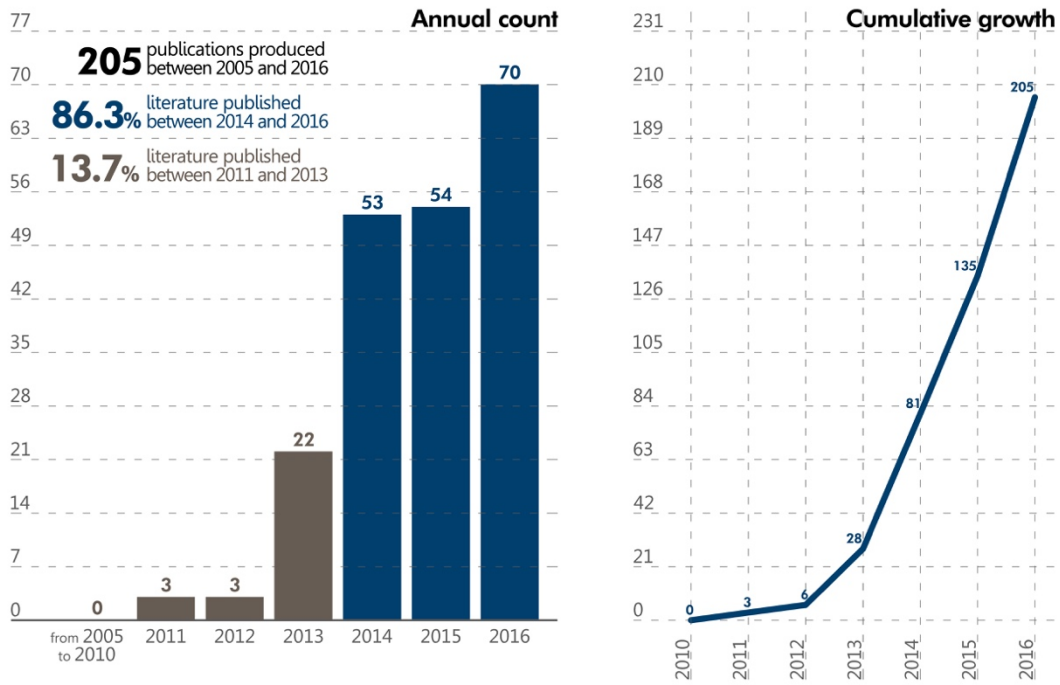

Figure 1. Annual count and cumulative growth of source documents

These publications initiated a scientific debate that has grown steadily over the years, especially between 2014 and 2016, a period in which 86% of the available literature on Smart Specialisation was published. This literature has been mainly produced in Europe (93.0%), where universities are the most active organisations. Their overall publication output is 69.9%, which corresponds to about 144 of the 205 source documents, while businesses, governments and other institutions belonging to European countries only account for 23.1% of the publication volume. The top universities for publication output are located in Italy, which has the highest level of production (15.4%), followed by Poland (8.9%), Spain (8.5%), United Kingdom (7.4%), Netherlands (6.8%), Lithuania (5.2%), Latvia (4.9%) and Romania (4.9%). In contrast, Cyprus (0.2%), Serbia (0.4%), Ukraine (0.5%), France (0.5%), Norway (0.5%), Slovenia (0.6%), Malta (0.7%), Bulgaria (1.0%) and Portugal (1.0%) exhibit a different pattern. With a total publication output lower than or equal to two source documents, they have the lowest level of

involvement amongst all the European countries conducting research in the field of Smart Specialisation (see Appendix A and Figure 2).

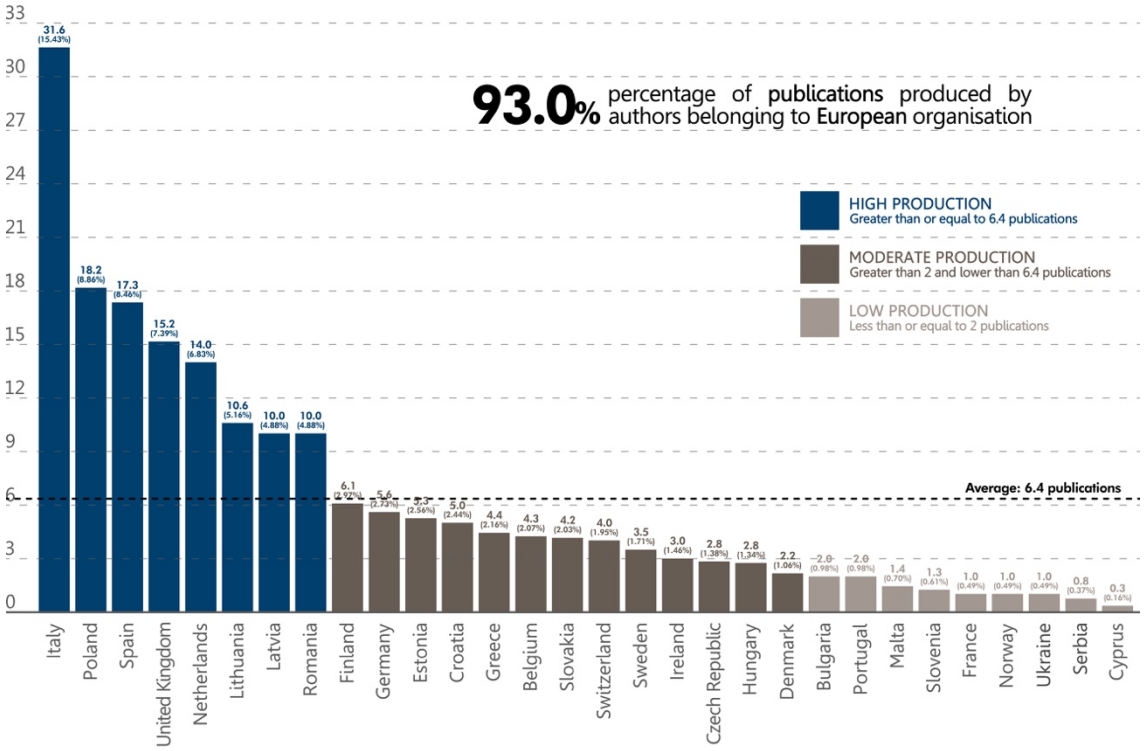

Figure 2. Level of production of European countries

3.2. Available workforce

Considering the period between the beginning of 2005 and the end of 2016, the scientific community conducting research on Smart Specialisation consisted of 395 researchers from 204 organisations located in 40 different countries. Figure 3 shows the progressive growth of this community, in which the number of active researchers has increased annually, together with the number of source documents. The data in Appendix A and Figure 4 suggests that these authors work mainly for European-based organisations (90.1%), where universities have the highest share of authors (64.8%). This data also shows that the percentage of researchers from businesses (7.6%) and governmental institutions (11.6%) reflects the low level of production of both sectors.[11]

[11] To be noted is that the smaller share of researchers from businesses and governmental institutions relates to their contribution to the production of scientific knowledge on Smart Specialisation, i.e. knowledge resulting from publications which are subject to the traditional

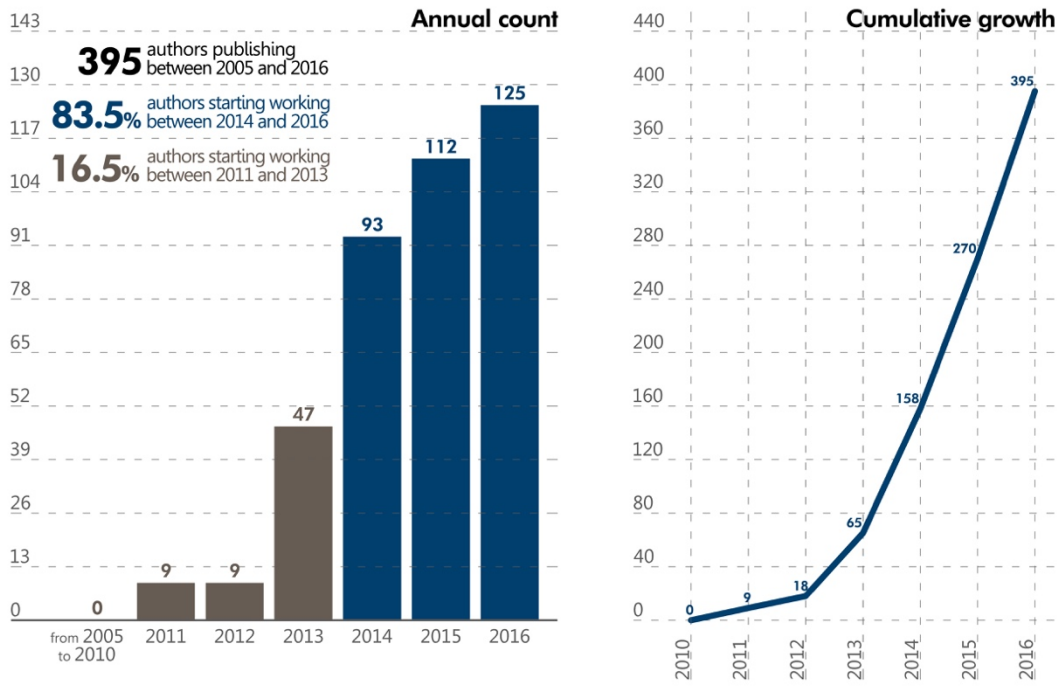

Figure 3. Annual count and cumulative growth of authors

Besides having the highest volume of output, Italy is also the country with the highest number of active researchers (14.7%). This positive correlation between workforce and publication output can be observed in the majority of the most productive countries, where the percentage of researchers working in the field of Smart Specialisation ranges between 3.0% and 9.1%: Spain (9.1%); Poland (7.1%); United Kingdom (6.8%); Romania (5.1%); Lithuania (4.6%); Latvia (3.8%); and Netherlands (3.3%). Germany, Finland, Croatia and Estonia are the only entities affected by a reverse trend. In these countries, the production of literature is lower when compared to the most productive countries, but the workforce level is similar (see Figure 3 and Figure 4).

academic peer-review process. The inclusion of grey literature in the analysis may yield different figures.

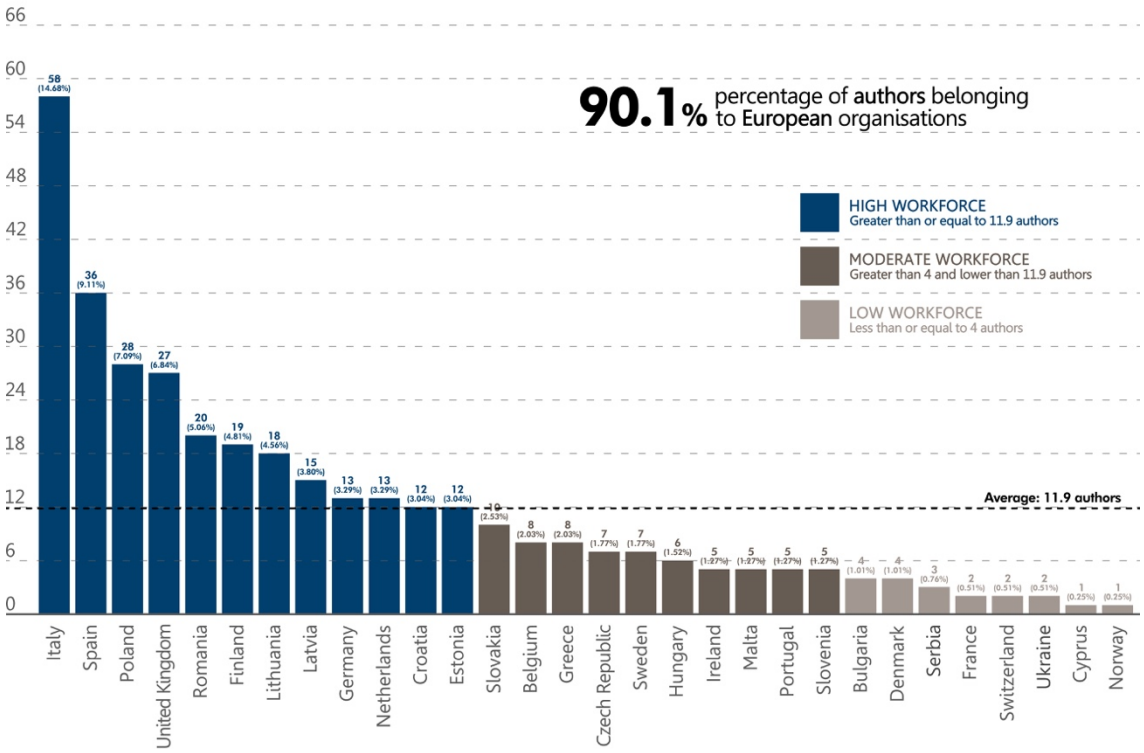

Figure 4. Workforce level of European countries

3.3. Influence in the scientific debate on Smart Specialisation

The share of citations that each country obtained during the period under investigation shows that research on Smart Specialisation is mainly driven by European countries and their universities. Together, these 30 active countries account for about 98.8% of the 303 total citations obtained by the source documents, and their universities have received the highest share (82.0%). Only 16.9% of citations relate to the research activity conducted by governmental organisations, the business sector and civic organisations (see Appendix A and Figure 5).

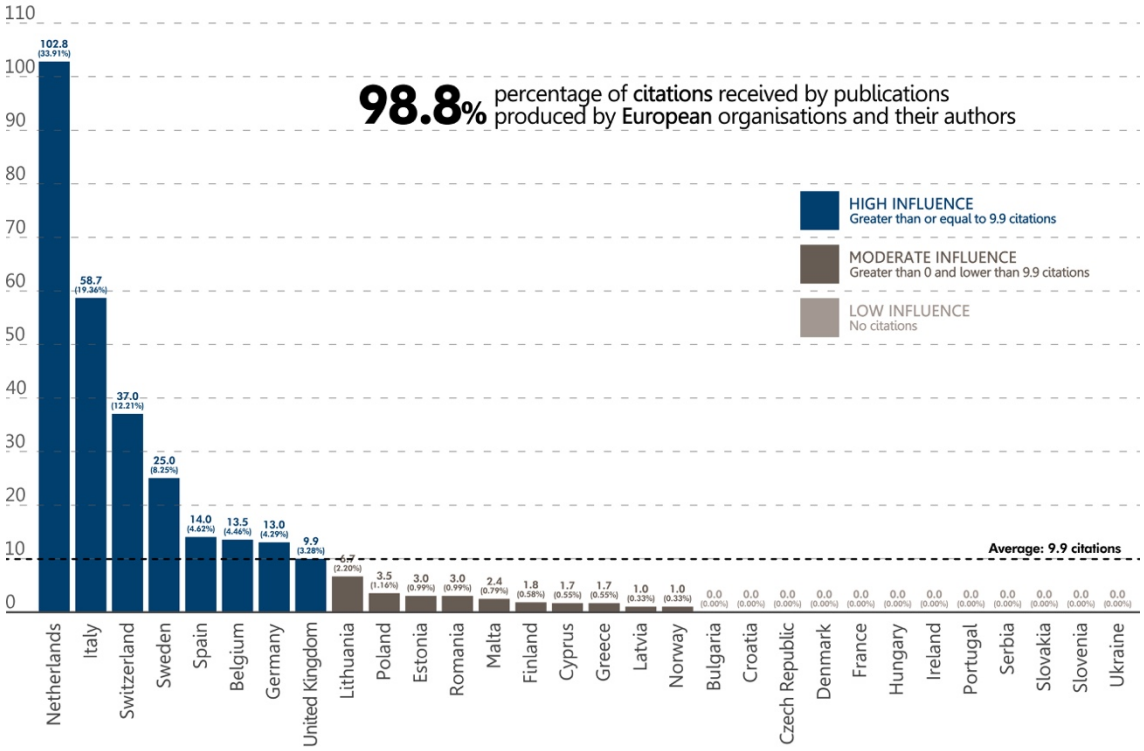

Figure 5. Influence of European countries

In addition, a comparison of the data on both influence and publication output yields the following key facts, which make it possible to divide the European countries conducting research on Smart Specialisation into four clusters (see Figure 6):

- 18 of the 30 European countries have a very limited or no influence in the field of Smart Specialisation, and this is due to a low level of publication output. These countries are Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Malta, Norway, Portugal, Serbia, Slovakia, Slovenia and Ukraine (Cluster 1);
- Despite the high level of publication output, Latvia, Lithuania, Poland and Romania have a moderate influence (Cluster 2);
- Belgium, Germany, Sweden and Switzerland (Cluster 3) are among the most influential countries in the field of Smart Specialisation. However, they leverage a far lower number of publications compared to Spain, Italy, Netherlands and the United Kingdom (Cluster 4), which are the top countries for both research output and influence.

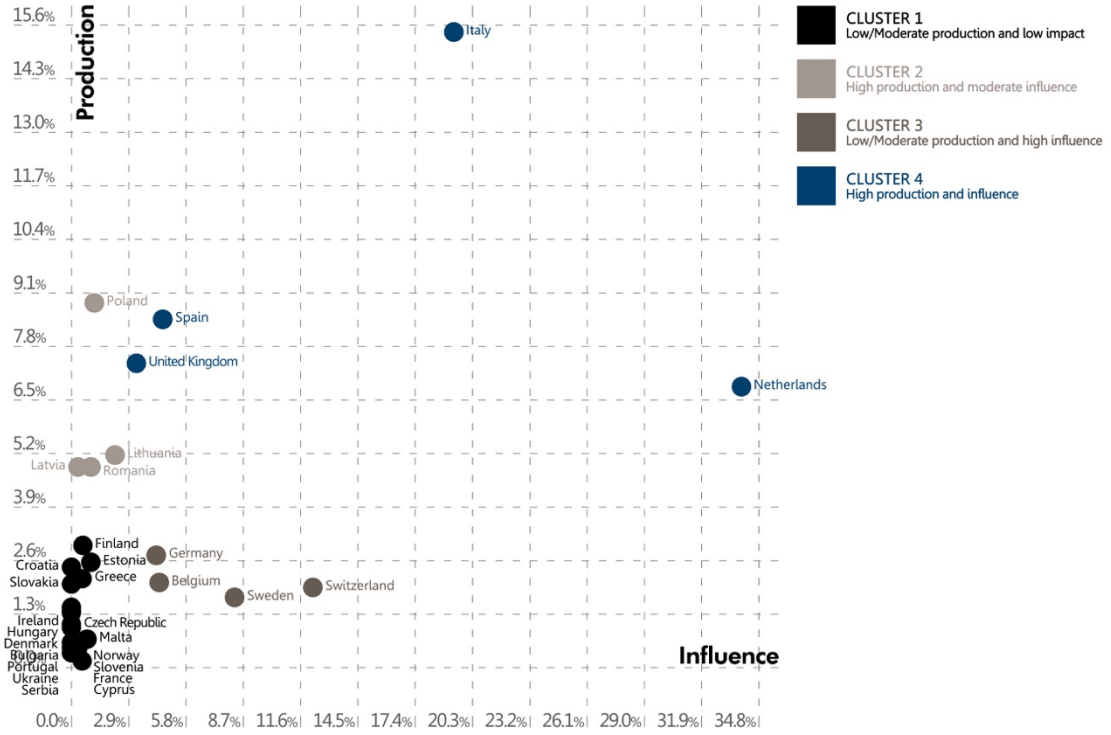

Figure 6. Comparison between production and influence of European countries

The results of the analysis suggest that Belgium, Germany, Spain, Sweden, Switzerland, Italy, Netherlands and the United Kingdom are the main regional knowledge hubs in the field of Smart Specialisation. The eight knowledge hubs are mapped in Figure 7, along with the key knowledge producers, which are listed as the top 15 organisations for number of citations. It is not surprising that most of these knowledge producers are in the regional knowledge hubs, where research is mainly driven by universities: Politecnico di Milano and Università Politecnica delle Marche in Italy; University of Groningen and Utrecht University in the Netherlands; Lund University in Sweden; Ecole Polytechnique Federale de Lausanne in Switzerland; University of Antwerp in Belgium; and Cardiff University in the United Kingdom. In addition to higher education institutions, the list of key knowledge producers includes: the non-governmental institutions Fraunhofer Institute for Systems and Innovation Research and Orkestra - Basque Institute of Competitiveness, which are respectively located in Germany and Spain; the European Commission and one of its Joint Research Centres; the Brussels' office of the consultancy Technopolis Group; the Institute of National Economy in Romania; and Visionary Analytics in Lithuania.

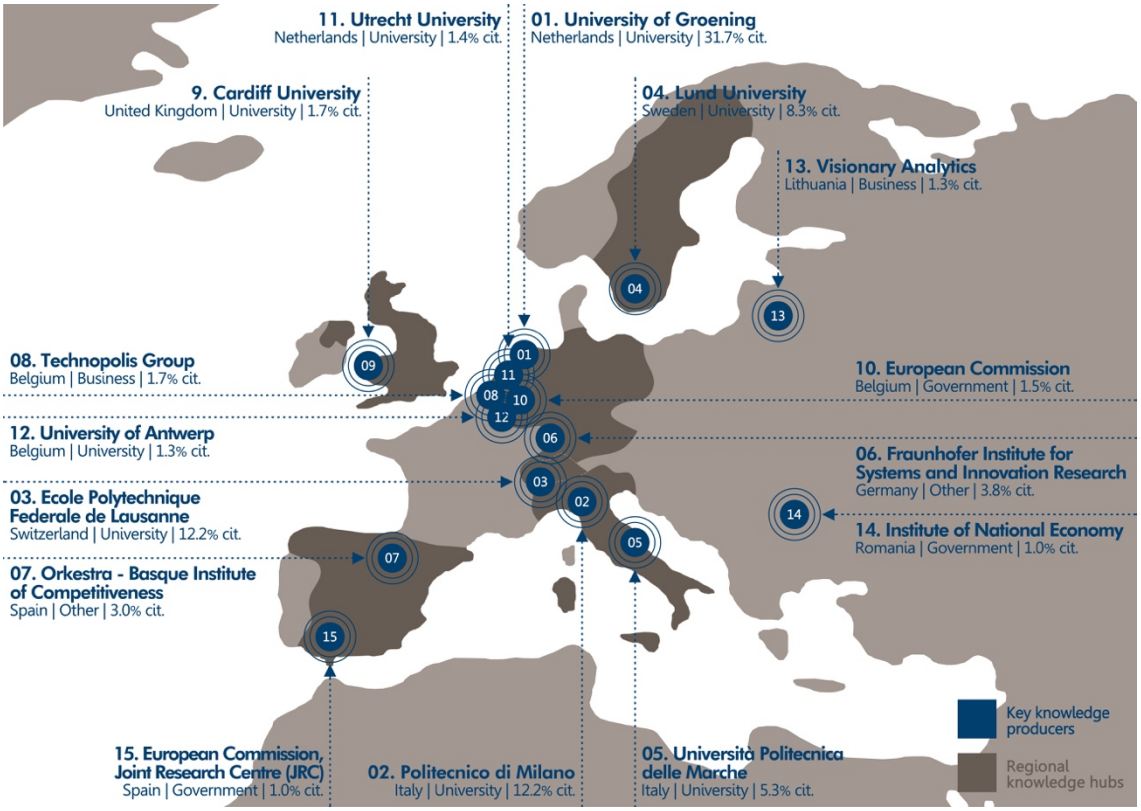

Figure 7. Regional knowledge hubs and key knowledge producers

3.4. Core literature

In order to visualize the network of citations connecting the source documents and identify the core literature on Smart Specialisation, the citation data was processed by deploying the open software Gephi. The result of the data processing is the network of directed and unweighted links represented in Figure 8, which was obtained using the Fruchterman-Reingold layout algorithm (Fruchterman and Reingold 1991). In this network, the 205 source documents are represented as nodes and the 303 edges connecting them are the citations. Each node is assigned a dimension which is directly proportional to the number of citations that it has received from others. In addition, nodes are distinguished by colour: source documents with at least 1 citation are blue or grey, whereas non-cited source documents are black. The arrows at the end of each link define the direction of the citation, making it easy to distinguish between citing references and cited references.

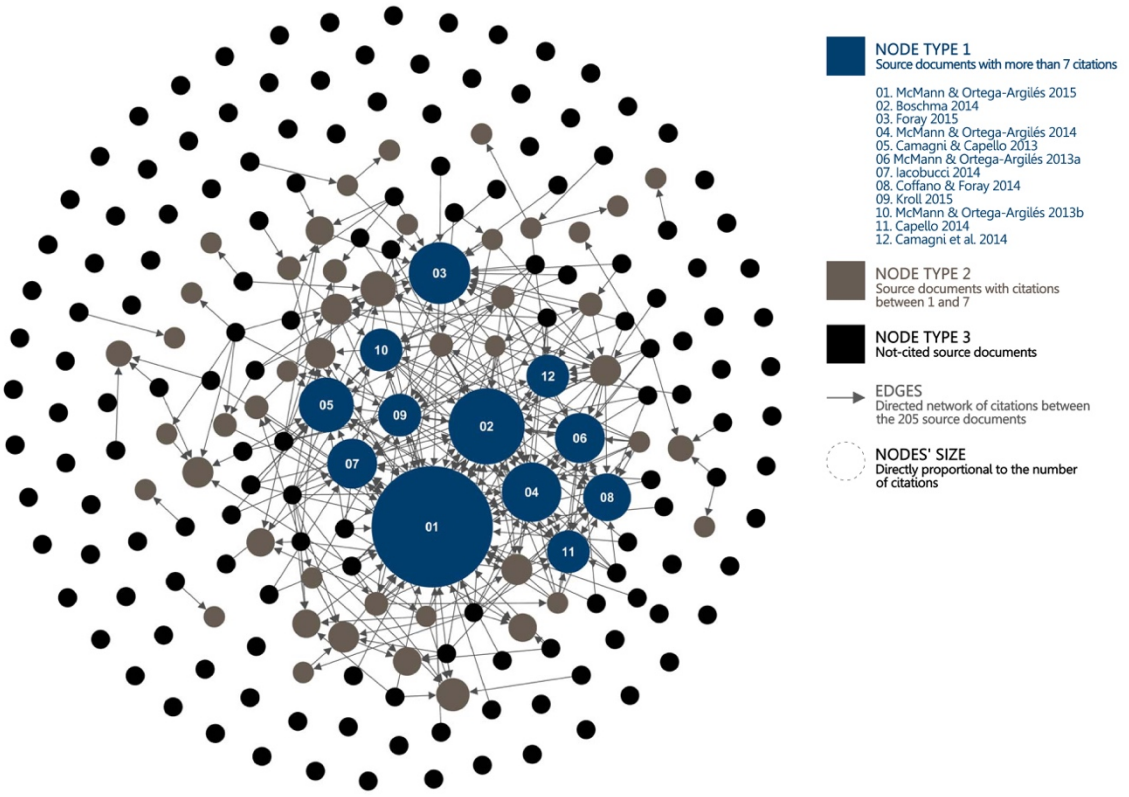

Figure 8. Document citation network

An analysis of the citation pattern was conducted to define the ratio between cited publications (58) and non-cited publications (147). It was found that: 72% of the source documents had not yet been cited; 22% had acquired between 1 and 7 citations; and the remaining 6% of cited references had received at least 10 citations each, and accounted for almost 65% of the total citations (see Figure 9). These highly-cited publications are listed in Table 2 and can be considered as the core literature in the field of Smart Specialisation.

REFERENCE	YEAR	TYPE	AUTHORS AND AFFILIATIONS	N° OF CITATIONS
McCann and Ortega-Argiles 2015	2013	Journal Article	McCann, P.; Ortega-Argiles, R. [University of Groningen, Netherland]	43
Boschma 2014	2014	Journal Article	Boschma, R. [Lund University, Sweden; Utrecht University, Netherland]	24
Foray 2015	2015	Book	Foray, D. [Ecole Polytechnique Federale de Lausanne, Switzerland]	18

McCann and Ortega-Argiles 2014	2014	Journal Article	McCann, P.; Ortega-Argiles, R. [University of Groningen, Netherland]	17
Camagni and Capello 2013	2013	Journal Article	Camagni, R.; Capello, R. [Politecnico di Milano, Italy]	15
McCann and Ortega-Argiles 2013a	2013	Journal Article	McCann, P.; Ortega-Argiles, R. [University of Groningen, Netherland]	13
Iacobucci 2014	2014	Journal Article	Iacobucci, D. [Università Politecnica delle Marche, Italy]	13
Coffano and Foray 2014	2014	Journal Article	Coffano, M.; Foray, D. [Ecole Polytechnique Federale de Lausanne, Switzerland]	12
Kroll 2015	2015	Journal Article	Kroll, H. [Fraunhofer Institute for Systems and Innovation Research, Germany]	10
McCann and Ortega-Argiles 201b	2013	Journal Article	McCann, P.; Ortega-Argiles, R. [University of Groningen, Netherland]	10
Capello 2014	2014	Journal Article	Capello, R. [Politecnico di Milano, Italy]	10
Camagni et al. 2014	2014	Journal Article	Camagni, R.; Capello, R.; Lenzi, C. [Politecnico di Milano, Italy]	10

Table 2. Core literature

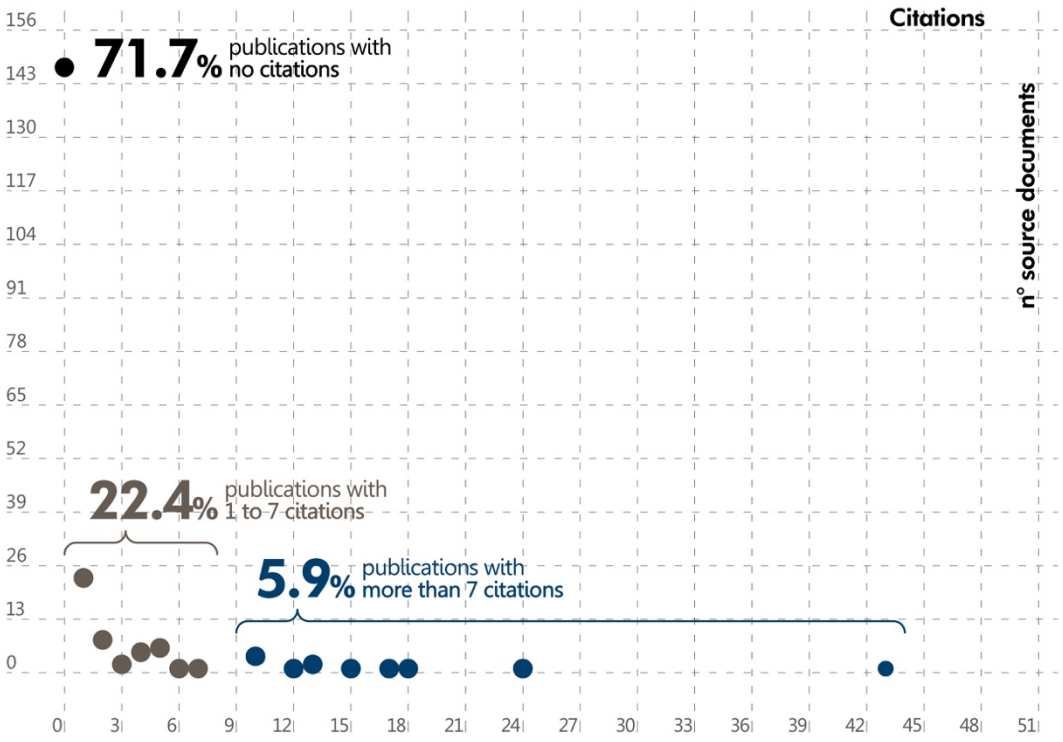

Figure 9. Distribution of source documents by number of citations

With 43 citations, McCann and Ortega-Argilés (2015) is the most cited publication. This journal article explains the origins of the Smart Specialisation concept and examines the rationale behind the policy-prioritization logic and the place-based approach to regional development that it promotes. This serves to highlight *"the critical role of knowledge diffusion processes between sectors, activities and occupations, and explicitly avoids automatically prioritizing high-technology sectors by taking a broader systems perspective"* (McCann and Ortega-Argilés 2015: 1293). The discussion on Smart Specialisation that McCann and Ortega-Argilés offer in this publication is expanded by way of three additional articles that they have co-authored. These articles explore the developments relating to regional innovation policy by reviewing the literature produced in recent years by international development institutions such as World Bank, OECD and the European Commission (McCann and Ortega-Argilés 2013a; 2013b; 2014). These developments include Smart Specialisation, which is described as *"a policy prioritisation agenda for regional innovation policy"* (McCann and Ortega-Argilés 2013a: 206) that results from the adaptation of the debate on non-spatial innovation policy to the European Cohesion Policy (McCann and Ortega-Argilés 2013a; 2013b).

Along with Iacobucci (2014), Kroll (2015), Foray (2015) and Capello (2014), these publications capture what is known about the concept of Smart Specialisation. In capturing this knowledge, they also suggest that the practical design and implementation process of strategies for Smart Specialisation remains at an early stage of development, and that a number of critical issues are still unresolved. As Capello (2014: 5) points out: *"no definitive view on the concept has so far been reached, and the challenges, strengths and risks associated with the best design and implementation of the Smart Specialisation strategy are still much debated"*.

Camagni et al. (2014) and Camagni and Capello (2013) have contributed to the debate with two articles supporting the general philosophy behind the Smart Specialisation concept, but criticize its direct application in regional development policies. Like McCann and Ortega-Argilés (2015), Camagni and Capello (2013: 361) suggest the Smart Specialisation approach *"looks highly valuable, appropriate and a good starting point for further reflections"*. However, the sectoral and non-spatial logic from which it emerges *"ignores the variability of regional innovation paths, [which] strongly depend on territorial elements rooted in the local society, its history, its culture and its typical learning processes"* (Camagni et al. 2014: 72). According to Camagni and Capello (2013: 357), this calls for a new *"rationale for a regionalized conception, design and delivery of innovation policies based on a territorial taxonomy"*, which their articles

outline. This taxonomy is proposed to facilitate the development of *"common approaches for similar types of regions [and] prevent [any] misallocation of public resources and unlikely local strategies"*.

The remaining core literature: (1) focuses on the complementary relationship between Smart Specialisation and Constructing Regional Advantage, two policy concepts which have attracted much attention at the European level, and *"provides important inputs to develop a smart and comprehensive policy design that avoids rent-seeking behaviour of vested local stakeholders but instead focuses on true economic renewal in regions"* (Boschma 2014: 64); (2) combines the data obtained from two questionnaire-based online surveys and a range of qualitative interviews with policy makers to gain deeper insights into the implementation processes of strategies for Smart Specialisation in European regions (Kroll 2015); and (3) explains the centrality of the entrepreneurial discovery process that drives the bottom-up and decentralized logic of Smart Specialisation (Coffano and Foray 2014).

4. Discussion and conclusion

This exploratory study has evidenced current trends in research on Smart Specialisation by means of a bibliometric analysis in which the count of publications, authors, organisations and citations was combined with network analysis to examine: (1) the scientific literature dealing with Smart Specialisation that was published during the first decade of research, corresponding to the period between 2005 and 2016; and (2) the community of researchers who produced such a literature.

The results of the counting process show that research on Smart Specialisation has increased steadily since the publication of the K4G Expert Group's policy recommendations, leading to the progressive development of a new and emerging research field in which the numbers of authors and scientific publications have grown exponentially. The first scientific publications dealing with Smart Specialisation date back to 2011, but most of the literature belonging to this research field was published between 2014 and 2016. This three-year period accounts for about 86% of the 205 publications produced during the first decade of research. The community of researchers working in this field has expanded following a similar growth pattern: the 9 authors publishing in 2011 became 65 in 2013 and 395 at the end of 2016.

These insights reveal that research on Smart Specialisation began immediately after the European Commission identified the application of the Smart Specialisation approach as one of the main actions to achieve the objectives of the Europe 2020 strategy.

This directive was issued in October 2010, with the publication of the Communication on *"Regional Policy Contributing to Smart Growth in Europe 2020"* (European Commission 2010b) and its accompanying document (European Commission 2010c). In addition, these two documents: (1) discuss the rationale behind the European Commission's decision to introduce the Smart Specialisation approach and the expected impact; (2) explain how this approach should be understood by national and regional governments as strategic statements able to maximise the impact of Regional Policy in combination with other EU policies; and (3) inform national and regional governments about the European Commission's intention to launch a Smart Specialisation Platform able to advise on the design and implementation of research and innovation strategies for Smart Specialisation (European Commission 2010b; 2010c). The platform is currently active and coordinated by the European Commission's Joint Research Centre located in Seville[12].

The production of the policy briefs that introduced the concept of Smart Specialisation in 2005 and the distribution of the first peer-reviewed publications in 2011 can be considered two milestones in the development of this research field. The growth in the number of active researchers and publications characterising the period between 2014 and 2016 represents the third one, and it was anticipated by significant developments in the European Union's legislative framework. A new Regulation was formally endorsed by the Council of the European Union in December 2013, which laid down a set of common rules aimed at governing the European Structural and Investment Funds during the period 2014-2020 (European Commission 2014). This new legislative framework provides a definition of Smart Specialisation strategies as: *"the national or regional innovation strategies which set priorities in order to build competitive advantage by developing and matching research and innovation own strengths to business needs in order to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts"*. In addition, it introduces the *"existence of a national or regional Smart Specialisation strategy in line with the National Reform Program"* as a thematic ex ante conditionality with which all the Member States must comply in order for the European Commission to provide them with funds for research and technological development (European Union 2013).

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[12] The European Commission's Smart Specialisation Platform can be accessed using the following link: http://s3platform.jrc.ec.europa.eu.

This new legislative framework has triggered the scientific debate on Smart Specialisation, which is now led by European countries. The results of this study show that 93% of the literature on Smart Specialisation is produced in Europe, where universities are the most active organisations, with an overall publication output of 70%. European countries and their higher education institutions also account for the main share of available workforce and citations. Around 90% of the authors work for European organisations and their publications have obtained 99% of the total citations. With 65% of the authors and 82% of all citations, universities have the highest share of both these measures.

Europe is also where the regional knowledge hubs on Smart Specialisation are located. These hubs include: Belgium, Germany, Spain, Sweden, Switzerland, Italy, Netherlands and the United Kingdom. Currently, 13 of the 15 top organisations for number of citations are based in the regional knowledge hubs, where research is mainly driven by universities: University of Groningen; Ecole Polytechnique Federale de Lausanne; Politecnico di Milano; Lund University; Università Politecnica delle Marche; Cardiff University; Utrecht University; and University of Antwerp. The other key knowledge producers belonging to the regional knowledge hubs are: the non-governmental institutions Orkestra - Basque Institute of Competitiveness and the Fraunhofer Institute for Systems and Innovation Research; the European Commission and its Joint Research Centre in Seville; and the consultancy Technopolis Group.

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