Operationalizing Smart Specialization in a Portuguese Follower Region

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Abstract

The inability of the European Union (EU) to grow has raised questions regarding the effectiveness of competitiveness and growth policies. To increase efficacy, the EU has determined that regions must undergo an exercise in smart specialization and devise a strategy for the same. However, particularly in follower regions facing severe locked-in problems and structural bottlenecks, the application of smart specialization may require adjustments and a more dynamic vision, especially with regard to the follower regions. Furthermore, many operational issues arise in the programming and policy-devising stages. This article aims to contribute to this debate by proposing a framework to guide the selection of priorities and by applying the proposed framework to the Portuguese North region.

Keywords: Smart specialization, innovation policy, regional innovation systems, follower regions.

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1. Introduction

The European Union (EU) is a construct that aims to create a unified and seamless economic, financial, and political zone within Europe. One of the pillars of this process is the belief that all EU members stand to gain and that Europe can be a world reference in competitiveness and, in particular, in innovation. In the last decade, the EU set a goal of becoming a world leader in innovation and has devised a trajectory of growth and jobs supported in the knowledge economy. The Lisbon Agenda aimed at steering the EU to be a beacon of innovation, and the focus of the subsequent Europe 2020 agenda and its flagship initiative Innovation Union have stayed along the same lines. These defined the ambitious targets in terms of innovation inputs (e.g., GERD/GDP reaching 3% in 2010) toward which the EU has, overall, failed to attain. This underachievement is closely linked with the lack of competitiveness that many European industries are facing and that translates into an unimpressive growth performance that underscores the need for a new model of competitiveness and innovation policies.

Acknowledging that innovation and competitiveness policies are structural policies that must be consistent and persevered across time to produce effects, the EU has dwelled between paradigms. The most recent has been the focus on Regional Innovation System (RIS) as the framework for cohesion policy and the present domination of smart specialization. Derived from the transatlantic productivity gap literature, smart specialization highlights the need for the EU to concentrate resources on fewer areas to reach an optimal scale on R&D and innovation.

In this article, we discuss the concept of smart specialization and its conceptual and operational novelty in relation to the RIS paradigm and analyze the case of follower regions and the corresponding challenges. We present a methodology to identify possible smart specialization domains and conclude with an empirical application for the North region of Portugal. In this regard, we contribute to the debate on how to implement smart specialization in practice by proposing a framework to guide the selection of priorities. We then use this framework in practice in the case of the Portuguese North region (NUTS2).

After the introductory remarks, Section 2 presents the recent EU innovation policy framework. Section 3 analyzes the concept of RIS for the case of follower regions. Section 4 illustrates the RIS3 in practice, bearing in mind the case of the North region of Portugal. Finally, Section 5 concludes the analysis.

2. Recent EU Innovation Policy frameworks: RIS vs RIS3

2.1. Regional innovation Systems (RIS)

The definition of regions follows an administrative reasoning that sometimes is not the best suited to frame the dynamic flows of knowledge and the economy. Nevertheless, it follows an established and stable framework (NUT) within the European Union and is the base for our article.

Although the RIS concept is recent, it has become one of the most influential in the EU for the design of regional development policies. A significant part of the RIS concept has been derived from the former concept of the National Innovation System (Freeman, 1987 and 1995; Nelson and Rosenberg, 1993; Lundvall, 2010). Following Saviotti (1997), an innovation system can be defined as a set of actors and interactions that have as the main objective the generation and adoption of innovations. This definition recognizes that innovations are not only generated by individuals, organizations, and institutions, but also by complex patterns of interactions between them. Therefore, within an innovation system, we can define the elements, interactions, environment, and frontier.

The relevance of the national innovation systems is related to the fact that the national dimension captures important aspects of the innovation process (namely, the policy and regulatory framework, the scientific, educational, and training framework, national economic and geographical environment, legislation, and others). As referred to by Cooke (2001), the recent idea of RIS results from convergence between works of regional scientists, economic geographers, and national systems of innovation analysts. The RIS has its relevance because proximity plays a major role on networks and interaction density; this is in general attributed to the tacit nature of a relevant part of knowledge. Tacit knowledge "is best shared through face-to-face interactions between partners who already share some basic commonalities: the same language, common "codes" of communication and shared conventions and norms…" (Asheim and Gertler, 2005: 293).

The regional dimension also generates a more "focused" knowledge base as a cumulative result of the clustering of economic and innovation-oriented activities. Asheim and Gertler develop analogous arguments and do not hesitate to stress that "The more knowledge-intensive the economic activity, the more geographically clustered it tends to be." (Asheim and Gertler, 2005: 291). Besides the cognitive and normative dimensions of RIS that can present different degrees of intensity, the political dimension should not be excluded. Cooke (2001) refers to "region" as a key component of a RIS and considers it as a meso-level political unit set between the national or federal and local levels of government that might have some cultural or historical homogeneity, but which at least have some statutory powers to intervene and support economic development, particularly innovation.

Difficulties associated to the use of the RIS concept as an operational regional policy tool remain important. First, the concepts of innovation systems and the limits established between national and regional systems still have some degree of vagueness. Another set of difficulties arises from the fact the RIS should be applied to quite different specific regional contexts instead, the RIS concept is shaped for regions with strong technological endowments and with well-established institutional and organizational networks. Even within a strict knowledge-based economy perspective, region differentiation is important because the knowledge base of the existing productive sectors is not the same everywhere and this affects the comparative relevance of actors and interactions.

2.2. Research and Innovation Smart Specialization Strategies (RIS3)

In recent years, following the knowledgeable recommendations of the growth of expert groups, the EU has embraced smart specialization as the theoretical reference for the design of innovation policies. The Barca report (2009) highlighted the apparent inefficacy of EU competitiveness policies and presented this as one of the underlying reasons for the scattering of resources and the use of a general approach to target heterogeneous contexts, namely regions (Foray and van Ark, 2007, Sandu, 2012, Kroll, 2015, Morgan, 2015, Lundström et al., 2017).

Beginning with the basic reality that regions cannot excel in everything, smart specialization emphasizes the need for place-based policies that are tailored to function with each regions' specific assets and knowledge bases as well as have potential to build sustainable competitive advantages globally (Foray and van Ark, 2007, Arancegui et al., 2011, McCann and Argiles, 2015, Lundström et al., 2017). Following those conclusions, the concept of smart specialization gained importance within the EU jargon and became a reference for the definition of a new approach to a cohesive policy. However, the concept itself remains blurry (Arancegui et al., 2011, Sandu, 2012) and, for once, the transfer into practice surpassed the conceptual consolidation of the theory. Foray et al. (2011) state this clearly when claiming a lag exists between policy practice and the theoretical framework of smart specialization. Thus, it is important to present and discuss the concept and how we can translate this into practice.

The smart specialization concept derives from two strands of economic literature, one focused on the transatlantic productivity gap and the other on the sectorial innovation systems

(McCann and Argiles, 2011). According to Foray and van Ark (2007) and Foray et al. (2009), smart specialization concerns the refocus of R&D and innovation in alignment with regions' distinctive features. In other words, regions must specialize to be able to generate critical mass. However, although Foray et al. (2009) appear to reject the hypothesis of picking winners or of overspecialization, the early version of the concept of smart specialization recommends the concentration of resources in a small set of sectors, which implies the design of a narrow technology trajectory with considerable risks of technological lock-in and of wrong choices, which forced the evolution of the smart specialization paradigm. Authors such as Pontiakis et al. (2009) and Giannitsis (2009) acknowledged that specialization enables economies of scale, but without diversity, the economies limit their ability to shift from technology trajectory and to readjust their economic structure.

Following this, related variety became a cornerstone of smart specialization or, as the McCann and Argiles (2011) name it, "specialized diversification". This is also expressed by the European Commission, which stresses the importance of diversification of related activities to reduce the risks of lock-in and of a shift in market demand (CEC, 2010). Also, Capello (2013) argues in favor of a "smart diversification and upgrading" and in a recent article defines smart specialization as a way of matching knowledge and human capital with the economic structure of regions and of having potential to build competitive advantages (Camagni and Capello, 2013, Churski et al., 2017). These authors also uphold the need for embeddedness of innovation policies in the local context, the importance of connectedness to ensure maximizing knowledge flows internally as well as linking to external knowledge bases (McCann and Argiles, 2011). However, these innovation policies and knowledge flows must be adapted to the specificities of each regional innovation pattern (Camagni and Capello, 2013) even as upgrading and diversifying the economic structure along technological and market relatedness (ESPON, 2012).

This represents a refocusing of smart specialization on regions instead of sectors. This mutation of the original concept also incorporates notions of the economic geography. The literature has also stressed the complexity of transferring the smart specialization concept into the economic geography context and the need to address the systemic nature of innovation, already present in the RIS literature (Camagni and Capello, 2013).

In fact, innovation is also a process of closeness and relatedness between people; this is why it is mostly a localized one. The RIS framework (Lundvall and Johnson, 1994; Tödtling and Trippl, 2005) demonstrated that innovation in different territories is based on local capabilities and cumulative learning processes embedded in human and relationship capital.

Therefore, knowledge diffusion is not a straightforward process but one that needs regionally tailored policies.

In sum, from the literature, we observe a set of commonalities that shape the concept of smart specializations. First, it is about choices and the focus of resources on domains (multisectorial and multi-institutional). The idea of concentration aims to ensure an adequate scale (critical mass) to base the development of a related variety of activities. Secondly, smart specialization must focus on the idiosyncrasies of regions. Given that innovation is a contextual process, smart specialization strategies can only be defined at a regional level. Thirdly, these strategies must focus on domains upon which regions can construct competitive advantages internationally. Finally, smart specialization is also about connectedness because linking to other knowledge bases and being integrated in international value chains is fundamental to improving the ability of a region's to innovate and grow.

3. RIS 3: the case of follower regions

The regional mapping of Europe highlights severe asymmetries regarding the maturity of the innovation system. In fact, leader regions that rank highly in terms of income per capita and rank in the first places of the standard innovation rankings (e.g., regional innovation scoreboard) coexist with follower regions that are trying to develop their innovation systems. In many cases, the follower regions are undergoing a structural transformation process and laggard regions appear to be locked in a situation of severe structural change incapacity. In this article, we address the specific case of a follower region, the Norte of Portugal. From a descriptive point of view, it is easy to identify the macro specificities of European follower regions with regard to innovation. In general, R&D activities in these regions still have a small expression (R&D expenditure often represents less than 1% of the GDP) and are mainly developed by the public sector. The extreme weakness of R&D activities in the business sector is accompanied by a very low level of patent indicators. Efficiency in R&D activities is apparently low as, for instance, the ratio of patent production in comparison to the level of R&D expenditures. However, within this set of regions, we can find different performances in productivity growth, which suggests that the nexus between knowledge creation and growth is complex.

As Fagerberg (1987, 1988) has pointed out, productivity growth can be seen as the result of two impulses: innovation and diffusion. The relative contribution of diffusion for productivity growth tends to be greater for follower countries or regions than in more advanced economies. However, as Fagerberg (1987; 1988) also states, based on the experience of successful catching-up economies, follower countries or regions cannot rely only on a combination of physical investment and the use of knowledge created outside their region. To assure a continuous catching-up, they must also develop their own technological effort.

It should also be stressed that diffusion does not occur easily, such as in a mechanical process of using imported knowledge in response to new market opportunities. For follower economies, the capability to use and adapt technology created outside is more than a question of buying new equipment or a codified product engineering. As Almeida et al. (2011, 2020), state, technical knowledge includes tacit knowledge. If follower countries or regions aim to promote the adoption of new technologies and be able to quickly respond to evolution of technologies, they must develop capabilities that include tacit knowledge. Thus, in a dynamic perspective, the distinction between innovation and diffusion is relative because the systemic factors that favor an effective diffusion are partly the same for innovation.

In a seminal text dedicated to technological accumulation in developing countries Bell and Pavitt (1992) have presented the distinction between productive and technological capacities. The first can be improved with the availability of resources needed to produce goods and services. In turn, technological capability appeals to skills, knowledge, and experience retained by individuals and organizations and these additional resources are largely the result of a learning process. Thus, as referred to by Bell and Pavitt (1992), it would be an error to consider that in developing countries, technological accumulation occurs as a simple "by-product" of production and this is also applicable to European follower regions.

The core of the evolutionary contributions on the complex relations of interdependence between innovation and diffusion must be permanently taken into account. The Nacional Innovation System (NIS) and the RIS concepts have been largely elaborated from the innovation frontier perspective. In follower regions, we must, on the contrary, build from the perspective of diffusion, and also discuss the feasibility of transforming the RIS into a policy tool capable of generating a proactive approach of increasing technological capabilities and fostering innovation. This is a fundamental acquisition of the evolutionary research program. The strategic approach to diffusion can no longer be understood as just an exogenous process of knowledge transfer, a strictly imitative process. The art of dealing with diffusion in a proactive manner creating innovative trajectories will be the central role of the RIS in follower regions.

Another specificity of follower regions concerns the preexistent weakness of R&D activities in the business sector and the apparent bias toward public R&D. However, firms must be at the center of an innovation system because innovation is by definition a commercial or business action and because innovation is not just the result of a "linear process" from formal R&D to production. As mentioned above, technological accumulation includes a learning process based on the conduction of productive processes. Thus, innovation policies that present a bias toward public R&D – as they do in follower regions – may have problems of "focus" and a lack of effectiveness. However, building a RIS in a follower region is not simply a challenge of rebalancing resources devoted to R&D between institutional sectors. This aimed rebalance must be seen more as a result than a prerequisite for a successful RIS.

In follower regions, the weakness of R&D in the business sector and the bias toward public R&D activities is a signal of a high degree of disconnection between productive and technological capabilities, whereas the connection between these two dimensions is at the center of RIS in frontier regions. Thus, building a RIS in follower regions is in large part a matter of identifying technological trajectories based on links between the two referred dimensions.

In this process, one set of difficulties can be linked to the technological characteristics of the existing economic activities. Following the taxonomy of Pavitt (1984), if the regional economic structure is based on "supplier dominated" activities, as it often is, technological opportunities created under a demand-pull mechanism will be scarce. In turn, regional economies with a high expression of "specialized suppliers" activities, based on Asheim and Gertler (2005) classification as synthetic knowledge, will be able to generate more technological opportunities and links toward R&D activities and to more technology-intensive activities.

The other set of difficulties concerns the "focus" of public efforts to reinforce the regional endowment on technological inputs (formal skills, R&D facilities, and so on). Firms and institutions have a limited cognitive capability and so cannot simultaneously accumulate knowledge in many diverse fields. This is clearly illustrated by the fact that advanced regions and countries with the same level of human capital and R&D effort present different technological vocations. This need for "focus" clearly applies to follower regions, where technological resources are even scarcer.

Simultaneously, the reinforcement of the regional endowment on technological inputs in follower regions must rely, at least during the initial phase, on public efforts. This public "technological push" needs a clear strategic orientation in terms of intended technological trajectories. This aspect puts regional coordination at the center of a policy aiming to achieve a RIS. Otherwise, under a "bottom-up" impulse originating in public actors such as universities and others, there is the risk of having a set of fragmented initiatives and a lack of "focus" in this process. Nevertheless, this aspect shows that coordination costs associated to innovation policy in follower regions can be high.

In follower regions, the creation of the RIS should rely on a mix of dynamics because it can hardly be supported by a simple model in which endogenous R&D activities are the main driver of the process or by a model centered on existing activities and firms. The taxonomy built by Asheim and Gertler (2005) encompasses the links between the regional production structure, the institutional set-up, and the different patterns of knowledge production evolving in regions (territorially embedded RIS, regional networked innovation systems, and regionalized National Innovation System (NIS); this contribution can be particularly useful to call for more diversified models of RIS, especially if we assume that the three above-mentioned types can be seen as different morphologies and also as components of a more composite process.

The concept of smart specialization was developed for the context of frontier regions but has tentatively been adapted in line with cohesion policy objectives. Smart specialization assumes the need to concentrate resources and distinctively specialized regions in accordance to their potential. Although the polarization argument makes sense, it also creates mechanisms for brain drain and economic crowding-out effects from follower regions to frontier regions. Foray et al. (2009) state that smart specialization should cluster the invention of key enabling technologies in a few regions, whereas other regions should try benefitting from knowledge diffusion and invest in coinventions applied to the existing industry (David et al., 2009; Sandu, 2012). This raises the question of whether follower regions are specializing in domains with less potential for productivity gains and perpetuating divergence toward frontier regions that would then get the lion's share (Arancegui et al., 2011).

As detailed previously, follower regions present structural shortcomings that need to be specifically targeted by public policy. In fact, besides the imbalance or lack of density in the RIS, the poor external perception and the prevalence of market failures (e.g., venture capital) hinder a smooth transition of the smart specialization concept to this reality (Sandu, 2012). Furthermore, some regions are overspecialized and this hampers the ability of creating a related variety of activities and hence building an appropriate ecosystem to coinvent.[1] Consequently, a smart innovation policy must address the creation of the preconditions for the consolidation of the RIS for follower regions to be able to specialize in the future. Also to be considered is not only the present potential, but also the provision of a framework to support emerging domains to reduce the risks of lock-in, with diversification as one vector of policy along with recomposition of the economic and knowledge bases. In this particular regard, we have delved into the case of the Basque country that has a history of readjusting priorities and redefining its specialization pattern to adjust to new paradigms of global competition. In methodological terms, the case of the Basque Country follows a more static approach and takes stock of the accumulated experience on devising innovation strategies and targeting policy tools. We have taken stock of the insights provided by Arancegui et al. (2011) and concentrated our work on operationalizing the concept of smart specialization and propose a framework of analysis to support policy making taking into consideration the case of follower regions.

4. RIS 3 in practice: the case of North region

Operationalizing smart specialization and elaborating regional innovation strategies is a particularly challenging exercise. The blurriness of the concept is the first difficulty policy makers face and although the authors state the importance of the exercise in the case of follower regions being an "entrepreneurial discovery process", the coordination and even a "push" from the regional development agencies is necessary.

The second major difficulty is related to the practical method of diagnosing a region's potential, how to design policies in accordance with the RIS3, and how we can create a system of indicators and milestones that are adequate to monitor the outcomes of a smart innovation policy, that is, a structural policy with long-term effects not visible in the short term. This article aims to contribute to the first two of these issues and focuses on how to evaluate a region's potential and identify the smart specialization domains and how to design innovation policy that can implement the strategy in the context of a follower region.

As stated, smart specialization evolved from a sectorial perspective (vertical perspective) to a domain perspective (combination of vertical and horizontal perspectives). In the latter, a combination of technology and market-related activities (Iacobucci and Guzzini,

[1] The case of Algarve, for example, an overspecialized region in tourism is paradigmatic of regions with structural imbalances so severe that without a public push to recompose regional assets and knowledge bases, smart specialization in its purest assertion would imply reinforcing this lock-in.

2016) along with institutions explore inter and intra-spillovers, creating the necessary "biodiversity" that mutually reinforces their competitive advantages. The domains must be identified based on:

(i) the existence or possible creation of an adequate scale of technological and nontechnological resources and assets: smart specialization is based upon the principle that regions should target technology trajectories and economic growth paths anchored in their own assets. However, the ability to build on those assets depends on their capacity to generate differentiation; otherwise, as globalization demonstrated, the price of resources will be the only determinant of the competitiveness of a region. In this first dimension, we must assess and map the existing resources and assets (human capital natural endowments) and their degree of inimitability and nontransferability. In the former case, we must consider if these assets can actually sustain differentiation and is not simply replicated elsewhere with cost advantage (if imitability is easy, there is no advantage in holding these specific resources). In the latter case, we are looking for assets that are embedded in the territory and hence are not easily dislocated to another region. Again, the same rationale applies. If it is easy to relocate, then the sustainability of those assets within a region is very susceptible to factors such as cost.

(ii) the evaluation of the potential to develop a set of related (in technology and/or market) economic activities that integrate those resources and assets to produce innovative goods and services and construct competitive advantages. In this regard, it is important to evaluate the existing economic structure and its alignment with the valorization of the mapped resources in (i). The key issue is to understand if the economic structure can sustain a technology trajectory that integrates those resources and assets and introduces innovative products and services hence, designing a steeper growth path. The successful integration depends not only on the renewal of the economic structure to which entrepreneurship is a central element, but also the development of collective entrepreneurship actions that, in a context of numerous micro firms, brokers and integrators can be incorporated to assist in the variable geometry aggregation of production capacities to leverage the response to market opportunities.

(iii) the alignment with international demand trends, which are determinant of the feasibility of each domain as one of smart specialization. This allows the matching of a static diagnostic perspective with a prospective exercise and evaluates the rationale of the "exit strategy". In other words, the specialization strategy based upon resources and assets and the economic structure (existing and potential) must be compliant with the global macro-trends, otherwise, it faces a serious risk of being unsuccessful.

The following scheme aims to illustrate this rationale.

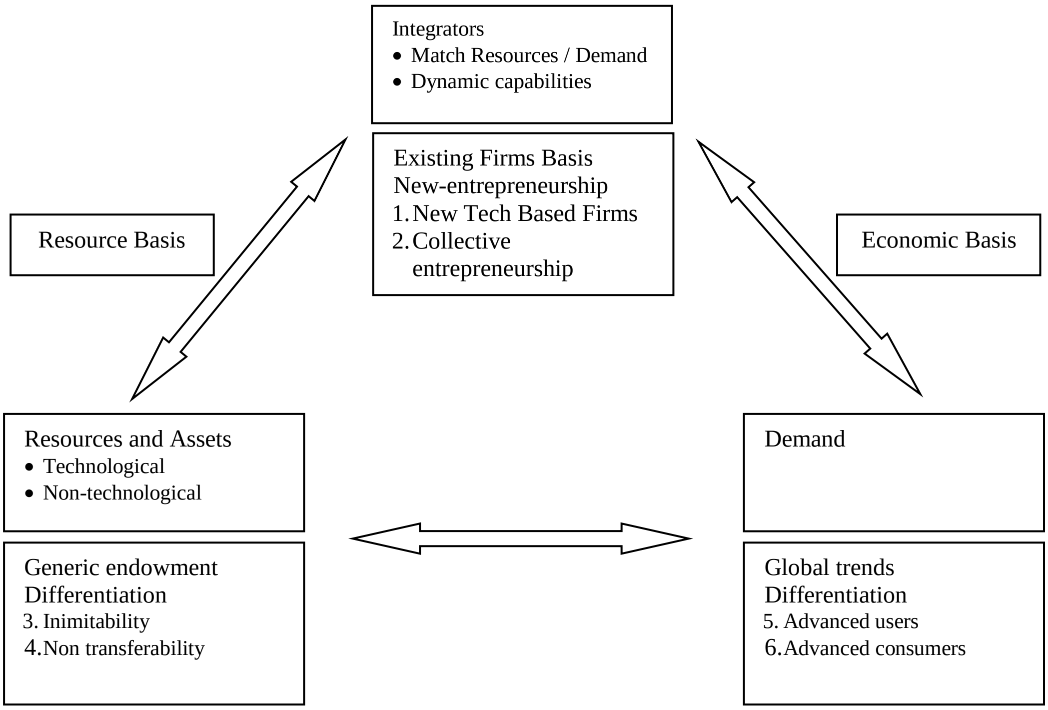

Figure 1. Operationalizing Smart Specialization.
Source: authors' own elaboration.

Relatedness and connectedness are underlying elements of Fig. 1 to ensure a full exploitation of the knowledge bases and of intra- and inter-sectorial spillovers. In a globalized economy, value chains are international and regional innovation policy must signal and foster the internationalization of the RIS. Regarding resources and assets, each region must identify its distinctive potential and how this can translate into innovation. In operational terms, this poses challenges in creating a unified operational framework that can better handle both technological and nontechnological resources and asset-based domains. Technological resources and assets, in turn, can be proxied as human capital, scientific publications, and infrastructures (Lorentzen et al., 2011). Patents could also be considered, but the time lag associated, the sectorial bias, and the relative low patenting propensity in "follower" regions, makes it a less interesting indicator.

We further need to evaluate their degree of inimitability and transferability to conclude the sustainability of its domain even as focusing on niches where regions may build a distinctive competitive positioning and be able to compete on retaining and integrating those assets. In the case of nontechnological resources and assets, these are endogenous and thus inimitable and nontransferable by nature. Some examples are natural resources (e.g., oil and gas) and cultural resources (symbolic capital associated with, e.g., UN World Heritage Sites). Integrators combine and convert those resources and assets into innovative tradable goods and services, aligned with demand and the ability to build competitive advantages and gain control over the value chain. Integrators are a relevant part of this framework not only because they are the core of the innovation system, but also because they provide the matching between resources, assets, and demand. In this case, we must not only account for established sectors, but also for the possibility of emerging ones. The appeal to concentrate funding and further focus innovation policies should also be flexible enough to assume risks and launch "wildcard" domains.

Finally, demand is relevant to determine whether the chosen specialization domain is feasible. When evaluating each region's potential, regions may conclude that although there are resources and assets and possible integrators to innovate them, they are misaligned with international demand. If the domain is not feasible, public policy must act to recompose the resources and assets, and induce structural change in integrators.[2] The way to proxy demand, and hence also a big part of the prospective purpose inherent in the elaboration of a regional innovation strategy of smart specialization, requires different approaches when analyzing domains of specialization based on technological and territorial assets. In the case of the former, the presence and connectedness to advanced users is relevant. Advanced users are of utmost importance because they contribute to the definition of the trends for global demand and translate it into technological challenges to be addressed. Proximity demand is important to better understand these new trends and take advantage of possible first mover advantages. In the case of nontechnological domains, some advanced users can be relevant but other factors are also determinant in defining international demand. In the next section, we present two applications to the North region, one based on a technological domain (Health and Life Sciences) and the other on natural resources (Symbolic Knowledge and Tourism).

The above framework devises the space for innovation policy intervention with both acting on the three vertices and on fostering the interlinkages amongst them. For instance, innovation policy can reinforce or stimulate the recomposition of the knowledge base when it

[2] The North region, for example, had significant low-qualified persons that sustained a low-wage economy with low levels of innovation and value chain control. Nowadays, with the lowering of trade barriers to China, the Demand for Portuguese products based only on cost is residual and such a strategy imposed a structural change process.

is misaligned with integrators and demand. On the other hand, innovation policy can promote structural change and the emergence of a new sector when regions have resources and assets on which it is possible to build a related variety of globally competitive economic activities that respond to demand opportunities. In the context of a follower region, public interventions are more pressing and broader to suppress bottlenecks and promote structural adjustment processes. In some cases, it is necessary to develop a completely new breed of entrepreneurs (e.g., deploying entrepreneurship support programs) and attract multinational companies to speed up the process. In other situations, public policy may only be needed to reinforce the matching quality between resources and assets and the economic structure. In some cases, the advanced user can also be targeted by innovation policy either by attracting a player that can generate a demand pull on both of the other vertices, or by directing public procurement when that advanced user is internal (e.g., Health System).

Nevertheless, there are some important issues to be dealt with when designing public policy. Firstly, it is important to avoid the temptation of a radical shift in policy every time a new planning framework is proposed. Many of the ongoing policies have long-term outcomes and their structural nature implies that results are only visible with a significant time lag. Persistence and coherence is important to produce results and this is a risk that policy makers must bear in mind. Secondly, smart specialization implies picking winners. Although regions can devise a strategy that diversifies its strategic bets and hence the risk of lock-ins, smart specialization implies establishing preferences and incentive schemes that favor some domains over others. This may generate pernicious crowding-out effects and also introduce rigidity in public policy. Innovation is about novelty and underlying it is uncertainty; therefore, innovation policy cannot be forged so definitely and the incentive schemes must allow for wildcards (emerging areas where some support is advisable).

In the next sections we apply our framework to the case of the North region, presenting the cases of two possible specialization domains based on technological (Health and Life Sciences) and nontechnological resources and assets (Symbolic Capital and Tourism).

4.1 Health and life sciences

To determine the North's potential smart specialization domains based on technological resources and assets, we must evaluate their focus and match them with existing and possible integrators to see how domains respond to international demand. Applying the framework of Fig. 1, we must first have a global view of the potential match and critical mass between human capital, R&D capabilities, and the economic structure. The crossings with highest potential of connection constitute core elements of possible smart specialization domains.

We first started by measuring the human capital created in the North region in the last 10 years. Considering the number of graduates of The International Standard Classification of Education (ISCED) levels 6, 7, and 8, and multiplying them by 1, 2, and 3 and clustering in accordance to the classification of the Portuguese National Science Foundation (we partially reproduce the results in the columns of Fig. 2) gives us an overview of the preconditions to innovate. Human capital is a core ingredient for R&D capabilities and the ability to connect and absorb knowledge from other innovation systems. We then analyzed the economic structure and characterized the value added generated by each sector (reproduced in the lines of Fig. 2).

Finally, we tried to evaluate the degree of matching and the potential articulation of the base and integrators of available resources, ranking them by intensity (the darker areas are the ones with higher potential of combination). Among the set of darker areas it becomes evident that Health and Life Sciences have a significant overrepresentation from the resources and assets in relation to the economic activity (mostly characterized by medical care hospitals and clinics). Hence, the North may present opportunities of developing a competitive Health and Life Sciences entrepreneurial system despite its current shallowness.

Table 1 not only contributes to identifying nodes of the innovation system, but also highlights some potential interconnection amongst different sectors (Iacobbucci and Guzzinni, 2016). Health and Life Sciences was selected as one potential case because of the massive accumulation of resources and the significant presence of advanced users, despite a less significant entrepreneurial base. Next, following the framework proposed in Fig. 1, we further develop this exercise for the case of “Health and Life Sciences”.

	Scientific area (%)												
Sector (%)	Agricultural sciences, 2.1%	Life, earth and environment sciences, 6%	Civil engineering, 4.3%	Creative, 5.5%	Energy, 0.4%	Physics and mathematics, 2.3%	Food engineering, 0.5%	Fashion, 0.4%	Materials, 0.6%	Metallurgic and mechanical, 3.8%	Chemistry, 3.9%	Health, 15.8%	ICT, 8.5%
Agriculture and fishing, 0.9%	H	H			M		H					H	L
Food industry, 3.8%	H	H			M		H			L		H	L
Fashion, 8.6%				H	M			H	M	L		L	L
Forest industries, 2.4%	H	H	M		M								L
Chemicals, 0.8%					M						H		L
Rubber and plastics, 2.1%					M				H		H		L
Nonmetallic minerals, 1.3%			H		M								L
Metallurgic and metals, 4.3%			H		M					H			L
Machinery and equipment, 3.8%					H	H			H	H			H
Automotive and components, 1.6%					M	H			H	H	H		M
Furniture and mattresses, 1.2%				H	M				L	L		L	L
Energy, 3.6%		L	M		H	H				M	H		M
Construction, 15.6%			H	H	H				H	M			L
Information and communication activities, 2.1%				H	M	H							H
Consulting, 4.9%					M	H							H
Administrative activities, 4.3%					M								H
Health, 7.8%					M		M	M	M			H	M
Creative activities, 1.8%				H	M			H					H

Table 1. Matching quality of resources and assets and the economy. Notes: Joint / connection intensity: H = high, M = medium, L = low. Sources: Authors´own elaboration based on INE and MCTES.

Stage 1: Resources and assets

At this stage, an in-depth analysis of resources and assets and on the existing or possible related variety of economic activities is necessary to validate the region's potential. Besides this, it is crucial to analyze international trends and understand how the region's innovation system on the domain of Health and Life Sciences can construct competitive advantages and respond to those market opportunities. We started by fine tuning the previous analysis and evaluating the representation for core areas of research in the region. In the case of the North, there have been 7,000 graduates per year in science, technology, engineering, and mathematics (STEM) and 1,500 Ph.D. degrees in the last decade. Also relevant is the human capital created in Health and Life Sciences that has also reached near 7,000 graduates per year and 965 Ph.D. degrees in the last decade. Hence, there are relevant flows of human capital and an increasing stock that can support innovation. However, smart specialization is about focus, which implies the identification of specific areas/niches. We do that by comparing publications in this domain and we noted Health and life Sciences registered the highest annual growth rate, namely in oncology, neurosciences, tissue engineering, and advanced bio-materials and molecular biology.

Stage 2: Integrators: related variety

This stage concerns evaluating the existence of a related variety of economic activities and/or trying to identify the potential to reinforce entrepreneurial activity. We focused on assessing possible inter- and intra-sectorial linkages that could be related to a variety of activities to integrate the different knowledge bases in the region and produce innovative goods and services. The North region economy is predominantly characterized by low knowledge intensive industries and services, even as companies present a low level of Ph.D. degrees (6.5% in total employment and in Holland the same figure reaches 30%). The Health and Life sciences entrepreneurial sector is quite shallow apart from some reference players and medical care units. Hence, the region must evaluate whether the resources and assets can support the expansion of that economic basis and be competitive globally.

Stage 3: Demand: advanced users and global trends

Advanced users are active agents in the innovation process and express the international demand trends that need to be considered when evaluating the formulation of a specialized domain and its feasibility. Advanced users are also able to translate the opportunities into technological needs for developing knowledge and innovations. Advanced users can be firms or institutions that have a high consumption potential of the knowledge and innovation created. The target is to stimulate a specialization pattern focused on developing an associated economic fabric that caters to these needs.

In the case of Health and Life Sciences, advanced users could be the Health Care Systems (public and private) and families, thereby creating the opportunities for specialization of the entrepreneurial base of the regional economy and the focus of resources and assets. Among the dominating trends is the need to reduce the cost of the health system (estimates for the U.S. indicate that by 2030 it will absorb 25% of GDP). Ageing population is also a trend that creates the need for longer health care and the opportunity for the development of ambient assisted living technologies for remote monitoring of patients/elderly people. Electronic Health is another trend that can potentiate the link of ICT companies with the Health System. Finally, regions should try to be aligned with Europe's 2020 targets as smart specialization must also address the societal challenges that EU has stated in Horizon 2020. Fig. 2 summarizes the analysis for the Health and Life Sciences domain.

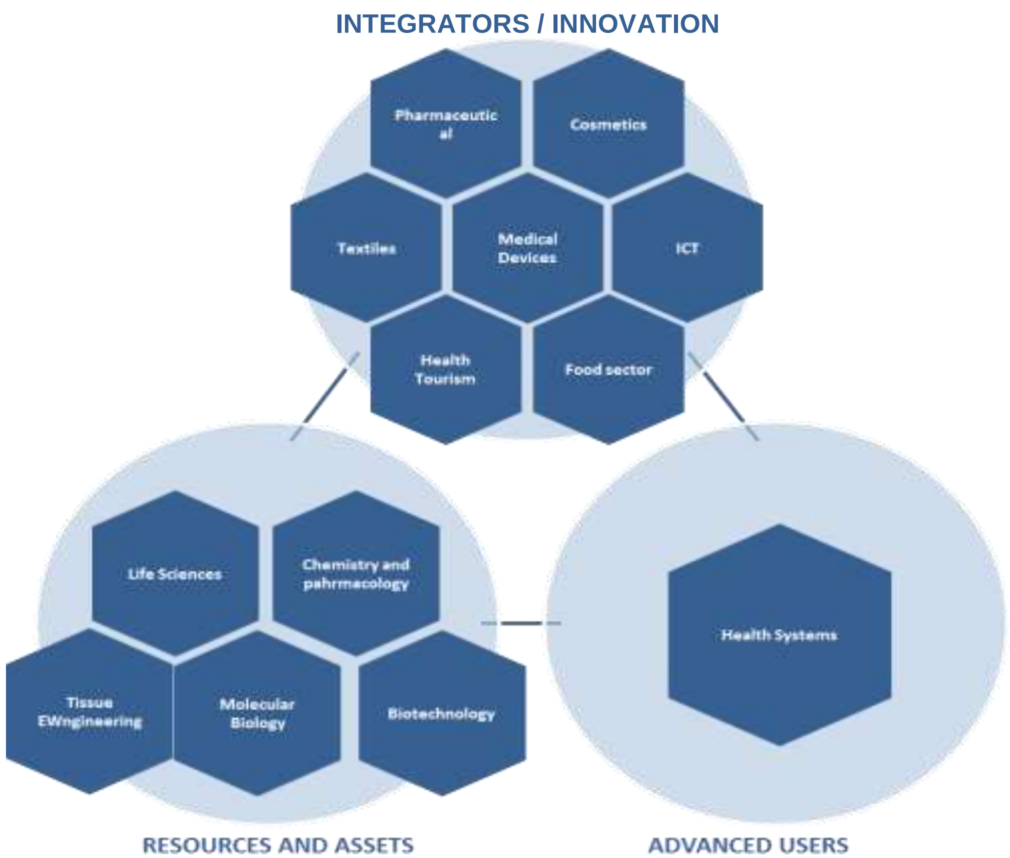

Figure 2. Priority Domain "Health and Life Sciences"
Source: authors' own elaboration.

The above figure represents the assessment exercise for Norte region and a potential specialization path on Health. On the lower left corner, we have compiled information on the existence of technological resources, identified, and fundamental to support innovation in the medical technologies manufacturing. In the upper level, we represent the economic structure. This economic structure highlights the existing sectors and the potential to integrate knowledge to produce medical devices and medical technologies. The right bottom part is identified as the Health Care System as a major advanced user. Considering the yearly expenditure on health services, the Health Care System represents a significant potential client that can induce innovation and the accelerated development of the entrepreneurial ecosystem dedicated to health technologies.

To better enlighten the above scheme, we provide an example of this triangle and the possible role of innovation policy. Recently, a consortium of R&D units specialized in oncology was formed. These consortia gathered about 600 researchers with relevant publishing backgrounds and international recognition. This new consortium just signed an agreement with the Portuguese Oncology Institute to create an Oncologic platform that links the latter (an advanced user) with the resources and assets toward developing new therapies, thus increasing efficiency and providing an adequate institutional playground for cooperation. However, as stated, the entrepreneurial base is shallow.

Public policy makers must, therefore, decide whether this is a domain for specialization. If so, target policy tools are needed to either attract multinational companies to explore the innovative milieu for cancer research or implement oriented entrepreneurship programs to enlarge economic activities. This would also support the increase in R&D capabilities within these areas of research aided by the intervention of the Portuguese Health System; Electronic Health is another opportunity. The region has relevant resources and assets in ICT and an emerging economy. An innovation policy could support hospitals to (i) generate public procurement for a common technologic solution, (ii) support the growth of ICT companies, (iii) reinforce internal human capital as well as support R&D with resources and assets to do applied research for the system architecture and operations mode, and (iv) for the development of complementary electronic solutions. This could also support coinventions in other sectors such as textiles through, for example, intelligent fabrics or equipment manufacturers for creating inventive gadgets.

4.2 Symbolic Capital and Tourism

Smart specialization was conceived for frontier regions that should develop. For that, we consider Table 1 a good starting point to assess a region's potential for smart specialization; however, these analysis only captures technological capabilities. Here is where smart specialization presents shortcomings in its original formulation. There are regions where competitiveness is founded on endogenous resources and assets (natural and cultural) and where overspecialization also hampers any attempt to apply smart specialization (e.g., Algarve). These resources and assets cannot be replicated elsewhere and have the properties of inimitability and nontransferability. This evaluation implies a practical adaptation of our framework and is presented in the following analysis.

Stage 1: Resources and assets

As stated, in this case, resources and assets are nontechnological but are natural or cultural. Hence, geographic position, the existence of inbound-outbound infrastructures, tradition and cultural richness, and diversity create the appeal of a destination and position a region in international tourism. To exemplify some of the most important resources and assets of the North region, we present the case of the Douro Valley. The Douro Valley is a secular man-made terraced construction that created a unique landscape of the nature and history associated with the development of winemaking. The classification as a UN World Heritage site (the North region has four areas thus classified) gives proof to the uniqueness of the Douro Valley and the "glamour/pedigree" of this area. This is not only about nature or winemaking but the symbolic capital in its entirety that created a unique feature for the North Region.

Stage 2: Integrators: related variety

Tourism is by itself a related variety comprising varied activities. In the case of the North, there has been a significant increase in aerial services, and hotel and restaurant offerings. The offerings, however, are still fragmented and lack the coordination of agents to potentiate synergies. The link with less "core activities exists, but could be extensively explored. It exists in the case of winemaking but could be much further extended toward the development of other agro industrial products and "cultural" foods. Another possibility is the promotion of medicinal waters, which could also contribute to the development of the cosmetic industry (as in France with Vichy). Besides that, it is important to stress the possibilities for the development of other activities such as, among others, niche shipbuilding, tailor made IT solutions, mobile apps and architecture, and urban planning.

Stage 3: Demand: advanced users and global trends

Similar to all domains and in the case of Symbolic Capital and Tourism, what determines demand is feasibility. However, unlike more technology-based domains and for Symbolic Capital and Tourism, advanced users may not express the full set of demand trends. In this case, although the proximity to advanced users is relevant, the analysis must take into account international players and the emergence of new touristic trends; for instance, a trend associate with globalization of medical care arises not from advanced users in the traditional tourism industry, but from the financial collapse of health systems in the western world, the inability to cater to national population needs, as well as the need to obtain revenue to support it. Hence, we reproduce Fig. 2 to this potential priority domain for the North Region.

Figure 3 summarizes the application of our framework to devise smart specialization domains based on nontechnological resources and assets.

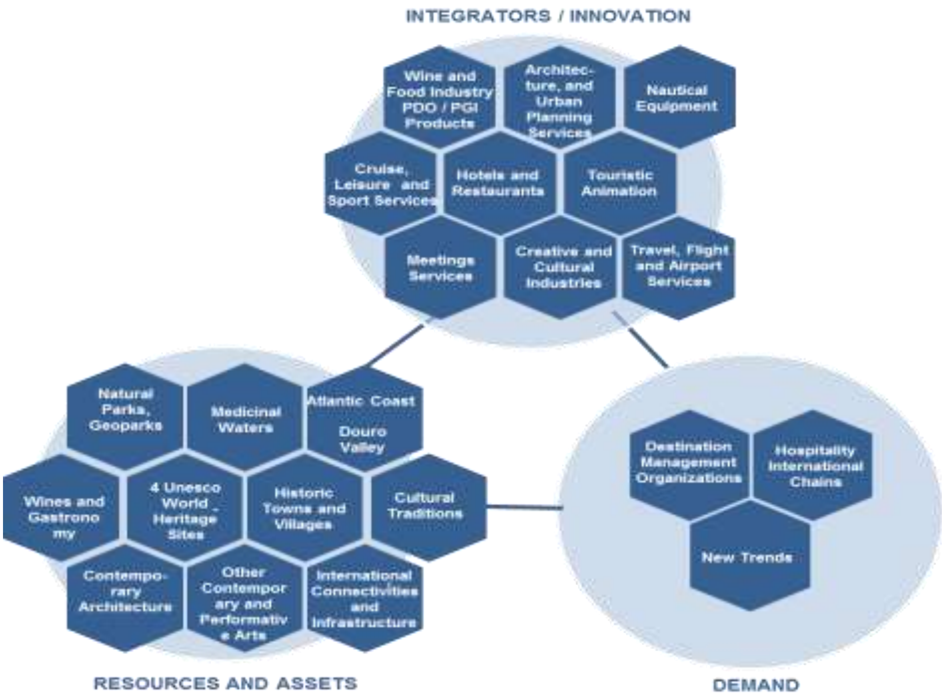

Figure 3. Priority Domain "Symbolic Capital and Tourism"
Source: authors' own elaboration.

5. Concluding remarks

The smart specialization concept is a different shade of the RIS concept that highlights the importance of focus of innovation policies on the areas with larger potential. Despite its conceptual blurriness, it is clear that at most smart specialization is an incremental innovation and that the concept was forged for the reality of frontier regions. The case of follower regions imposes additional difficulties that policy makers must tackle besides the ones resulting from the lack of a consolidated theoretical and methodological referential that could support implementation in practice.

Smart specialization in practice is still a highly complex and daunting task. As demonstrated, practice is, in this case, way ahead of theory and so policy-makers have been dealing with the issue of trying to implement a new paradigm without it being fully defined. Considering the new paradigm for Cohesion Policy, we research on the concept of smart specialization, proposing a theoretical framework to help clarify the objectives of smart specialization, namely its transformative character, and a methodological approach to identify and select the thematic priorities. In this article, we propose a framework of practical analysis. Firstly, smart specialization is about choices and the focus of resources in domains (multisectorial and multi-institutional). The idea of concentration aims to ensure an adequate scale (critical mass) to base the development of a related variety of activities. Secondly, smart specialization must focus on the idiosyncrasies of regions. Given that innovation is a contextual process, smart specialization strategies can only be defined at a regional level. Thirdly, these strategies must focus on domains upon which regions can construct competitive advantages internationally. Finally, smart specialization is also about connectedness because linking to other knowledge bases and being integrated in international value chains is fundamental to improve a region's ability to innovate and grow.

Thus, we concentrated our work in operationalizing the concept of smart specialization, proposing a framework of analysis to support policy making and taking into consideration the case of follower regions. The structural debilities and market failures, alongside with undergoing transformational processes increase the challenge. As addressed in the article, the application to Norte highlights that a smart innovation policy must address the creation of the preconditions for the consolidation of the RIS for the follower regions to be able to specialize in the future. It has also to consider not only the present potential, but also provide a framework to support emerging domains, reducing the risks of lock-in, with diversification as one vector of policy along with recomposition of the economic and knowledge bases.

Nevertheless, there are still empirical and methodological limitations to this article regarding a unified methodology to analyze technology and nontechnology-based domains. We will attempt to minimize these problems as well as increase the theoretical robustness and the application richness in in the following versions of this article.

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