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Fostering regional innovation, entrepreneurship and growth through public procurement

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Abstract

RIS3 is a policy initiative aiming to achieve structural change. Structural change needs to consider the processes and means through which (innovation) policies can facilitate a radical transformation by substantially changing a regional economy's competitive bases. In this paper we are interested in studying how certain policy instruments are actually implemented, and how the capabilities requires for their effective rollout are built in practice. In particular, we focus on public procurement as a policy instrument that can foster regional innovation, entrepreneurship and growth, while also transforming the industrial structure of a territory.

The rationale for focusing on public procurement is threefold: (i) despite been identified as one of the relevant policy instruments to implement RIS3, little is yet known about how public procurement can be used for higher-order political purposes such as innovation-based diversification and transformation; (ii) public procurement remains an underexplored policy tool in sub-national innovation strategies; and (iii) public procurement links to the two key concerns of RIS3, namely, policy prioritization and the entrepreneurial discovery process.

The paper provides evidence on two public procurement initiatives in Galicia (Spain), one in health and the other in unmanned aerial vehicles. We adopt a mixed-method approach, relying on a qualitative exploration of the factors leading to the institutionalization of public procurement in policy-making. Our results evidence that innovation-oriented public procurement has the potential to develop local priorities and strategies while also creating the necessary capabilities on both supply and demand. As a result, it can lead to the territorial transformation and to the emergence and further development of entrepreneurial firms.

Plain English Summary

Public procurement can foster innovation, entrepreneurship and growth while transforming the industrial structure, but... how to implement it for its effective rollout?

Simplified summary of the study and its conclusions

The paper provides the following implications for the practice of innovation policy. For an effective implementation, governments need to adopt a mission orientation that addresses grand challenges and provides directionality to the policy. It is also necessary to mobilize financial resources from supranational, national and regional funds, what requires coordination and multi-level governance. When governments lack previous experience in innovation policy they can conduct trial-and-error experiments that facilitate policy learning and lead to the development of capabilities, both on the demand and supply side. This experimentation should follow open innovation approaches by incorporating end-users, to open up policy definition to societal actors. At the same time, this facilitates the development of early market conversations that help to better frame the policy, institutionalize the policy definition process and gain internal legitimacy. Policies also should seek for creating positive spillovers and knowledge transfer between large and small firms.

Keywords: Innovation-oriented public procurement; Smart Specialisation Strategies; Innovation; Entrepreneurship; Growth.

JEL codes: L38, L52, O32, O38,

1.- Introduction

Together with their policy governance subsystems, national innovation systems provide the framework conditions for innovation policy (Leyden 2016). However, most needs/challenges/problems are locally anchored. Hence, if innovation policy is only framed at national levels, we run the risk of not adapting to local specificities, but rather supporting one-size-fits-all approaches that have a higher chance of failure (Tödtling and Trippl 2005).

The idea of regional innovation policy has become increasingly important in Europe over the last two decades (Zabala-Iturriagagoitia et al. 2008). The European Commission's agenda for Research and Innovation Strategies for Smart Specialisation (RIS3) (European Commission 2011) is the latest example of initiatives seeking to empower regions to define their own policies and strategies. The core aim of the RIS3 is to help regions to develop new specialization horizons by departing from existing capabilities. This should be achieved while ensuring that priorities are not duplicated Europe-wide, and that the potential for complementarities across the European knowledge base increases (Foray et al. 2009, p. 20).

The governance model set up by RIS3 envisages the building of interactive processes and structures in which all relevant regional stakeholders participate in the definition and design of policy content and context. The public sector assists regional stakeholders in the identification of priorities throughout the RIS3 process. At the same time, it looks to boost connections among them to define long-term political goals through 'entrepreneurial discovery processes' (Foray 2014) in which entrepreneurs are able to identify what opportunities are available in order to act and thus fill those gaps (Rosiello et al. 2013). RIS3 does not, however, simply aim to support transformation through regional diversification. It also aims to link innovation promotion activities with existing research and development (R&D) and science and technology capabilities, which may be spread across traditionally close or distant areas and actors on both the supply and demand sides, to derive a set of key strategic sectors for the development and sustainability of socio-economic goals. RIS3 is an example of mobilization of regional capabilities intending to articulate the demand and define directions for the region. RIS3 can thus be seen as a strategic innovation policy initiative (Grillitsch et al. 2019) aiming to achieve structural change in innovation systems.

According to Kaloudis et al. (2005), effective structural change processes should address contexts of falling employment, as this employment should be replaced by the growth of new innovative firms in their respective market segments. However, structural change cannot only be understood as a gradual evolution in which small – entrepreneurial – firms grow and large established firms are replaced. It is also necessary to consider the processes and means through which (innovation) policies can facilitate a radical transformation by substantially changing a regional economy's competitive bases. At the same time, policies for transformative change (Fagerberg 2018; Schot and Steinmueller 2018) require more targeted or selective process-oriented interventions, broader and more complex instrument portfolios, and more inclusive and multi-level governance arrangements that urge the public sector to continuously develop new capabilities to foster territorial innovation (Trivellato et al. 2021). The key question lies in how to

undertake these endeavours, namely, how to develop new capabilities in the public sector, how to select interventions, how to implement increasingly complex instrument portfolios and develop more inclusive and multi-level governance systems.

From these multiple research gaps, in this paper we are interested in studying how certain policy instruments are actually implemented, and how the capabilities required for their effective rollout are built in practice. In particular, we focus on public procurement as a policy instrument that can foster regional innovation, entrepreneurship and growth, while also transforming the industrial structure of a territory.¹ The rationale for focusing on public procurement lies in the fact that, despite been identified as one of the relevant policy instruments to implement RIS3 (European Commission 2012), little is yet known about how it can be used for higher-order political purposes such as innovation-based diversification and transformation (Uyarra et al. 2020).

The use of public procurement has been associated with a number of benefits in relation to innovation. First, it may provide a 'lead customer' or a 'lead market' for innovative goods/services/processes (European Commission 2007), simply because the main role of public procurement is to purchase 'something new' (see Edquist and Zabala-Iturriagagoitia 2021). Furthermore, 'lead customers' also create substantial economic gains by adopting those new technologies or products in the early stages of their development that are ahead of the current market demands. Public procurement contracts also incentivize the development of new technologies and applications, some of which may not be granted through R&D subsidies and schemes. Procurement may 'legitimize' product standards, creating new markets or expanding existing ones (Uyarra et al. 2020), contributing to the acceleration of technological development as well as its adoption, and leading to potential changes in the economic structure. Summing up, innovation-oriented public procurement (PPI) can play a significant role in the creation of an innovation-friendly climate, generating the necessary systemic conditions to foster the dynamic formation of new markets and their further development (Mastroeni et al. 2013; Mazzucato 2018), with its consequent effect on the potential for transformation of a territory.

The paper is based on a case study in the region of Galicia (Spain). This area was selected for the experience it has gained in the articulation of regional diversification through PPI. This case helps us to address the previous research question, illustrating how PPI has the potential to develop local priorities and strategies while also creating the necessary capabilities on both the supply and demand sides. The paper adopts a mixed-method approach, relying on a qualitative exploration of the process followed in Galicia to institutionalize PPI in its policy-making. The results are shown in the form of narratives, which are gathered from a set of semi-structured interviews with regional stakeholders and from the analysis of policy documents and other written material from the websites of public institutions and government reports.

The remainder of the paper is structured as follows. Section 2 presents the state of the art. First, it introduces the rationale, process and challenges associated with regional

¹ In the context of this paper, and following Schot and Steinmueller (2018, p. 1562), territorial transformation is understood as a process that requires "radical change in all elements of the configuration".

development strategies, focusing in particular on the relevance of RIS3, and the potential role of PPI. Then, it also provides the main characteristics and challenges associated with PPI. Section 3 presents the context in which the research has been conducted as well as the methodology used. Section 4 illustrates how PPI can support regional innovation and entrepreneurship. On the one hand, it shows the results observed in two cases in Galicia, one in health and the other in unmanned aerial vehicles. On the other, it provides an interpretation of the insights and findings that are drawn from the previous cases. Finally, Section 5 draws the implications of the paper, both for theory and for practice, also pointing to potential further research areas related to innovation policy-making.

2.- State of the art

2.1.- RIS3: fostering regional entrepreneurship, innovation and diversification

Support for regional innovation policy has significantly increased in Europe over the last two decades, encouraged by devolution processes and the rise of spatial innovation approaches (Zabala-Iturriagagoitia et al. 2008; Doloreux et al. 2019). Indeed, systemic innovation approaches developed in the 1980s and 1990s have been highly influential in innovation policy thinking (Miettinen 2002). In the last decades of the 20th century, there was a growing concern on the development of new technologies and how their application could increase productivity. The search for solutions to incorporate technological innovation into industrial policies led to an extensive literature that became labeled as innovation studies (Martin 2012), headed by scholars such as Freeman (1987), Lundvall (1992), Nelson (1993), or Edquist (1997), among others. The innovation systems' approach also emphasized the value of interactions as a determining factor of innovation, and the role of institutional settings in shaping innovation paths. Summing up, the innovation systems' approach has been used as a tool to analyze and compare innovation processes at different levels of aggregation (i.e. national, regional, sectoral), identify systemic failures, and define policy interventions targeting these (Edquist 2011).

In parallel, and as a result of the increasing claims made in the literature about the need to define and implement policies in multi-level settings (Laranja et al. 2008), we have witnessed a progressive shift from spatially blind innovation policies to place-based innovation policies, not just in theory but also in practice (Barca et al. 2012). As Hajer and Wagenaar (2003) note, the topography of policy-making has changed with the emergence of new spaces for policy design and formulation (i.e. networked governance). They discuss how policies are like a "matryoshka" (p. 8) in which lower levels of government fit within higher ones.

The EU Research and Innovation for Smart Specialisation Strategies initiative – better known as RIS3 – has become the cornerstone of current regional policy thinking in Europe (Foray 2013). One of the main rationales behind RIS3 is to improve the coordination of research, development and innovation efforts, so as to help reduce redundant duplication and enable the development of thriving regional innovation systems (Mastroeni et al. 2013, p. 9). This represents a shift in regional innovation policy thinking from the predominant 'regional innovation systems' approach (Cooke et al. 1997) towards a view more rooted in industrial policy thinking (Hausman and Rodrik

2003; Aiginger and Rodrik 2020). RIS3 strategies are defined along these lines (European Commission 2011, p. 7 – the bold characters are ours):

*“smart specialisation is about placing greater emphasis on innovation and having an **innovation-driven development strategy** in place that focuses on each region’s **strength and competitive advantage**. It is about **specialising** in a smart way, i.e. based on **evidence and strategic intelligence** about a region’s **assets** and the **capability to learn** what specialisations can be **developed** in relation to those of other regions”.*

The RIS3 approach aims to encourage regional actors to move away from setting obvious but perhaps unrealistic high-tech priorities and ‘picking the same winners’ (Mazzucato et al. 2020), towards a strategy focused on identifying distinctive specialisation paths (Moodysson et al. 2016) which build on regional capabilities and strengths. Strategies under RIS3 should take into account the views of various stakeholders, rather than only those of public policy actors.² This new approach shifts from previous ones based on functional and systemic rationales, emphasizing instead the importance of setting vertical and horizontal priorities. Previous policy-led approaches focused on diagnosing and tackling either market or systemic failures (Mazzucato 2016). As Weber and Rohracher note (2012, p. 1037), innovation system approaches emphasize the relevance of improving innovation capabilities – both on the side of firms and in the institutional settings supporting them – but they are less suited for dealing with the strategic long-term challenge of transforming innovation, production and consumption (i.e. transformative change) (see also Leyden, 2016).

Under RIS3, there are future areas of specialization, economic diversification and new path development that remain to be discovered. Policy-makers may find it useful to work with local entrepreneurs who are able to recognize new technologies and innovations that may be/need to be developed due to the existence of locally anchored capabilities (Uyarra et al. 2017). In this view, long-term strategy formulation is largely a question of prioritization that builds on territorial strengths, in which the context, the content and the process of prioritization are important.

RIS3 aims to identify strategic goals for territories. From this perspective, policy instruments are one possible means of reaching these long-term goals. As already noted, PPI is regarded as a potential instrument to implement RIS3. The RIS3 guide identifies some of the main barriers that public actors have to overcome to effectively implement PPI. It also highlights that PPI has the potential to work in RIS3 as a tool for systemic change and transformation, especially in fields in which technologies are in an early development stage and in contexts in which public actors may play a ‘lead user’ role. In order to exploit that potential, the guide suggests that regional governments should have the necessary capabilities to implement PPI.

² RIS3 may be considered a challenge and/or mission-oriented innovation policy (Chiang 1991), since the starting point is given by the selection of the societal (i.e. grand) challenges to be tackled (Mazzucato 2018). Note that mission-oriented policies and those oriented towards grand challenges are not necessarily the same (e.g. defense policies are mission-oriented but not oriented to grand challenges).

However, beyond the above, little explanation has been offered as to *how* PPI links to the two key concerns of RIS3, namely, policy prioritization and the entrepreneurial discovery process, as means to reach transformative territorial effects. In addition, there is little evidence of its use as part of regional or local development strategies, which is a gap we help fill with this paper. Moreover, PPI is not necessarily seen as a straightforward instrument by regional policy-makers (European Union 2016). It can involve high implementation costs for regions with no previous experience, and most regional actors continue to have a limited view of how this approach could benefit local supply, even if (often) not in a direct way. As a result, public procurement remains an underexplored policy tool in sub-national innovation strategies.³

2.2.- The potential of PPI at the regional level

Public procurement is estimated to account for roughly 15-20% of GDP in developed countries. There are also clear differences in the level of procurement spending by regional and local governments. While in countries like Belgium, Spain or Italy, around 90% of procurement spending is executed by sub-national governmental levels, in Norway, Estonia, Great Britain, Luxembourg, Portugal and Ireland, the lion's share of this spending is shouldered by the national government (OECD 2017).

Despite the new policy rhetoric related to PPI that has emerged in the last two decades, particularly in Europe, this is mostly conceptualized in terms of short-term efficiency gains. As discussed by Lember et al. (2015, p. 404), governments mainly attempt to make the process of public procurement more innovation-friendly, but do not acknowledge the wider role public procurement can play in long-term structural change. Nevertheless, PPI can have a transformational role (Neij 2001; Uyarra and Flanagan 2010). The potential of PPI for prioritization is higher than other traditional R&D and innovation instruments, as it necessarily implies a proactive process of prioritization linked to certain public needs, which is less directly achievable with the implementation of supply-oriented measures. At the same time, RIS3 aims to reinforce the system as a whole, which can also be attained by using PPI as a generic process (Borrás and Edquist 2019). In particular, PPI helps overcome demand articulation failure, which reflects public bodies' deficiency in anticipating and learning about (user) needs (Weber and Rohrer 2012, p. 1043).⁴

PPI can be characterized not only as a process but also as an interactive learning space. This is owing to the fact that interaction between procurers and suppliers is required to mitigate the potential drawbacks of information asymmetries and to create the conditions for the subsequent development, diffusion and uptake of innovations (Edler and Georghiou 2007), a rationale also shared by RIS3.⁵ Both users and producers need

³ For some exceptions see Kalvet and Lember (2010), Lember et al. (2011), Lehtinen (2012) or Nijaki and Worrel (2012).

⁴ Morgan (2017) considers that PPI is the 'sleeping giant' of regional innovation policy.

⁵ Public procurement directives in Europe have introduced a set of procedures to allow for these interactions to take place: open, restricted and negotiated procedures, competitive dialogues, design contests, and innovation partnerships. See Directive 2014/25/EU on the coordination of the procurement procedures of entities operating in the water, energy, transport and postal services, and Directive 2014/24/EU on the coordination of procedures for the award of public works contracts.

some degree of interaction to face the numerous challenges and risks associated to the uncertainties underlying PPI and RIS3. A culture of risk aversion is frequently cited for the low levels of innovative and proactive supply strategies in the public sector (Dale-Clough et al. 2016). Users' uncertainties are related to the technological characteristics of the products to be procured, their performance, their potential impact on the targeted users, the risk aversion in the definition and the granting of contracts, financial risks, and the organizational and societal risks associated with the procuring organization (ibid). Conversely, producers' challenges are mostly linked to the capabilities required to meet the demands and needs signalled by the public agencies in charge of procurement policies, and the technological challenges related to the performance requirements so as to meet procuring agencies' needs. The communication of these potential needs is another central feature of procurement processes, as it signals both the state and the level of sophistication of the demand (Edquist et al. 2015).

One of the key advantages of PPI is that it leaves room for articulating entrepreneurial discovery processes. As argued by Timmermans and Zabala-Iturriagagoitia (2013), regional institutions can consider breaking contracts down into smaller and more specific lots (i.e. coordinated unbundling) to make them more attractive to local firms and SMEs. As a result, small firms have an opportunity to bid for different portions of a contract (Karjalainen and Kempainen 2008). On the other hand, coordinated bundling can be used when the procurement requires increasing the size of the contract, for example, to benefit from scale or scope economies. This second strategy facilitates the participation of big companies, which are able to undertake large societal projects.

Local sourcing has often been seen as a goal that conflicts with or undermines the innovation potential of public procurement (Mahroum and Al-Saleh 2013). Protectionism and prioritizing local businesses in procurement processes can easily lead to product replication, corruption and irrational investment (European Union 2016). However, as Uyarra et al. (2017) point out, locally anchored procurement does not imply privileging local and/or incumbent suppliers. Along the same lines, McCann and Ortega-Argilés (2013, p. 196) argue that modern innovation policy is rather more a matter of "choosing races and placing bets", and instead of bolstering monopoly-like 'national champions', it is aimed at identifying the technological transitions best suited to the regional context. However, in some cases, the knowledge needed to develop an innovative solution for a problem/need may be linked to already existing regional assets or capabilities. Encouraging early conversations can promote procurers' appreciation of place-specific knowledge assets and expertise so that this knowledge can shape the procurement design and the definition of specifications.

If such assets do not exist locally, then it may be possible to encourage extra-regional conversations that can in turn help upgrade local capacity (Moldogaziev and Resh 2016). Such conversations could improve the likelihood of achieving solutions to existing local problems, while linking existing innovation capabilities to those available in the region (Mason and Brown 2013). Being attractive for global players to enter particular markets and as a site for experimental learning can also benefit the innovation capabilities of territories. Therefore, anchoring supply through procurement might be useful both for

reinforcing capabilities where a region already possesses assets and for developing new assets in the framework of established priorities.⁶

3.- Context and methodology

3.1.- The context

Located in the North West of Spain, Galicia is a coastal region with a clear rural character. Its 3 million inhabitants are highly dispersed across the four provinces (i.e. A Coruña, Ourense, Lugo, Pontevedra). Galicia has three particularities which have influenced its RIS3. First, it is rich in natural resources. As a result, the regional economy has traditionally been based upon SMEs working in traditional sectors such as forestry, fishing, maritime activities and related industries. In 2019, 96.3% of the firms in Galicia had less than 10 employees, and only 78 firms (0.000388%) had more than 500 employees (INE 2020). Second, its population is one of the oldest in Spain, with about 24% of the inhabitants over 65. Finally, the unemployment rate was around 12% in December 2018, despite having risen to over 20% during the years of the last financial crises, between 2012 and 2015 (ibid).

Galicia has traditionally stood out as a leader in health research (i.e. ageing, biomedicine, molecular biology), particularly for the University of Santiago de Compostela (established in 1495). As a result, the University's activities have led to more than 100 academic start-ups in the medical area in the last three decades (Innovamas 2015). This entrepreneurial development is also a result of the lack of keystone organizations (Iansiti and Levien 2004) in the region that could pull the extant research and bring it to the market. These strong science and technology capabilities, together with the regional demographic structure, laid the groundwork for further development of the Galician RIS3, and the decision to focus on health as one of the key priority areas for the region.⁷

Galicia has made extensive use of PPI at multiple levels, such as in the Galician Health system (SERGAS), the University of Santiago de Compostela, and the city of La Coruña (Xunta de Galicia 2011). This interest in using PPI in health was explained by the high demand for health services in the region due to its demography, which could provide an incentive for firms due to the large potential for (internal) growth. As a result, Galicia has been singled out for its effective use of PPI in policy-making.⁸ One of the key reasons why Galicia decided to use PPI was the availability of funding from the European Technological Fund 2007-2013 (see Uyarra et al. 2020). The Technological Fund is included in the wide spectrum of funds available from the European Regional Development Funds (ERDF). It is dedicated to the promotion of business R&D and

⁶ In line with Mahroum and Al-Saleh (2013, p. 323), 'anchoring supply' processes are here defined as the ability to identify and apply external sources of innovation in the local economy.

⁷ See Xunta de Galicia (2014) for a detailed discussion of the diagnosis made during the formulation of the RIS3 for Galicia 2014-2020, in which 10 priorities, grouped into 3 challenges were identified.

⁸ In 2013 the region was recognized by the European Commission as a reference in active ageing. That same year, the SERGAS was given the national award in innovation and design-based PPI (see: <https://www.sergas.es/docs/premioID2013/index.html>). Finally, in 2015 the region received the second European procurement of innovation award (see: http://eafip.eu/wp-content/uploads/2015/06/eafip_Paris_programme.pdf).

innovation, and Galicia was eligible as one of the Spanish territories regarded as 'convergence regions'. Hence, Galicia took advantage of such an opportune moment to focus initially on this policy instrument and gain experience from its implementation.

Due to the experience with PPI processes prior to the establishment of the RIS3, the regional government identified PPI as one of the central means by which the Galician RIS3 could be articulated (Xunta de Galicia 2014). So far, PPI has targeted those regional challenges and priorities related to the health sector, with ageing as the main issue being addressed. However, Galicia aims to become, through PPI, the leading region in Southern Europe in the implementation of new technologies in the field of active ageing and healthy living, and in the promotion of personal autonomy (ibid, p. 105). The purpose of the Galician RIS3 lies in the development of technologies and innovations that can be used not only to satisfy internal market needs but also to be exploited elsewhere. The Galician RIS3 has a clear focus on internationalization, rather than only fostering local economic development.

The Galician region has been chosen as a research setting to conduct the case study for the following reasons. First, it is one of the Spanish regions where PPI has become well established as an instrument for innovation policy-making.⁹ Second, Galicia is a typical peripheral region, which differs greatly from other leading regions in terms of innovation capabilities for policy-making. Peripheral regions are characterized by institutional thinness, and lack of technological capabilities and critical mass. As Sánchez-Carreira et al. (2019, p. 120) point out, "the public sector as a driver of innovation from the demand side might be more crucial in these regions, because the private sector is less dynamic and innovative", and it may therefore "lack the required capabilities to meet public demand" (ibid, p. 125). Having the appropriate institutional settings matters for regional diversification. As a result, peripheral regions usually tend to diversify less than non-peripheral regions (Balland et al. 2019). Third, one of the sectors where PPI has been studied most in the literature is health (OECD 2017). While the Galician government also started experimenting with the use of PPI in health, it showed positive externalities in which the capabilities developed by the public sector have been used to stimulate innovation and entrepreneurship in emerging sectors like artificial intelligence and the drone industry.

3.2.- The methodology

We take a single case study approach (Eisenhardt 1989), which is appropriate in areas for which 'when', 'how' or 'why' questions are being posed, as it is the case here (Yin, 1984). Furthermore, analyzing atypical cases can also help reveal additional information "because they activate more actors and more basic mechanisms" (Flyvbjerg 2006, p. 229), which can later be transferred to other contexts. Methodologically, we adopt a narrative approach (van Eeten 2007), which relies on narratives –arguments– as ordering devices that provide reasons for policy analysis. Narratives help to make sense

⁹ See:

https://www.isciii.es/QueHacemos/Innovacion/Documents/Guia_de_buenas_practicas_en_compra_publica_innovadora_ITEMAS.pdf (in Spanish).

of the factors underlying policy processes and foster critical learning (Arrona and Zabala-Iturriagagoitia 2019).

The paper combines the results of the analysis of policy documents on the Galician RIS3, its regional innovation policy and the context for PPI with a series of in-depth interviews. Initially, we started with desk research, collecting secondary data, checking existing literature, policy documents (e.g. tender calls, laws, plans, white papers, evaluations), and other written material from the websites of public institutions, government reports and brochures from the national and regional government.¹⁰ To support the results of this content analysis and gain knowledge of the different stages undertaken to develop full expertise in the use of PPI, we also held in-depth semi-structured telephone and personal interviews with a range of actors from the Galician region. These semi-structured interviews were guided by a set of questions grouped into three blocks, one on the rationales for the use of PPI, a second one on the factors determining the implementation and consolidation of PPI as a driver of innovation, entrepreneurship and growth, and a last one on the final evaluation and assessment of the results achieved.¹¹

These interviews helped us gather first-hand information on the dynamics and decisions made by local stakeholders, which have led Galicia to consolidate its innovation policy processes, particularly as regards PPI. The literature has extensively addressed the barriers faced by suppliers in PPI processes (e.g. Pickernell et al. 2011; Uyarra et al. 2014; Edquist et al. 2015). Accordingly, given the purposes of the paper, we have focused on gaining insights from the demand side.

Each interview lasted from 60 to 90 minutes and targeted a variety of stakeholders related to innovation policy-making in the region. Each interview was transcribed and sent back to the interviewees for validation, and to help clarify any eventual uncertainties. Following the stakeholder theory (Friedman and Miles 2002), with this diversity of actors, we aimed to get a holistic view of the two initiatives under study to increase the accuracy of the findings. Overall, 13 semi-structured interviews were conducted between April 2018 and March 2019. We adopted a theoretical sampling method, stopping when the interviews ceased to provide additional unknown information.¹² The analysis of the content of these interviews was carried out following the methodology outlined by Ryan and Bernard (2003), and which allows to compare and contrast the content of each interview for theme identification.

¹⁰ These secondary data include: the guide of good practices to stimulate PPI in Galicia (*Guía de buenas prácticas para favorecer la Contratación Pública de Innovación en Galicia*), the initiatives and calls launched by the Galician Innovation Agency (GAIN) on public procurement (see <https://gain.xunta.gal>), the information collected by the Health Knowledge Agency (see <https://acis.sergas.gal>), the definition of the needs targeted by the procuring entities, the early market demands identified in health and in the Unmanned Aerial Vehicles (see sections 5.1 and 5.2 respectively), the questions posed by potential suppliers and the answers provided by the relevant purchasing bodies in the early market dialogues and consultations, and the documents describing the procurement contracts for innovative technologies in the Innovasaúde, Hospital 2050, and the Civil UAV initiatives, among others.

¹¹ Online appendix 1 introduces the questions that guided the interviews conducted during the research process.

¹² Online appendix 2 summarizes the profiles of the interviewed stakeholders.

4.- Regional innovation, entrepreneurship and growth through PPI

This section illustrates the extent to which regional entrepreneurship, innovation and growth can be achieved through PPI by providing evidence from two PPI cases in Galicia, one on health and the other on Unmanned Aerial Vehicles (UAV).

4.1.- Health: Innovasaúde and Hospital 2050

Crisis contexts require innovation and creativity. Back in 2008, Spain was on the brink of a financial crisis that would last for almost a decade. The organization responsible for delivering healthcare services in Galicia is the Servizo Galego de Saúde – Galician Health Service – (SERGAS). The strategic plan of the SERGAS, created in 2009, reflected that innovation was required to be able to meet the needs of the ageing Galician society, among other factors, due to the financial crisis that was about to hit the Spanish economy. PPI was not mentioned in this strategic plan, but key factors for PPI such as innovation in healthcare processes and the need for public-private partnerships were included. The lack of previous experience in the use of PPI prompted the Galician government to conduct **trial-and-error experiments** and test alternative approaches to foster regional innovation through PPI.

“The work on PPI at the SERGAS was designed as an innovation platform whose goal was to generate an innovation ecosystem. The platform included a group of 3-4 technicians with different backgrounds who channelled the proposals that were collected from the hospitals, which included technological, teaching and research-related and sanitary needs. Each of these individuals was trying to change things on a small scale. However, they were making a difference, although they were not aware of it at the time. When the funding from the technology fund was “found” two very large projects were set up, Hospital 2050 and InnovaSaúde, to learn about PPI and create the ecosystem we were aiming for” (Coordinator of European Projects - Galician Health Knowledge Agency, and Director of innovation programs - Galician Innovation Agency).

By means of the 2009 strategic plan, the SERGAS adopted a **mission-oriented policy**. After interacting with other government levels, specifically with the Ministry of Economy and Competitiveness and the Centre for the Development of Industrial Technology, the regional government managed to successfully **mobilize financial resources** from supranational, national and regional funds to benefit from the entrepreneurial opportunity that was afforded by the technology fund to promote PPI. Taking advantage of the moment, Galicia defined two large projects in health, using PPI as the instrument used to deploy them (i.e. Hospital 2050 and InnovaSaúde). These two projects started to run in 2011 and, with an approximate budget of 90M€, represented the two most ambitious PPI initiatives ever in Spain.

“Without the financial crisis, large projects such as Innovasaúde and Hospital 2050 would have never been defined, and the positive externalities that these have produced across Galicia would have not been observed. Without having access to the ERDF funds – the technology fund – the regional government would have introduced PPI with its own funds, and the trajectory would not have been

the same. The ERDF led us to reconsider the PPI management and to develop our own governance model” (Healthcare IT and Digital Health Program Manager - Galician Health Service).

With these projects the SERGAS aimed to **address**, on the one hand, the **global challenge** of improving elderly care and health (Xunta de Galicia 2014), **while supporting the regional supply** to start a transition and start offering their goods/services in international markets on the other. The experimentation that these two projects afforded had a positive effect on the **generation of capabilities** in the corresponding public institutions. This was due to the definition of a systematic process, which consisted of the following stages:

1. Identification of challenges/needs: internal working groups at the SERGAS write some “sheets” based on the functions that are required.
2. Opening dialogue with the market to convey these needs: these early market consultations are essential, since they make potential suppliers aware of the calls before they are published and their details are known, so they have a chance to influence them (more on this below).
3. Suppliers (i.e. firms, technology centers, public research organizations) propose their potential technologies and solutions.
4. An internal group at the SERGAS assesses and classifies these proposals using criteria such as the degree of maturity of the technological solution, the availability of the solution already in the marketplace, or the potential delivery dates.
5. An early demand map is prepared: it includes the elements that will be launched through the final procurement call. It is published prior to the publication of the call, so interested firms can know beforehand what is going to be purchased, when, and for how much.
6. Publication of the final tender together with the contracting procedure.

In deploying the previous process, the SERGAS aimed to use all the procedures allowed by the European procurement directives (e.g. competitive dialogue, bidding with negotiation, innovation partnership, pre-commercial procurement) to **experiment, learn and build capacities** (Sánchez-Carreira et al. 2019).

“The mindset of the people who were involved in the public administration at that time was that legal advice slows down innovation, and particularly innovation in the public administration. We believed it was fundamental to innovate more, and that normative development was essential to achieve this. The opposite would be to merely exercise oversight (Former Director of the Galician Innovation Agency).

The procedure to be used in each case depends on the purpose of the procurement, and particularly, on the extent to which the solution already exists or must be developed. For example, based on the experience gathered during the last decade, it has been concluded that the bidding with negotiation is useful when the degree of definition of the needs is large (e.g. in ICT projects), and hence, using technical requirements becomes

sensible. If, on the other hand, only the need is known, but there is no evidence of what a feasible solution might be, then competitive dialogues are more effective, as they allow for a lower degree of definition initially, and companies can help develop the specifications, together with the public (health) professionals. Finally, the innovation partnership seeks to generate technology and ensure that it will be the one that is finally purchased. It is a way of giving continuity to the pre-commercial procurement (see Edquist and Zabala-Iturriagoitia 2015). Otherwise, after a pre-commercial procurement the technology developed in the pre-commercial stages may not be finally bought. In this regard, a “serendipity clause” is included to license those technologies that may emerge in the pre-commercial procurement process, but which were not initially expected (i.e. unintended results).

The SERGAS had already started experimenting with the potential of **early market consultations** in order to broadcast the two funding opportunities, although these consultations were initially unstructured and the audience reached was rather limited. As a result of these market consultations, the SERGAS elaborated an **early demand map**, which defined and described the challenges arising from the existence of public demand, and identified the capabilities that firms had to address these challenges.¹³ This entrepreneurial behaviour was associated with risks and uncertainties. However, the reaction on the market side was positive and 280 proposals were received (22 proposals on average per challenge), of which 101 were funded by Innovasaúde and Hospital 2050, being 91 allotted to firms and 10 to public organizations. It is worth noting that in the 33 PPI contracts signed, 82% of the firms involved in these had participated in the early market dialogues. One of these examples is a start-up that developed an artificial intelligence project for use in tumour detection, and another which developed avatars applied to surgical operations. In both cases, these start-ups have not only provided advantages to the SERGAS, but have also initiated an entrepreneurial discovery process along the lines of the RIS3. This has upgraded the regional economy by mixing the assets of local firms and creating lead markets that can be transferred to other territories.

Table 1 characterizes the challenges included in Innovasaúde and Hospital 2050 and the PPI projects funded in them. One of the main results of the Innovasaúde and Hospital 2050 was that SMEs were involved in 76% of the contracts, being 62% of these Galician SMEs. However, at the same time, in 72% of the contracts there was a multinational firm involved, meaning that in more than 70% of the contracts SMEs were working together with large players. As a result, the Innovasaúde and Hospital 2050 PPI initiatives have helped to **internationalize** the **innovation** activities of **SMEs** by introducing them in global value chains. By **creating positive spillovers and knowledge transfer** activities **between** the **large and domestic suppliers**, the latter were able to improve their technology capabilities and provide more sophisticated services.¹⁴

Table 1.- Main characteristics of the Innovasaúde and Hospital 2050 PPI initiatives

Innovasaúde ¹⁵	Hospital 2050 ¹⁶
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¹³ See this early market demand (in Spanish) at: https://www.sergas.es/Docs/H2050_IS/Mapa%20demanda%20temprana.pdf

¹⁴ In this paper sophistication is understood as the search and development of innovative solutions that are not available on any market.

¹⁵ For the projects funded in Innovasaúde see: <https://bit.ly/2YTF0i9>

¹⁶ For the projects funded in Hospital 2050 see: <https://bit.ly/2FXbSOc>

Funding: €45M 223 contracts with 101 firms 21 PPI contracts 14 innovation action lines Involvement of >200 professionals from the SERGAS in the contracts Challenge 1: Patient-centered healthcare Challenge 2: Safe and agile health care Challenge 3: Smart healthcare	Funding: €45M 94 contracts with 44 firms 12 PPI contracts 9 innovation action lines Involvement of >100 professionals from the SERGAS in the contracts Challenge 1: Safe hospital Challenge 2: Green hospital Challenge 3: Sustainable and efficient hospital
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Source: own elaboration based on information from the SERGAS.

Another result of the experience gained in the SERGAS is the **incorporation of end-users** in PPI calls, particularly in the early dialogues. The Galician patients' advisory council is a forum that collects the patients' opinions and their needs, and which also proposes solutions different from those raised in the PPI procedure. This **open innovation** approach, in which civil society is engaged in policy-making, is in line with the demand to open up policy definition to a wider group of stakeholders (see Mazzucato 2018).

“Listening to patients and engaging them in the PPI process is something that will have to be consolidated in the future, developing lines of projects in which the final user (i.e. patient) is included. I believe that the ‘enlightened despotism’ of doctors should be changed, so instead of working ‘for patients but without patients’ they should see it is necessary to work ‘for patients and with patients’”
(Health Innovation and Development Area - Galician Health Knowledge Agency).

The SERGAS has begun to systemize patient empowerment in the new PPI initiative related to health in Galicia (Código100).¹⁷ One of the requirements included in Código100 is the inclusion of the end-user's perspective, so as to guarantee that there is continuous dialogue and engagement with the patient. This transition was no easy task. However, healthcare professionals have progressively increased their 'permeability' towards **joint experimentation with users**, since they have observed that it allows them to identify needs that are far from the solutions that exist on the market. Similarly, companies, and in particular SMEs, have also become more open to socializing their ideas and solutions, breaking with their initial fear that competing firms could 'steal' their technologies. This learning has occurred because the companies themselves have observed that if they do not share their ideas/technologies, these may end up being left on the shelf, while if they socialize them, they may have a chance to generate a demand that they would not have otherwise created autonomously.

4.2.- Civil UAV initiative

The **learning by doing** that took place between 2008 and 2015 in the SERGAS led to the **institutionalization of PPI** in Galician innovation policy-making. As a result, the

¹⁷ To date Código100 has received 215 proposals, of which 65% are related to the application of ICT in health. 48.5% of them come from large firms (>250 employees), 7.4 from middle-sized companies (between 40 and 25 employees), 17.3% from small firms (between 10 and 40 employees) and 26.7% from micro-firms (<10 employees). 47% of these proposals come from the Galician region.

regional government considered the possibility of fostering innovation, entrepreneurship and growth by making strategic and **deliberate use of PPI**. The Civil UAV Initiative was defined with the goal of improving public services by use of UAVs through public-private partnerships with strategically chosen technology and industry partners. When Galicia defined its RIS3, the region was in the midst of a shipping and automotive crisis, so the regional government decided to transform the region by diversifying its industrial base. It focused on aeronautics as a potential sector of activity that could use the capacity that the region had developed in the shipping and automobile industries respectively.

The Civil UAV initiative aims to develop innovative solutions in the emerging unmanned vehicle industry (i.e. drones) Unmanned vehicles are regarded as a horizontal technology that can positively impact the **diversification** of some **of** the region's most **relevant sectors**, such as land management, agriculture, or the development and use of marine and energy resources. It should not be understood as a targeted intervention like the case of the health sector, but rather as a transversal policy aimed to create opportunities in other related sectors. In particular, the application of UAVs was sought in the following public services (see Table 2):¹⁸

Table 2.- Applications of the Civil UAV initiative

On-shore	Off-shore	Air space
Fight against forest fires	Fisheries' surveillance	Interoperability between manned and unmanned aircraft
Preventive forestry, forest management and use of biomass	Inspection of marine crops and control of shellfish	Integration in non-segregated airspaces
Post-fire forest and hydrological restoration	Control of water quality	Low air traffic management
Control of forest and agricultural pests	Identification of ships and floating bodies	
Territorial planning and control of cultural heritage	Maritime rescue and rescue applications	
Watershed management and civil works	Transport of critical material from UAVs for attention in situations of difficult access	

Source: own elaboration.

The program, which was launched in 2015, will last until 2026 and has a total budget of €149M, 50% funded from the public side, and another 50% from the private side. The **creation of the technology park** at the Rozas airfield (located in Castro de Rei, Lugo) will be the focal point of the initiative, with the aim of positioning it as a reference center for the UAV industry. The technology park will become a test center with the necessary testing infrastructure for aircraft and aerospace systems, which will allow safe and efficient verification of a broad range of technologies.

“This center is exceptional in Europe. It can be attractive to any company that needs to certify drones, which is a demand that we expect will grow in the future. On top of that, it is located in a deprived region, with a low population and little

¹⁸ See <https://www.uavgalicia.com/> and <http://www.civiluavsinitiative.com/>

industrial activity, so it has all the necessary ingredients from the perspective of economic development and regional diversification” (Former director of the Galician Innovation Agency).

The development of high technology aerospace equipment in Rozas took place between 2015 and 2017 with a budget of €10M, and the regional government of Galicia (Xunta de Galicia, the Galician Innovation Agency, and the Galician Institute for Economic Promotion), the Ministry of Economy and Competitiveness of Spain and the Spanish National Institute for Aerospace Technology were involved in it. Some of the activities that will be carried out in this center include:

- design and certification of UAVs and on-board accessory devices,
- manufacture and integration of UAVs and on-board accessory devices,
- training of UAV operators and pilots,
- development of software systems to support UAV related missions,
- integration of UAVs in the airspace.

The initiative was organized in **two phases**. Phase A aimed to develop R&D-based technology solutions through **pre-commercial procurement** (€115M for the period 2015-2026). A consortium of 32 partners, including two universities, nine public research organizations, large firms (e.g. Indra, Babcock, Boeing, Airbus), and 11 public agencies is involved in this first phase. Phase A was fully backed with own (regional) funds. This evidences the high degree of maturity that Galicia has achieved in the use of PPI. Although this first phase is still running, some start-ups have already been created and international aerospace companies are showing interest in the projects being developed.

On the other hand, Phase B is oriented to the **improvement of the public services** offered by the regional government through the **procurement** of UAVs (€24M for the 2015-2019 period). The products/services to be bought will be selected from the previous phase A, and will have Technology Readiness Levels 8 or 9. It is expected that the main beneficiaries of these products will be smaller firms. Besides the actual procurement, the goal of this second phase is the development of a novel and international aerospace sector in Galicia, attracting foreign direct investment to the region and linking the local supply base with multinational firms (Acs and Szerb 2007; Uyarra et al. 2020).

“The advantage of being able to attract a large multinational firm to the region is that it also raises awareness of the capacities of local firms. On many occasions, small firms are very capable of doing things of great technical complexity, but they are often not aware of it, and they only realize this when they can sell directly to a large company. Ultimately, these relationships help to generate an innovation ecosystem (i.e. make the territory a hub for the provision of services). Having such an ecosystem makes the transfer of knowledge and technology (from research organizations to firms, and between firms), entrepreneurship (start-up creation and intra-entrepreneurship), and improving the articulation of the system much more effective. These externalities (i.e. generating an innovative and

entrepreneurial ecosystem) are not observed with regular public procurement” (Director of innovation programs - Galician Innovation Agency).

As it was the case in the SERGAS, **early market consultations** were used to inform the supply base about the requirements of the initiative. As a result of these, an **early demand map** was defined.¹⁹ To date, 110 proposals have been received following these market consultations and 5 tenders have been assigned for Phase B, for a total amount of €7.25M.²⁰

One of the advantages of the Civil UAV initiative is that it leads to more sophisticated **capacities in local beneficiary firms**. A case in point is a local welding firm that has participated in phase A. This family firm had traditionally done welding on pipes and construction elements. After its involvement in the Civil UAV initiative, the company has specialized in one type of welding, and has been able to make a transition towards welding components for drones. It is now experiencing a large international demand.

The previous results were not, however, achieved overnight. As Lawrence and Suddaby (2006) argue, significant institutional work is needed to **persuade** others of the merit of the policy, experiment with it, adapt it, **gain internal legitimacy**, and **build connections** to facilitate the new structure or practice. In this regard, for PPI to become institutionalized at the policy-making level it is necessary to train the managers and technicians on the public side, and the potential supplier firms.

“When we consider contracting a firm, the classic behaviour of the public administration is to expect that it will have to do what we demand, when and how we demand it. But then, we still believe that when the product/service is delivered the firm does not need to bother about how we are going to use it. We need to change this logic, and let firms know that we are no longer demanding a good/service, but that we want them to offer us a business model for the product/service they are going to develop to meet our needs. The fact that the government purchases their product should not be interpreted as a signal that they do not need to sell their goods/services elsewhere. It is not about how the SERGAS wants the product to function, but is about what the company wants the product to be like so they can address these same needs on other international markets. It is essential that we foster this change and that both firms and public actors become aware of it” (Healthcare IT and Digital Health Program Manager - Galician Health Service).

4.3.- Conclusions

The previous case studies were conducted to answer the research question that guides the paper, namely: how certain policy instruments such as PPI are actually implemented, and how the capabilities requires for their effective rollout are built in practice? This

¹⁹ See this early market demand (in Spanish) at: http://documentos.galiciainnovacion.es/CUI/Mapa_Demanda_Tempera_GL_ES_EN.pdf

²⁰ The details of these 5 projects can be found here (in Spanish): <http://gain.xunta.gal/artigos/308/publicacion+5+primeras+licitaciones+programa+soluciones>

section aims to provide an interpretation of the insights and findings that are drawn from the previous two cases.

The first conclusion that can be achieved is the potential of mission-oriented policies, not only as a means to provide a solution to a societal (i.e. grand) challenge, but also to stimulate entrepreneurship, innovation, and growth, and hence, to transform local economies, and sophisticate the local supply. By targeting global challenges that are common to most territories the regional industrial base can develop new capabilities and products that may be later transferred to other territories with similar needs. This on the one hand boosts the local economy through the internationalization of the local supply and introducing these firms in global value chains, stimulating the creation of positive spillovers and knowledge transfer activities between large and local suppliers. On the other, and at the same time, the development of new technologies that may emanate from mission-oriented policies can also support the diversification of relevant sectors of the local economy and create opportunities in other related sectors.

These policies, beyond their underlying uncertainty, also require the mobilization of large amount of financial resources. In this regard, it is necessary to combine several financial mechanisms, what in turn implies the need to use different policy-mixes in which PPI (in the case of this paper) is combined with other policy instruments. It has to be noted that the complementary policy instruments to be used will depend on the stage of development and the level of institutionalization of PPI.

Finally, in order to institutionalize PPI in policy making, our two cases evidence that a transition from learning by doing to a deliberate use of PPI will have to be undertaken. It is important that trial-and-error cases are thus used to 'experiment' with the use of the policy instrument under analysis, learn about the challenges and difficulties associated to it, and ultimately, build the required capacities on the public side.

5.- Discussion

Since the financial crisis at the end of the last decade, expectations have grown as regards the potential of innovation policies not only to drive local and regional economic development but also to transform the efficiency and effectiveness of public services (Foreman-Peck 2013). Policy-makers are looking for ways to match public policies aimed at encouraging system-level changes with respective new practices at the local level (Saari et al. 2015, p. 325).

In recent decades, sub-national levels have become increasingly important as spaces for policy-making. The current focus on RIS3 is the latest manifestation of this trend. RIS3 processes rely heavily on public policy actors articulating and facilitating entrepreneurial discovery processes around regional assets and capabilities, so as to articulate and boost new and/or existing demands. Regional strategies can be set up based on highly place-specific needs, or respond to global societal challenges (see Acs and Szerb 2007). Public procurement can prove helpful in both scenarios. It can be narrowly framed to address very immediate and concrete needs with little room for innovation or may address broader socio-economic problems or challenges that are place-specific or common to many regions.

The literature shows extensive evidence on entrepreneurship support policies (Leyden 2016; Fotopoulos and Storey 2019), but there is limited evidence on the extent to which public procurement, as a generic policy tool, can also be instrumental in supporting a form of entrepreneurship that leads to (radical) structural change, and hence supports innovation and growth at the territorial level. While PPI is acknowledged as a potential tool for smart specialisation, there has been little discussion as to how PPI links to the two key concerns of RIS3, that is to say, policy prioritization and the entrepreneurial discovery process, as means to reach transformative territorial effects. To bridge this gap, we conduct a qualitative study that sheds light on the role played by a regional government in promoting regional diversification and smart growth in Galicia (Spain). As a result, the paper contributes to the literature with additional evidence on how certain policy instruments such as PPI can improve local economic performance by stimulating innovation and entrepreneurship.

The paper has discussed how regional innovation, entrepreneurship and growth can be achieved through the implementation of public procurement initiatives, which help raise and articulate demand for innovation within RIS3 while improving the conditions for the generation, diffusion and uptake of innovations (Edler and Georghiou 2007, p. 952). It has also evidenced how this demand articulation failure can lead to the diversification and transformation of territories, showing that it is possible to start new diversification processes that break with previous institutional inertias and paths.

The results of the paper evidence the central role that the state can play in the articulation of public policies that identify societal needs that require innovations, and to which entrepreneurial firms can respond to. PPI can thus lead to a “creative construction” (see Lambooy 2005; Scott 2006) according to which new markets and opportunities are created. Our results also support the claims made by Colombo et al. (2019, p. 423) as regards the need to adopt organizational structures in which governance, leadership, motivation and coordination need to be reinforced by public policies. From this perspective, entrepreneurship would not only be the fruit of “the spontaneity and creativity of the human imagination” (Leyden 2016, p. 554) but also the result of the intended directionality of public policies. In this sense, the same qualities that have traditionally been attributed to entrepreneurs (Leyden 2016) (e.g. risk taker, innovator, decision maker, leader, manager, coordinator of resources, etc.) can also be ascribed to civil servants who also act as entrepreneurs in policy making (see Leyden and Link 2015; Henning and McKelvey 2020).

We have not focused on a region with high innovation-related capabilities, but rather on a peripheral region with low innovation capacity (European Union 2019). Peripheral regions can suffer from lock-in situations due to their limited capacity to access new external knowledge (OECD 2007; European Union 2016), which may eventually influence the opportunities to develop innovation endogenously. We argue that novel contexts such as peripheral regions can also contribute with theoretical and practical implications for the advancement of public (innovation) policies. The Galician case helps explain the evolution of the public sector in stimulating innovation, entrepreneurship and growth, as well as the development of the capabilities required to achieve diversification and territorial transformation goals.

Galicia lacked experience in demand-side policies. Hence, it was necessary to create these capabilities in the public sector to implement PPI in order to advance regional economic development. One of these capabilities is the knowledge of local players, firms, their cultural aspects, and therefore, their potential to address the particularities of the future (public and private) demand. Other relevant capabilities on the public side lie in the ability to communicate public needs sufficiently in advance to local actors, link these to their technologies, identify the necessary specifications (functional and technical), design a tender, define the evaluation criteria and how the intellectual property derived from the projects is going to be managed, and assess the proposals, so these can have higher probabilities of meeting their needs. Public procurers also need to gain experience and develop skills to nurture PPI through openness and willingness to experiment and explore. Finally, the public side is also required to coordinate with other policy levels.

This capability building has led to the professionalization of public procurement in the region. However, when the entire process started, back in 2008, the region lacked specific training on this matter, and hence, experimentation was required. When the first results achieved in the Hospital 2050 and Innovasaúde projects started to emerge, the technicians and policy-makers running the PPI started to cooperate with other European regions, so they could continue learning and developing capabilities (e.g. on how to develop the preliminary market consultations) as a result of this exchange of experiences.

The Galician experience suggests a trade-off between institutionalization and the malleability of an innovation ecosystem (see Colombo et al. 2019). In 2011, the Galician Health Knowledge Agency, which is responsible for promoting innovation within the SERGAS, was created. On the one hand, this agency endowed the health system with a greater structure, but at the same time, it also favoured internal hierarchy and task division. As a consequence, the ability to promote initiatives in a collaborative way, which had been the case before its establishment, was diminished. On the other hand, the command of the procedures and needs associated with an effective and systematic PPI increased. This apparent trade-off between the institutionalization of public policy and the ability to spontaneously integrate different units seeking for radical innovations requires additional examination.

Further research could also analyze the impact that different structural settings have on the implementation of PPI as an instrument that supports entrepreneurship, innovation and growth. How can policies be place-based in territories that are structurally dominated by large multinational groups? What if there are no local champions in the specific priority the government wants to focus on? The cases included in the manuscript provide some preliminary evidence, although additional issues such as the schemes to implement bundling and anchoring strategies require further study. Similarly, the scale and the critical mass for upscaling and the contexts under which a transition from mission-oriented policies to diffusion-oriented policies can be made are elements of demand articulation that call for further clarification. Future research could also explore how diffusion processes take place after a radical innovation is manifested, and clarify the extent to which procurement policy can influence the diffusion of radical innovations.

Learning is indeed one of the key elements supporting a policy transition leading to innovation, entrepreneurship and growth. Therefore, the final claim we make here for

further research is related to the need for evaluation approaches that allow for the study of the additionality of public funds in improving the sophistication of the public demand and the capabilities of the public sector. From our point of view, there is a clear association between the degree of sophistication of the public demand and the learning that emerges from the practice of PPI (i.e. capabilities). Hence, we strongly believe that future research could shed new light on this relationship. Further work on these dimensions in the context of PPI in RIS3 type initiatives will help us build a richer understanding of the role that demand plays in the study of territorial directionality.

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Electronic Supplementary Material (online appendix only)

Online appendix 1.- Questions guiding the interviews

Block 1: Rationales for the use of PPI

Q1: Which was the main motivation for the regional government to use PPI as one of the main policy instruments of its RIS3?

Q2: Why was health originally identified as a sector of activity in which PPI could be initially experimented?

Block 2: Factors determining the implementation and consolidation of PPI

Q3: How is PPI funded?

Q4: How was the relationship maintained with the national government? How was this multi-level governance coordinated?

Q5: Who and how defined the future needs to be targeted by PPI?

Q6: How is the PPI carried out? Which are the procedures used?

Q7: How are these needs communicated to potential suppliers?

Block 3: Evaluation and assessment of the results

Q8: Has PPI led to a higher sophistication of public demand? And to the sophistication of the local supply?

Q9: Are there cases of radical innovations developed as a result of local firms participating in PPI initiatives?

Q10: Which are the capabilities that are required on the public side to deploy and articulate PPI processes in a systematic and professional manner? How have these capabilities been developed?

Online appendix 2.- Profiles of the interviewed stakeholders

Interviewee	Affiliation	Role
1	University of Santiago de Compostela.	Lecturer. Research focused on regional innovation policy.
2	University of Santiago de Compostela.	Lecturer. Research focused on regional development and regional divergence/convergence.
3	University of Santiago de Compostela.	PhD candidate, focused on innovation-related public procurement.
4	City of Madrid.	Responsible for European funds and general coordination of administrative action. Former deputy director of innovation at the Ministry of Science and Innovation in Spain.
5	Ministry of Economy, and Competitiveness of Spain.	Deputy Directorate General for the Promotion of Innovation. General Secretariat for Science and Innovation.
6	Ministry of Economy, and Competitiveness of Spain.	Deputy Directorate General for the Promotion of Innovation.
7	Centre for the Development of Industrial Technology. Ministry of Economy and Competitiveness.	Innovative Public Procurement Coordinator.
8	Science and Innovation Link Office.	Director of Public sector management. Former Director of the Galician Innovation Agency.
9	Galician Innovation Agency.	Director of innovation programs.
10	Galician Innovation Agency.	Director general.
11	Galician Health Service.	Healthcare IT and Digital Health Program Manager.
12	Galician Health Knowledge Agency.	Director general.
13	Galician Health Knowledge Agency.	Health Innovation and Development Area. Coordinator of European Projects.

Source: own elaboration.