SMARTSPEC

SMART SPECIALISATION FOR REGIONAL INNOVATION

Regions with Less Developed Research and Innovation Systems

Research Working Paper: Work Package 3

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Contents

Introduction

In the Grant agreement, the key objectives of WP3 are set in the following key points:
• To identify regions with less developed research and innovation systems
• To identify the challenges for Member States and Regions with less-developed research and innovation systems to maximise the impact of their smart specialisation strategies, focusing on: the role of economic structure, the role of knowledge institutions, the role of governance and strategy design.

This Research Working Paper aims at providing the interim findings regarding the challenges and opportunities facing regions with less-developed research and innovation systems to maximise the impact of their smart specialisation strategies. Therefore, this Research Working Paper represents an important step towards the final outputs as agreed in the Grant Agreement, i.e. to elaborate final manuscript(s) of a peer-reviewed book (collected volume) or 2-3 peer-reviewed book chapters or peer-reviewed articles submitted to or accepted by publisher or peer reviewed journal.

2. Identification of regions with less developed research and innovation systems

Abstract

The aim of this working paper is to contribute to the debate on how to identify regions with less developed research and innovation systems. We look at both conceptual and empirical approaches that figure prominently in scholarly work on regional innovation systems. Based on a critical review and discussion of the literature we shed light on a large number and variety of barriers and weaknesses that may hamper regional innovation and industrial change. It is shown in this paper that the regional innovation system concept can essentially inform the current debate on the design and implementation of smart specialisation strategies. It offers rich insights into various dimensions of regional innovation systems that may be weakly developed and allows for the development of typologies that capture the heterogeneity of these systems. We also demonstrate that empirical approaches to identify regions with less-developed research and innovation systems fall short of taking account of the conceptual advances made in the recent past.

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1 Introduction

Smart specialisation has become the new innovation policy paradigm in the European Union. This policy concept "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" (European Union, 2011, p. 7).

Smart specialisation shares a number of commonalities with and has been inspired by other modern and influential policy concepts such as the Constructing Regional Advantage (CRA) approach (European Commission, 2006; Asheim et al., 2011a; Asheim, 2014; Boschma, 2014a): It considers knowledge and innovation as key determinants of regional development and emphasizes the need to avoid imitation of successful policies pursued in other regions and "one-size-fits all" strategies (Tödtling and Trippl, 2005). Smart specialisation strategies are place-based policy strategies that aim to promote economic diversification of regions (McCann and Ortega-Argiles, 2013; Boschma, 2014a) taking into account their unique characteristics and assets. Specialised diversification or diversified specialisation (Asheim 2014) should thus rank high on policy agendas. The identification and selection of prioritised areas for policy intervention are suggested to be the outcome of an "entrepreneurial discovery process", a notion that has been heavily debated in the recent past (Foray and Goenaga, 2013; Foray and Rainoldi, 2013; Asheim, 2014; Boschma, 2014a). There seems to be an agreement, however, that an inclusive approach to the identification of policy priorities (that is, inclusive governance structures that allow for the involvement of regional stakeholders in selecting promising areas for innovation policy) is important for the success of smart specialisation.

A key question is if smart specialisation strategies are applicable to any type of regions. It has been argued that regions with less-favoured research and innovation systems have a low potential to diversify into new industrial areas due to unfavourable economic structures and a weak endowment of knowledge organisations (Boschma, 2014b, Isaksen and Trippl, 2014a). In addition, some less-developed regional research and innovation systems suffer from weak policy and governance capacities, which could curtail the effective use of Cohesion policy funds (Charron et al. 2014) and may form major barriers to the successful formulation and implementation of smart specialisation strategies (Rodriguez-Pose et al., 2014).

This working paper is part of Work Package (WP) 3 of the project "Smart Specialisation for Regional Innovation" (funded by the European Commission in the context of the seventh framework programme). One of the key goals of this project is to gain new insights into the nature, opportunities and challenges for smart specialisation strategies in a large variety of regional settings. WP 3 focuses specifically on regions with less-developed research and innovation systems. The objectives of this WP are (1) to identify regions with less-developed research and innovation systems; and (2) to get a better understanding of the challenges for these systems to maximize the impact of smart specialisation strategies, focusing on the roles of economic structures, knowledge organizations and governance and strategy design.

The aim of this working paper is to contribute to the first objective, that is, to identify regions with less-developed research and innovation systems. It would be beyond the scope of this paper to engage in a discussion of how the specific elements of these systems influence the opportunities for smart specialisation or how the challenges faced by these regions might be overcome to enhance the impact of smart specialisation strategies (for insights into these issues see the other working papers generated in the context of WP 3 as well as the empirical reports on a number of case studies that will be published at a later stage of the project). This working paper paves the way for these analyses by discussing several conceptual and empirical contributions to identify regions with less-developed research and innovation systems, focusing in particular on key barriers and missing elements that may be found in these systems. For the sake of clarity, it is important to note that in the following parts of this paper only the notion "regional innovation system" (RIS) will be used, because we consider the regional research system as a subsystem of RIS.

The remainder of this working paper is organised as follows. Section 2 reviews the conceptual debate on RIS, system failures, organisational and institutional thinness, knowledge bases and regional industrial path development and demonstrates how these concepts can contribute to identifying various types of regions with less-developed RIS. In section 3, we provide a critical discussion of empirical approaches to categorise less-developed RIS based on measurements of their innovation performance. Finally, section 4 concludes and outlines some key issues that should receive due attention in future research.

2 Conceptual Approaches

Research on RIS has grown significantly since the notion's first articulation and development in the early 1990s (for an overview on the theoretical antecedents and origins of the RIS approach, its development over the past two decades and recently made advances see Asheim et al. 2011b). RIS come in many shapes and various typologies have been suggested to capture this variety (see, for instance, Asheim and Isaksen, 2002; Cooke, 2004; Asheim and Gertler, 2005; Asheim and Coenen, 2006). In this section we focus on those conceptual ideas (and the typologies that emanate from them) that are most relevant for identifying less-developed RIS. We review contributions on system failures, organisational and institutional thinness, knowledge bases and new regional industrial path development to shed light on potential factors and dimensions in RIS that can restrain regional innovation and change.

2.1 System failure approaches

A well-known conceptual approach for identifying less-developed innovation systems draws attention to various types of system deficiencies or system failures that result in low levels of innovation activities. Several typologies of system failures exist (see, for instance, Lundvall and Borras, 1999), enabling us to spot various dimensions of innovation systems that may be less-developed or not working adequately. Klein Woolthuis et al. (2005), for example, distinguish between infrastructural failures, institutional failures (hard and soft institutional problems), interaction failures (strong and weak network failures) and capability failure. Recent work on

transformational system failures (Weber and Rohracher, 2012) has further advanced the debate, pointing to a set of factors that limit a system's capacity to undergo processes of transformative change towards sustainability. A distinction between four types of transformational failures can be drawn: i) directionality failure, ii) demand articulation failure, iii) policy coordination failure, and iv) reflexivity failure (Weber and Rohracher, 2012). In the context of this debate, innovation systems might be referred to as "less developed" if they exhibit a weak capacity to foster transformative change. These insights are highly relevant for smart specialisation as the promotion of sustainability and social innovation are often seen as one of the key aims of such strategies.

Tödtling and Trippl (2005) have applied the system failure approach to the regional level to analyse various deficiencies of RIS. The authors propose a typology that distinguishes between three forms of system deficiencies, namely, organisational thinness, negative lock-in, and fragmentation (Table 1).

Table 1: RIS failures

System failure / deficiencies	**Type of region**
Organisational thinness: crucial elements of a RIS are missing: low levels of clustering & weak endowment with key organisations	Peripheral regions
Negative lock-in: over-embeddedness & overspecialization	Old industrial areas
Fragmentation: lack of interaction between RIS elements	Metropolitan regions

Source: Tödtling and Trippl (2005)

This provides the foundation for discerning three main types of less-developed RIS (Tödtling and Trippl, 2005; Martin and Trippl, 2014):

- *Organisationally thin RIS* are systems in which essential elements are only weakly developed or even missing. Examples include the lack of a critical mass of innovative firms, a weak endowment of other key organisations and institutions and low levels of clustering. Organizationally thin RIS are often present in peripheral areas. These regions are characterised by insufficient levels of R&D and innovation due to the dominance of SMEs in traditional sectors, the lack of assets to nurture new industries, a weak capacity to absorb knowledge from outside the region, and a thin structure of supporting organisations (Doloreux and Dionne, 2008; Karlsen et al., 2011).

- *Locked-in RIS* are characterized by an over-embeddedness and over-specialization in mature sectors and out-dated technologies. Locked-in RIS often prevail in old industrialised areas. The capacity of firms in these areas to generate radical innovation is limited and the supporting organisations tend to be too strongly oriented on traditional industries and technologies. Various forms of negative lock-in (functional, cognitive and political ones)

keep these regions in ancestral development paths (Grabher, 1993; Trippl and Otto 2009; Hassink, 2010).

- *Fragmented RIS* suffer from a lack of connectivity due to a suboptimal level of networking and knowledge exchange between actors in the system, leading to insufficient levels of collective learning and systemic innovation activities. Fragmented RIS can frequently be found in metropolitan areas (Blazek and Zizalova, 2010; OECD, 2010). In this type of region fragmentation is often the outcome of too much diversity and a lack of related variety, resulting in levels of regional knowledge exchange and innovation below what could be expected given the often rich endowments of knowledge exploration as well as exploitation organisations found in metropolitan regions.

The application of the system failure approach to the regional level has provided important insights into potential misconfigurations of RIS, pointing to a variety of elements that might be less developed or functioning inadequately. However, the key notion of "thickness" is defined in a rather simple way (number of organizations) and remains poorly conceptualized. In particular the role of institutions for regional development and innovation (Gertler, 2010; Rodriguez-Pose, 2013; Charron et al. 2014), that is, the institutional dimension of thickness is only insufficiently captured.

More recently, an attempt has been made to elaborate on the notions of thickness and thinness of RIS. Based on a comprehensive review and critical discussion of the respective literature, Zukauskaite et al. (2014) advocate a clear distinction between the organisational and institutional dimension of thinness. Organisational thickness (thinness) refers to the presence (absence) of a critical mass of firms, universities, research bodies, support organizations, unions, associations, and so on. Institutional thickness (thinness) is defined as the presence (absence) of both formal institutions (laws, rules, regulations) and informal institutions (such as an innovation and cooperation culture, norms and values) that promote collective learning and knowledge exchange.

Departing from this clear-cut distinction, we advance the argument that RIS may suffer from institutional thinness, organisational thinness or a combination of both dimensions of thinness. This leads us to distinguish between three types of less-developed RIS (see Table 2):

Table 2: Organisational and institutional thickness / thinness of RIS[1]

	Organizational thickness	**Organizational thinness**
Institutional thickness	Metropolitan / city regions in Northern & Western Europe	Industrial districts in the Third Italy, Nordic peripheral regions

[1] This matix is based on an idea by Björn Asheim, outlined in a project application for the Marianne and Markus Wallenberg Foundation.

Institutional thinness	Larger cities in Southern and Eastern Europe; OIA in Western Europe	Southern and Eastern peripheral regions

Source: own compilation

- Institutionally thick *but* organisationally thin RIS: Good examples for this type of RIS are industrial districts in the Third Italy and regions in the North of Europe. Italian districts are well known for a pronounced culture of cooperation (institutional thickness) but they lack specific RIS elements such strong research organizations or science-based firms (organisational thinness) that are essential for the generation of more radical forms of innovation. Nordic peripheral regions benefit from a high quality of government institutions (institutional thickness) but are only poorly endowed with innovation relevant organizations (organisational thinness).

- Organisationally thick *but* institutionally thin RIS: This type of RIS can often be found in larger cities in Southern and Eastern Europe but also some old industrial areas in Western Europe may fall under this category. These places are characterized by the existence of a critical mass of firms as well as research, educational and other supporting organizations (organizational thickness). However, innovation activities are seriously curtailed by the absence of an innovation and cooperation culture as well as a low quality of government institutions (institutional thinness).

- Institutionally thin *and* organisationally thin RIS: Such constellations tend to prevail in peripheral regions located in the South and East of Europe. More often than not, these areas are poorly endowed with innovation-relevant organisations (organisational thinness) and suffer from an institutional set-up that is not conducive to innovation (institutional thinness).

2.2 Knowledge base approach

The literature on differentiated knowledge bases (Asheim and Gertler, 2005; Asheim et al., 2011a) has sharpened our view that all industries and not only high-tech ones can be innovative and it has provided the analytical tools for explaining inter-sectorial variations of innovation patterns. Three types of knowledge bases can be distinguished: analytical, synthetic and symbolic (see Table 3). Scholarly work on knowledge bases clearly challenges old approaches that equate innovation with R&D and high-tech activities. Innovation systems that are characterised by lower levels of R&D and a dominance of mature industries (that often are knowledge intensive but not high-tech) cannot automatically be categorised as less developed ones.

Table 3: Differentiated knowledge base approach

	Analytical (science based): genetics, biotech, IT, nanotech.	**Synthetic (engineering based): industrial machinery, shipbuild.)**	**Symbolic (arts based): film, TV, design, fashion**
Rationale for knowledge creation	Developing new knowledge about natural systems by applying scientific laws	Applying or combining existing knowledge in new ways	Creating meaning, desire, aesthetic qualities, affect, symbols, images
Development and use of knowledge	Scientific knowledge, models	Problem solving, custom production	Creative process
Actors involved	Collaboration within and between research units	Interactive learning with customers & suppliers	Experimentations in studios, project teams
Knowledge types	Strong codified knowledge content, highly abstract, universal	Partially codified knowledge, strong tacit component, more context specific	Creativity, cultural knowledge, sign values; strong context specificity
Importance of spatial proximity	Meaning relatively constant between places	Meaning varies substantially between places	Meaning highly variable between place, class and gender

Source: Asheim et al. (2011a, p. 898; own modification)

An analytical knowledge base prevails in research-intensive industries such as biotechnology or nanotechnology where innovation is driven by scientific progress. Radically new products and processes are developed in a systematic manner involving mainly basic but also applied research. Firms usually invest heavily in intramural R&D, but rely also on knowledge generated at universities and other research organisations. Linkages between firms and public research organisations are thus pivotal and occur more frequently than in other industries. The "science-technology-innovation" (STI) mode clearly dominates in analytical industries, whilst synthetic and symbolic sectors rely more on the "doing-using-interacting" (DUI) mode of innovation (for a detailed discussion of the STI and DUI modes of innovation, see Lorenz and Lundvall, 2006; Jensen et al., 2007; Asheim, 2012).

A synthetic knowledge base is dominant in mature industries operating in fields such as industrial machinery or food processing. Innovation is often more incremental in nature, based on the use and new combination of existing knowledge and learning by doing, using and interacting (mainly along the value chain, that is, with customers and suppliers). Linkages between university and industry are relevant, but occur more in applied research and education, and less in basic research.

The symbolic knowledge base is present in creative and cultural industries (advertisement, fashion, new media and design). Innovation is devoted to the creation of intangible dimensions such as aesthetic value and images. Symbolic knowledge is highly context-specific; the meaning and the value associated with it can vary considerably across places. More often than not, innovation occurs through experimentations in studios and the formation of temporary project teams.

A key question that follows from the discussion about knowledge bases concerns the relation between RIS configurations and different knowledge types. Arguably, different types of knowledge bases require different types of RIS. Asheim and Gertler's (2005) distinction between narrowly defined and broadly defined RIS is eminently important in this regard (Table 4). A *narrowly defined RIS* is constituted by two subsystems and the systemic interaction between them to support the STI mode of innovation: the knowledge exploration and diffusion subsystem (universities, technical colleges, R&D organizations, technology transfer agencies, business associations and finance organisations) and the knowledge exploitation subsystem (firms in regional clusters and their support industries). A *broadly defined RIS*, in contrast, also benefits the DUI mode of innovation. It includes the wider setting of organisations and institutions (like a specialized labour market that provides experienced workers, applied research centres, non-R&D-based business services, local technical culture, and so on) that support knowledge creation, learning and innovation and their interactions with firms located in the region.

A narrowly defined RIS forms an adequate setting for analytical industries and the STI mode of innovation. Although synthetic and symbolic sectors may also benefit from some elements of a narrowly defined RIS (in particular applied research), they need a broader defined RIS (a wider set of organisations and institutions) that supports the DUI mode of innovation to prosper and innovate. If a RIS is weakly developed (and what specific RIS elements are missing) can thus only be determined in relation to knowledge bases and modes of innovation. An innovation system can be considered as "less-developed", if one or more of the above mentioned elements are absent or if the existing ones are not "fine-tuned" to the knowledge bases that dominate in the region. The theoretical advancement made by the differentiated knowledge base approach and insights offered on modes of innovation clearly challenge too "one dimensional" definitions of RIS and narrow policy approaches that put too much emphasis on R&D only and ignore other important sources of regional innovativeness and competitiveness.

Table 4: Knowledge bases and RIS configurations

Knowledge bases	**RIS**
Analytical knowledge base (basic research); synthetic and symbolic knowledge bases (applied research)	Narrowly defined RIS (linkages between universities; R&D institutes, TTOs and firms in the region)
Synthetic and symbolic knowledge bases	Broadly defined RIS (systemic interactions between wider system of organisations supporting learning and innovation and firms)

Source: Asheim and Gertler (2005)

The approaches discussed above have shed light on various elements and dimensions of RIS that may be weak or even missing. They have also allowed for the development of different typologies of less-developed RIS and they have led to valuable policy suggestions (see Tödtling and Trippl (2005) for policy implications following from RIS failures and Asheim et al. (2011a)

as well as Martin and Trippl (2014) for policy conclusions drawn from the knowledge base approach).

The RIS concept, however, has also been criticized for providing a rather static perspective. Uyarra (2010, p. 129), for instance, notes that many analyses of RIS are "inventory-like descriptions of regional systems, with a tendency to focus on a static landscape of actors and institutions". Recent scholarly work, however, has essentially contributed to the development of a more dynamic view. Advances in evolutionary economic geography and the literature on related variety (Frenken et al. 2007, Boschma and Frenken 2011) and combinations of knowledge bases (Asheim et al., 2011a, 2013; Strambach and Klement, 2012) have enhanced our understanding of key sources of regional industrial change. Isaksen and Trippl (2014a) integrate RIS in the analysis of such change processes and explore conceptually the link between different types of RIS and various forms of regional path development (see below). This is highly relevant for the purpose of this paper. Regional economies and innovations systems increasingly face the challenge to renew their industrial structures and embark on new growth paths. Promotion of such regional industrial renewal processes is one of the core aims of smart specialisation strategies.

2.3 Regional innovation systems and new path development

Recent work on regional industrial path development provides important insights into the ways regions change over time. This work moves beyond traditional approaches of path dependence, which are primarily concerned with illuminating the continuation and persistence of regional industrial structures and restrictive lock-ins, and seeks to explain economic renewal and new path development in regions. A distinction between three main forms of regional industrial path development is drawn (Asheim et al., 2013; Tödtling and Trippl, 2013; Isaksen, 2014; Isaksen and Trippl, 2014a).

- *Path extension* occurs through mainly incremental innovations in existing firms and industries. However, such *intra-path changes* may in the long run lead to stagnation and decline due to a lack of renewal (Hassink 2010). Regional industries are then locked into innovation activities that take place along existing technological paths limiting their opportunities for experimentation and space to manoeuvre into radical innovation. Ultimately, this erodes regional competitiveness and can lead to *path exhaustion*.

- *Path renewal* takes place when existing firms and industries located in the region switch to different but possibly related activities and sectors. This is in line with the notions of regional branching and related diversification (Boschma and Frenken, 2011; Boschma, 2014b) as well as combinatorial knowledge bases and the integration of STI and DUI modes of innovation (Jensen et al., 2007; Asheim et al., 2011a, 2013; Manniche, 2012, Strambach and Klement, 2012; Grillitsch and Trippl, 2014).

- *New path creation* corresponds to unrelated diversification (Boschma, 2014b) as it refers to the establishment of firms in entirely new sectors or to the introduction of products new to

the market (i.e. radical innovations) (Martin and Sunley, 2006; Tödtling and Trippl, 2013) New path creation is often research-driven and requires active policy interventions (Asheim et al., 2013) and the creation of supportive institutional structures.

Several scholars have argued that macro-institutional structures have a major influence on directions of regional change. Storper (2011) claimed that path renewal is typical for Europe whilst the US has a stronger tendency for radical innovations and new path creation. Boschma and Capone (2014) provided empirical evidence that national institutions in liberal market economies promote unrelated diversification (new path creation) while coordinated market economies encourage related diversification (path renewal), as their less flexible institutions do not allow them to move in more unrelated fields of activities. However, such tendencies found in coordinated market economies can be compensated by strong pro-active policy interventions as is seen, for example, in Sweden by VINNOVA's (Swedish Governmental Agency for Innovation Systems) centre of expertise policy of building regional innovation systems or strong regional research and innovation milieus. This perspective has important implications for the potentials of a smart specialisation strategy as well as for how to design and implement such a strategy.

Recent conceptual work that points to varying capacities of regional economies (Boschma, 2014b) and RIS (Isaksen and Trippl 2014a) to renew their economic structures is highly relevant given the purpose of this paper. Boschma (2014b) argues that regions characterized by industrial diversity, weak ties and a loosely coherent institutional structure have better chances to develop new growth paths. Isaksen and Trippl (2014a) explore the relation between RIS configurations and various forms of regional industrial path development. They distinguish between three different types of RIS: organizationally thick and diversified systems; organizationally thick and specialized systems; and organizationally thin systems. Through a conceptual analysis it is demonstrated that these three RIS types differ enormously in their capacity to promote new path development (Table 5).

Table 5: RIS types and regional industrial path development patterns and challenges

	Characteristics	**Typical development patterns**	**Weak RIS structures for …**
Organizationally thick and diversified RIS	Wide range of heterogeneous (but related) industries and knowledge bases → high potentials for cross-sectoral knowledge flows & recombinations of knowledge; strong research organizations → high potentials for commercializing research; bridging (& bonding) social capital	Path renewal and new path creation	… path extension (too little exploitation) → lack of industrial focus; emerging paths may not achieve critical mass; instability in institutional arrangements (fragmentation)
Organizationally thick and	Narrow industrial base, specialized knowledge & support	Path renewal	… switching to new growth paths (lack of industrial and

specialized RIS	structure; bonding (& bridging) social capital	Path extension (positive lock-in) Path exhaustion (negative lock-in)	organisational variety; too little exploration)
Organizationally thin RIS	Weakly developed clusters, poor endowment with knowledge & support organizations, bonding social capital	Path exhaustion	… new path development (lack of critical mass of actors, little variety)

Source: own compilation based on Isaksen and Trippl (2014a)

Thick and diversified RIS offer excellent conditions for path renewal and new path creation due to the presence of related variety, combinatorial knowledge dynamics, academic entrepreneurship and a favourable set-up of knowledge generating organisations. Organisational thick and specialized RIS, in contrast, tend to support path extension but face the risk of path exhaustion if positive lock-in turns into negative lock-in. However, some RIS belonging to this group benefit from a sufficiently large generic competence in their field of specialisation, which may form the basis for path renewal processes. Investment into the region's research infrastructure to strengthen and widen the exploration capacity of the RIS can essentially enhance such processes (Asheim and Grillitsch, 2014). Path renewal may also be triggered by the inflow of non-local knowledge and its combination with the highly specialized assets available within the region. Organisationally thin RIS have a limited capacity of promoting path extension and thus they have to deal with the danger of path exhaustion (although for different reasons than organisationally thick ones).

Both organisationally thick specialised regions and especially organisationally thin regions have thus weakly developed RIS structures for supporting new regional industrial path development. The main development challenge for these RIS types is to avoid being caught in the "path exhaustion trap". Organisationally thick and diversified regions, in contrast, may suffer from weak structures for path extension mainly due to a reduced industrial production (exploitation) capacity. A too strong focus on and use of assets and resources for knowledge exploration and new path development can lead to a too rapid decrease in knowledge exploitation capacity, causing fragmentation problems.

2.4 Summary

To summarise, the system failure approach, the notions of organisational and institutional thinness, the knowledge base concept as well as recent work on the relation between RIS types and new path development offer many insights into what exactly might be less developed in RIS. A RIS can be seen as less developed if it is ill equipped to generate innovations along existing industrial and technological paths (static view). However, it might also be less developed in the sense that it lacks the capacity to support the renewal of the regional economy over time (dynamic view). Given the fact that smart specialisation strategies aim at initiating regional transformation, it is the latter aspect that should deserve more attention in future research. Key issues that remain poorly understood include amongst others the role of exogenous sources (external connectedness of regions) of regional change (Isaksen and Trippl, 2014b) and how multiscalar institutional frameworks shape path renewal and new path creation (Gertler, 2010).

3 Empirical Approaches

This section takes a closer look at three empirical approaches to measure innovation activities in regions and to identify less developed RIS. The approaches selected for a critical examination include the Regional Innovation Scoreboard (European Commission, 2014), the Regional Innovation Monitor (European Commission, 2013) and the typology of regions suggested by the OECD (2011).

3.1 Regional Innovation Scoreboard

The Regional Innovation Scoreboard provides a comparative assessment of 190 regions within the European Union, Norway and Switzerland and is complementary to the Innovation Union Scoreboard, which benchmarks innovation performance at the national level. The latest Regional Innovation Scoreboard was completed in 2014, using the same methodology as the Innovation Union Scoreboard. Due to problems of data availability, however, it is based on fewer indicators (see Table 6). Three main groups of variables with regard to innovation are considered: enablers, firm activities and outputs (European Commission, 2014).

In the Innovation Union Scoreboard three types of **enablers** are covered: human resources; research systems; and finance and support. Due to a lack of regional data, they are only considered to a limited extent in the Regional Innovation Scoreboard. Only two indicators are included, namely 'percentage of population aged 25-64 having completed tertiary education' as a measure for human resources, and 'R&D expenditure in the public sector as % of GDP' as an indicator for finance and support. No indicators for measuring the openness and attractiveness of research systems are available. Indicators for **firm activities** are grouped into firm investments, linkages & entrepreneurship and intellectual assets. Firm investments are measured by 'R&D expenditures in the business sector as % of GDP' and by 'non-R&D innovation expenditures as % of turnover' in SMEs. The latter indicator is based on CIS data and is supposed to indicate the diffusion of new production technology and ideas by measuring, for example, investments in equipment and machinery or the acquisition of patents and licenses. Data from CIS is also used for the two indicators on linkages and entrepreneurship, to measure the share of SMEs that have innovated in-house and are involved in innovation co-operation with others. Intellectual assets are covered by the number of EPO patent applications in relation to regional GDP.

Table 6: A comparison of the indicators included in the Innovation Union Scoreboard and the Regional Innovation Scoreboard (data availability in parenthesis)

Innovation Union Scoreboard	Regional Innovation Scoreboard
ENABLERS	
Human Resources	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	Regional data not available
Percentage population aged 30-34 having completed tertiary education	Percentage population aged 25-64 having completed tertiary education (94.9%)
Percentage youth aged 20-24 having attained at least upper secondary level education	Regional data not available
Open, excellent and attractive research systems	

International scientific co-publications per million population	Regional data not available
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	Regional data not available
Finance and support	
R&D expenditure in the public sector as % of GDP	Identical (71.8%)
Venture capital (early stage, expansion and replacement) as % of GDP	Regional data not available
FIRM ACTIVITIES	
Firm investments	
R&D expenditure in the business sector as % of GDP	Identical (75.1%)
Non-R&D innovation expenditures as % of turnover	Similar (only SMEs) (55.3%)
Linkages & entrepreneurship	
SMEs innovating in-house as % of SMEs	Identical (60.9%)
Innovative SMEs collaborating with others as % of SMEs	Identical (64.2%)
Public-private co-publications per million population	Regional data not available
Intellectual assets	
PCT patent applications per billion GDP (in PPS€)	EPO patent applications per billion regional GDP (PPS€) (87.6%)
PCT patent applications in societal challenges per billion GDP (in PPS€)	Regional data not available
Community trademarks per billion GDP (in PPS€)	Regional data not available
Community designs per billion GDP (in PPS€)	Regional data not available
OUTPUTS	
Innovators	
SMEs introducing product or process innovations as % of SMEs	Identical (64.5%)
SMEs introducing marketing or organisational innovations as % of SMEs	Identical (63.3%)
Employment in fast-growing firms of innovative sectors	Regional data not available
Economic effects	
Employment in knowledge-intensive activities (manufacturing and services) as % of total employment	Employment in medium-high/high-tech manufacturing and knowledge-intensive services as % of total workforce (91.8%)
Contribution of medium-high and high-tech product exports to the trade balance	Regional data not available
Knowledge-intensive services exports as % of total service exports	Regional data not available
Sales of new to market and new to firm innovations as % of turnover	Similar (only SMEs) (49.6%)
License and patent revenues from abroad as % of GDP	Regional data not available

Source: European Commission (2014, p. 9)

The indicators of innovation **outputs** aim to measure the innovative outputs of firms (the innovators) and the regional effects. Based on CIS data, two indicators are used for measuring the performance of innovators: the share of SMEs introducing product or process innovations, and the share of SMEs introducing marketing or organisational innovations. As regards economic effects, the Regional Innovation Scoreboard considers the share of employment in knowledge-intensive activities and the sales of new-to-market and new-to-firm innovations in relation to turnover.

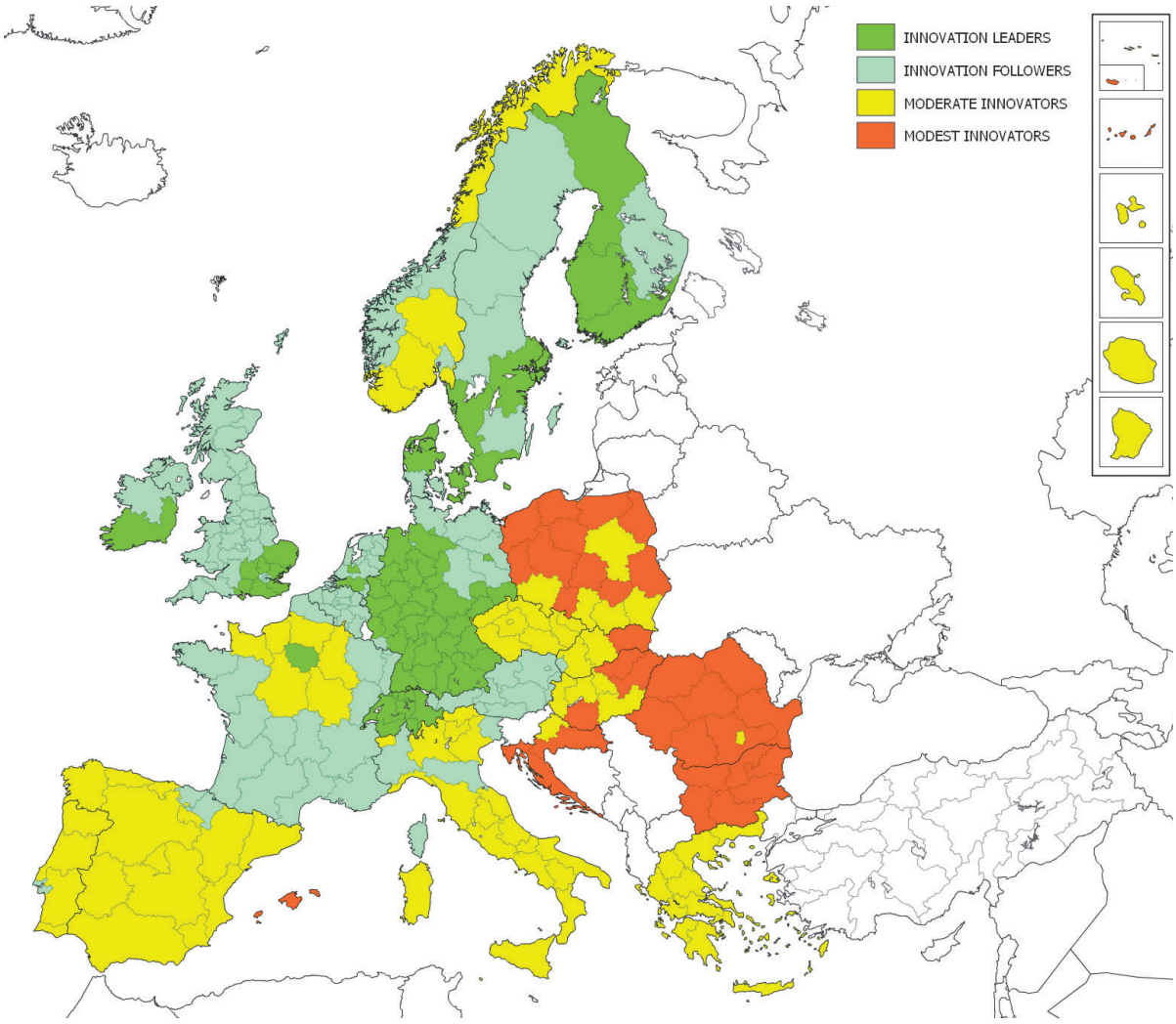
In addition to the lack of regional data for a number of indicators (see Table 6), almost 30% of data for the indicators included in the Regional Innovation Scoreboard is missing. For some of the indicators, such as 'sales of new-to-market and new-to-firm innovations' and 'non-R&D innovation expenditure', data availability is only around 50%. Furthermore, data availability differs between countries. In Bulgaria, the Czech Republic and Slovakia, the availability is 100% whilst in Denmark, Croatia and Switzerland it is below 30%. To increase data availability a technique for regionalization has been adopted from CIS, followed by a number of imputation practices for the remaining missing CIS data and for the indicators using other data (primarily Eurostat) (European Commission, 2014).

Using the Regional Innovation Scoreboard, regions in Europe can be categorized in four categories based on their relative performance, with thresholds at the same levels as in Innovation Union Scoreboard. **Innovation Leaders** are those regions performing 20% or more above the EU average. In the Regional Innovation Scoreboard 2014, these regions have the highest performance in all indicators except the share of SMEs involved in innovation co-operation with other companies. Among the key strengths of innovation leaders are business activities and higher education. **Innovation followers** are regions at levels between 90% and 120% of the EU average. They are performing well on indicators measuring SMEs co-operation in innovation activities and share of SMEs innovating in-house but less well on indicators related to the performance of their business sector. **Moderate innovators** are performing between 50% and 90% of the EU average and **modest innovators** perform below 50% of the EU average, the latter with low scores on all indicators except being equipped with a relatively well-educated population (72% of the EU average).

Following the map laid out in Figure 1, we can observe that the regions belonging to the modest innovators are largely to be found in the post-socialist transition economies. Others are to be found in Croatia and the islands off the Mediterranean coast of Spain. Moderate innovators are more broadly distributed across Europe, with significant groupings in the southern member states (Spain, Portugal, Italy and Greece) the Czech Republic, and parts of Slovakia, Hungary and Poland. Furthermore, there are pockets of moderate innovators in countries that generally exhibit higher levels of performance, such as northern France (surrounding Ile de France) and Norway.

The features that characterize these modest and moderate innovators vary across regions and national context, and we suggest that the patterns illustrated above provide the basis for identifying three key categories: first, regions and countries experiencing post-socialist transitions; second, regions and countries located in southern Europe; and third, regions underperforming in comparison with their surrounding context.

Figure 1: Regional performance groups in the Regional Innovation Scoreboard 2014



Source: European Commission, 2014, p. 16

In a comparison of the initial performance levels and the change in performance between 2004 and 2010 for all regions in the Regional Innovation Scoreboard, no 'catching-up' processes can be observed. Less-performing regions are not growing faster than well-performing ones during this time period. However, most regions have improved their innovation performance during the observation period. In regions located in southern Europe and regions underperforming in comparison with their surrounding context, a decrease in innovation performance is seen in some regions such as the east coast of Spain, but the main pattern is that innovation performance is increasing. In regions experiencing post-socialist transitions innovation performance growth is more divergent, most notably with groups of decreasing regions in Eastern Poland, Croatia and Western Romania. Here we have a number of less-performing regions experiencing a relative decline of innovation performance over time.

The Regional Innovation Scoreboard suffers from several shortcomings. As already mentioned above, it is based on a rather low number of indicators and data is missing for many regions. For some indicators, survey data is used, whilst others are based on register data. Another problem is that the Regional Innovation Scoreboard sometimes corresponds to NUTS1 and sometimes to NUTS2 regions. Among the indicators in the Regional Innovation Scoreboard, there is a bias towards measuring R&D-driven innovation activities and even though non-R&D activities are targeted (for example through non-R&D expenditure as % of turnover in SMEs), it remains obscure what is covered in this regard. Whilst some indicators are broad and can include a wide variety of innovations, most are more narrow and targeted towards measuring analytical knowledge, the STI mode of innovation and narrowly defined RIS. Neither does the Regional Innovation Scoreboard consider the degree of regional specialisation, neglecting, for instance, the possible dependence of regions on an industrial mono-structure, fragmentation problems or a lack of positive lock-ins. Thus, it fails to identify what system failures or system deficiencies are prevailing in the region. Moreover, it does not offer insights into problems of organisational and institutional thinness, nor does it capture the capacity of regions to support regional industrial change.

3.2 Regional Innovation Monitor

The Regional Innovation Monitor (RIM) provides information on regional innovation policies for 20 EU Member States[2]. The aim is to provide intelligence on innovation policies in some 200 regions across these member states, and to offer easy access and a comparative overview of regional innovation policies. Information and analysis of policy documents, governance structures and existing innovation policy initiatives are collected at NUTS1 and NUTS2 levels. The RIM repository gives a comprehensive overview of the state of development of regional innovation policies and strategies as well as the state of the implementation of these, in all 200 regions. In addition to this, 80 in-depth regional reports (RIM Plus) have been prepared since 2011 (European Commission, 2013).

In these in-depth regional reports, the focus is on identifying areas for improvement or challenges in the RIS, regardless of the regions' innovation performance. The policy governance and policy instruments are analysed and conclusions for future policy making are drawn. Through qualitative analyses the RIM Plus reports seek to provide insights into how to address the prevailing challenges in the region. However, they do not provide a clear-cut way of identifying less-developed RIS.

Each region in the RIM repository has been categorized in one of three categories: world-class performers, regions with strong focus on industrial employment and regions with a focus on the service sector and public R&D. The classification has been made using the regional distribution of employment and R&D expenditure. If these categories are related to the Regional Innovation Scoreboard (see above), we find that a majority of world-class performers are labelled innovation leaders in the scoreboard. About two thirds of the regions that have been classified as modest and moderate innovators in the scoreboard, are categorised as regions with strong focus on industrial employment in the RIM analyses (European Commission, 2013). In summary, the RIM focuses

[2] Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden and the United Kingdom.

primarily on the policy and governance dimension of RIS. It could be used as a tool for identifying what deficiencies, especially with regard to the policy subsystem, are dominant in less-developed regions.

3.3 OECD approach

By using data from the OECD Regional Database, Ajmone Marsan and Maguire (2011) suggest a categorisation of regions with the aim of capturing the regional socio-economic and production structure as well as variables associated with innovation activities. This is the approach used to categorise regions in the report "Regions and Innovation Policy" (OECD 2011). Based on the availability of data in the OECD Regional Database, twelve variables are selected to reflect the regional socio-economic structure, industrial structure and some input- and output-indicators "commonly associated with an innovation-friendly environment" (Ajmone Marsan and Maguire, 2011, p. 11). When selecting variables, there was a trade-off between the breadth of variables and the number of countries with available data, in an effort to maximise the number of regions for the analysis[3]. Three broad categories are identified and are divided into eight sub-categories (see Table 7). A majority of regions (60%) were identified as **industrial production zones**, characterized by an industrial structure that faces specific challenges for restructuring and transformation. The highest wealth levels and best performance on science- and technology based innovation-related indicators are found in the **knowledge hubs**, constituting 15% of all regions. Finally, 24% of all regions are **non-S&T-driven regions**, sharing a peripheral location and are lacking knowledge absorption and generation capacity to keep up with other OECD regions.

Table 7: Variables and categorisation of OECD regions

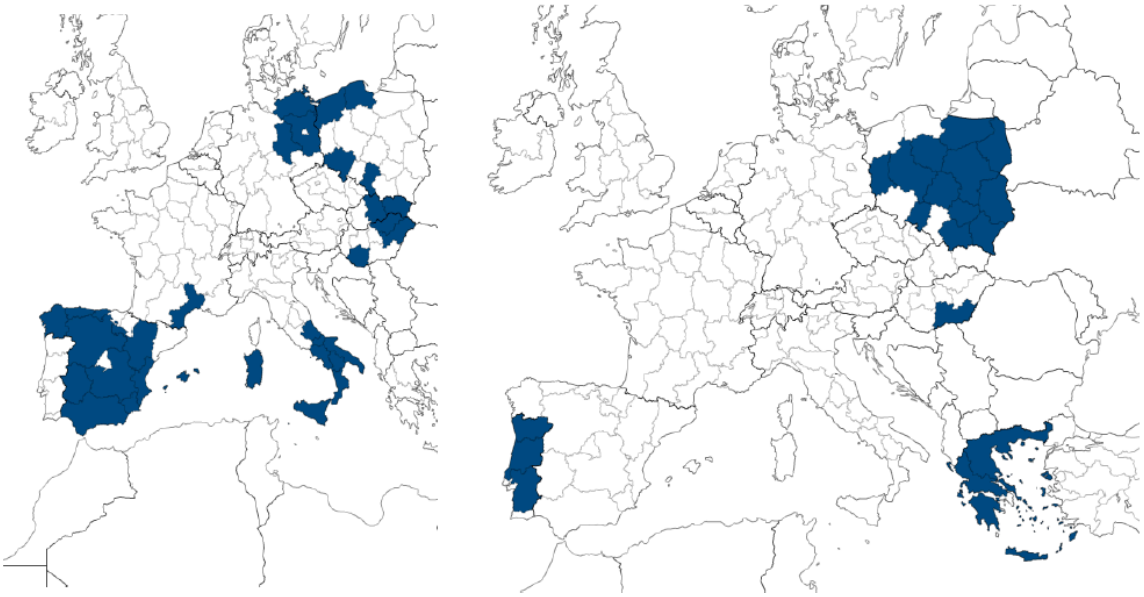
Variables (Ajmone Marsan and Maguire (2011)	**Categorization of OECD regions** (OECD 2011)
Gross Domestic Product (GDP) per capita	**Knowledge hubs (38 regions)**
Population Density	Knowledge intensive city/capital districts
Unemployment Rate	Knowledge and technology hubs
Percentage of the labour force with tertiary education	**Industrial production zones (145 regions)**
Gross domestic expenditure on R&D as share of GDP	US states with average S&T performance
Business R&D expenditure as a share of total R&D expenditure	Service and natural resource regions in knowledge-intensive countries
PCT patent applications per million inhabitants	Medium-tech manufacturing and service providers
Share of employment in the primary sector	Traditional manufacturing regions
Share of employment in the public sector	**Non-S&T-driven regions (57 regions)**
Share of employment in manufacturing	Structural inertia or de-industrialising regions
High & medium-high technology manufacturing as a & of total manufacturing	Primary-sector-intensive regions
Knowledge-intensive services as % of total services	

Sources: Ajmone Marsan and Maguire (2011), OECD (2011)

[3] All OECD countries except Australia, Chile, Estonia, Iceland, Israel, Japan, Mexico, New Zeeland, Turkey, Slovenia and Switzerland are included in the analysis.

The non-S&T-driven regions are divided into 'structural inertia or de-industrialising regions' and 'primary-sector-intensive regions' and account for only 8% of the sample GDP (compared to 14% of the population). These are regions that face processes of de-industrialisation or experience structural inertia and regions with a significant share of their economies in primary sector activities or low-technology manufacturing, located across primarily Eastern and Southern Europe. The primary-sector-intensive regions are lagging behind all other groups, in terms of GDP per capita and innovation-related indicators. As seen in Figure 2, these regions largely correspond to regions experiencing post-socialist transitions and regions in southern Europe and are considered by Ajmone Marsan and Maguire (2011) to capture the peripheral economies in Europe. However, with the exception of two regions in southern France, no regions underperforming compared to their surrounding context are found. This probably relates to the methodology used, measuring the industrial structure by the share of employment in broad sectoral terms (primary, public, manufacturing and service sectors), leading to a spatial clustering of regions within the same category.

Figure 2: Structural inertia or de-industrialising regions (left) and primary-sector-intensive regions (right)



Source: Ajmone Marsan and Maguire (2011, pp. 25-26), own modification

The indicators proposed by Ajmone Marsan and Maguire (2011) are useful for identifying regions with weak economic structures as well as weak innovation capabilities. Measurement of innovation is, however, restricted to variables such as R&D and patenting intensity that may capture activities in analytical sectors and the STI mode of innovation but are inadequate to assess the performance of other knowledge bases, innovation modes and broadly defined RIS (see below). Furthermore, these indicators are mainly targeting the current economic state of the region and, as the authors themselves acknowledge, are lacking a dynamic dimension. The OECD typology do not consider what factors are determining the transformative capacity of a RIS, or what factors are resulting in a lack of such capacity. Moreover, as already stated above, the indicators used in the OECD typology approach to proxy the innovation environment are mainly measuring analytical knowledge and narrowly defined RIS. Neither do they cover the degree of specialisation in the regional industrial structure. In addition, even though non-S&T-

driven regions are identified as less-performing regions, the OECD approach does not take into consideration the heterogeneity existing within this group. This issue is also seen in the case with regions categorised as industrial production zones, where this approach acknowledges that these regions are facing challenges for restructuring and transformation but treats these challenges as specificities to each region, failing to provide insights into more general innovation and transformation problems that might curtail development in these regions.

4 Conclusions and Outlook

The critical review and discussion of conceptual and empirical approaches to identify less-developed RIS has shed light on a large number and variety of barriers and weaknesses that may curtail innovation and regional industrial change. The RIS concept offers many insights in this regard and allows for the development of useful typologies of less-developed RIS that are highly relevant for the current debate on the design and implementation of smart specialisation strategies.

There are several challenges for future research. First, future conceptual research should further advance our understanding of opportunities and challenges for regional industrial change in different types of RIS. Recent work on the relation between RIS configurations and new path development has made an important contribution in this regard. The focus has thus far been on how the degree of organisational thickness and the degree of specialisation of industrial structures shape the direction of regional industrial change. The institutional dimension of RIS has received less attention in this work. A key issue of future research is thus to explore how institutions at various spatial scales and institutional change affect new path development in different RIS types. Another core question that deserves due attention in future work concerns the role of exogenous sources of regional industrial change. New path development has thus far been conceptualised as a process that builds on endogenous assets. The role of global innovation networks and other forms of exogenous development impulses (and their interplay with locally available knowledge) have been underplayed in the literature and remain poorly understood. There is thus a need for systematic analyses of how extra-regional knowledge flows and external connectedness affect the extension, renewal and creation of regional industrial paths. Third, little is known about the nexus between RIS transformation and regional industrial change. Future research should thus address the question of how various RIS types transform themselves as a result of path renewal and new path creation.

Second, existing empirical approaches fall short of taking account of conceptual insights into system failures, organisational and institutional thinness, misconfigurations of RIS in relation to knowledge bases and weak RIS structures for different forms of path development. In other words: advances that have been made in conceptual debates on specificities of less-developed regions are only partly reflected in existing empirical approaches. There is still a tendency to measure narrowly defined RIS, analytical (R&D based) knowledge and the STI mode of innovation and build typologies based on the findings of these exercises. There is a need to consider in particular recent findings on the role of different types of knowledge bases and innovation modes (as well as their combination) and broadly defined RIS in empirical research that aims at revealing misconfigurations of RIS. In addition, the transformative potential of RIS, that is, their capacity to support new path development, is hardly captured. There is a need for

developing new measures and indicators to be used in quantitative research as well as new designs for qualitative case studies that take into consideration the issues raised above. Building on the analytical insights provided in this working paper, current research in the context of the project "Smart specialisation for regional innovation" could make a valuable contribution to enhance understanding of how diversified specialisation or specialised diversification can be achieved among the heterogeneity of European regions.

3. Challenges and opportunities facing regions with less developed research and innovation systems - the role of economic structure: the global production networks perspective

Introduction

It has been argued in the Reflection paper that economies of regions with less developed research and innovation systems can be characterised by the following triad of key weaknesses of their economic structure. First, by widely prevalent branch-plant syndrome (this issue has been already extensively covered by the literature on trans-national corporations and on FDIs including investigations of their spillovers and impacts - see for example, Massey, 1984, Dunning, Lundan, 2008, Pavlínek, Žížalová, 2014, Pavlínek et al 2009). Second, these regions are typical by weak endogenous SMEs sector (this issue is also frequent in the literature, but often lacks proper theoretical framework). The third feature of these regions is locking-in of a sizeable part of companies in these regions as the lower-tier suppliers of global production networks/global value chains (GPNs/GVCs). These studies are generally well-embedded into sound and still advancing theoretical framework (e.g. Ernst and Kim, 2002, Gereffi et al, 2005, Coe et al, 2008, Barrientos et al, 2011), but much less attention is being paid to a normative side, i.e. to possible policy implications (for exceptions see Humphrey and Schmitz, 2002, Humphrey, 2006). However, even these studies focus predominately upon challenges stemming for local firms from GVC/GPN perspective from the angle of developing countries. Consequently, all three above-mentioned features translate themselves into limited internal connectivity among regional actors (firms, R&D institutions, various intermediary bodies etc.) which represents – in line with the theory of regional innovation systems (Cooke, 2004) – one of the principal bottlenecks for development of these regions (Tödtling, Trippl, 2005, Tödtling and Trippl, 2013).

Therefore, the aim of this research paper is to make an attempt to advance the discussion about the evolutionary dynamics of actors engaged in GPNs with the ultimate aim to stimulate discussion about possible policy implications for European regions with less developed research and innovations systems. This should be achieved by an attempt to develop a typology of functional upgrading and of downgrading. Consequently, it will be argued that acknowledging different types of functional downgrading – arguably the most desirable type of upgrading – and of different types of downgrading, each inducing different challenges but also offering different opportunities would contribute not only to enhancing understanding of multiplicity of evolutionary trajectories of suppliers integrated in GPNs, but would also open the space for developing of much more targeted policy interventions.

Regions with less developed research and innovation systems – a global production network perspective

Over the last 20 years has been proceeding a vigorous debate on the role of GPNs/GVCs in current globalised economy (Gereffi, 1999, Humphrey and Schmitz, 2002, 2004, Henderson et al, 2002, Cattaneo et al, 2010, Barrientos et al, 2011, Sturgeon et al, 2008). The research helped to unravel various modalities of governance of these networks or chains (Humphrey and Schmitz, 2002, 2004, Gereffi et al, 2005) and later even their evolutionary dynamics (Patel-Campillo,

2010, MacKinnon, 2011, Ponte, 2014). Scholars identified various mechanisms and processes integrating particular GPNs/GVCs such as various types of strategic coupling, resp. decoupling and recoupling (Yeung, 2009, resp. Horner, 2013) as well as analysed interrelations of these economic meta-structures to host of other actors such as governments, regulators, trade unions, NGOs, etc.(Ponte, 2014).

The theory of global production networks is a powerful tool for i) understanding of the changing economic geography of the world (Gereffi, 1999), and ii) for understanding the challenges facing the firms, which are integrated into these networks/chains (Humphrey and Schmitz, 2004, Humphrey, 2006). Key argument of GPNs/GVCs approach is that sizeable part of world's production is organized by large enterprises, which command the networks/chains of suppliers of different tiers and these networks are governed by different modes of governance, which are differentiated not only among particular GPNs (Humphrey and Schmitz, 2004), but even within them (Isaksen, Kalsaas, 2009). Therefore, global production networks are mostly commanded by lead firms, which are usually large transnational corporations leading the market "in terms of their brand names, technology, products/services, and marketing capabilities" (Yeung, 2009, p. 330). However, due to managerial reasons, the lead firms are directly dealing only with a limited number of first-tier suppliers, which are providing them with key components or most sophisticated (sub)systems, even though this is not a universal model of governance (see Humphrey and Schmitz, 2004). First-tier suppliers (often also large transnational corporations) then command their own suppliers of a second- or third-tier.

Obviously, in reality, various modalities of governance strategies can be found. For example, lead firms within the automotive sector employ not only contrasting strategies to penetrate new markets, but also sharply different modes of governance of their GPN/GVC (Sturgeon et al, 2008, Glogar, 2013). The varying governance strategies of lead firms concern not only external suppliers, but even branch-plants in their possession (Glogar, 2013). Importantly, among firms and other actors integrated into GPNs proceed intensive mutual links and learning, which are often spanning the regional and national borders (Pavlínek, Žížalová, 2014). Among the examples of benefits emanating from engagement in GPNs are improvement of management and logistics methods and systems, improvements of technology standards, including the systems for quality control, cooperation in the sphere of R&D etc. (Isaksen, Kalsaas, 2009). Therefore, Humphrey and Schmitz (2004) even explicitly talk about "tutoring role" of buyers.

Importantly, each stratum of suppliers within GPNs/GVCs commands its own advantages but also disadvantages. In particular, the third-tier suppliers, which represent the most frequent type of suppliers in regions with less developed research and innovations systems (Csank, 2012) have guaranteed demand (often in large volume) for standard goods produced on a well-known technology, and obviously, do not have to bother with market research.

On the other hand, three-tier suppliers are exposed to tremendous cost pressure and are operating under permanent threat of being replaced by cheaper suppliers (e.g. from the Far East, see Humphrey, Schmitz, 2004). Evidently, the cost pressure is not unique to third-tier suppliers, nevertheless, according to Glogar (2013), the specific situation of these suppliers (often local SMEs) stems from the fact that they are frequently squeezed in-between large suppliers both from "above" (i.e. from higher-tier suppliers) and from "below" (i.e. from large firms, which are supplying them with the basic production materials such as various metals, plastic granule,

energy etc.). Therefore, bargaining power (and hence, the profit margin) of these lower-tier suppliers is really limited. According to some evidence, the profit margin of lower-tier suppliers often varies between 3-5%[4].

However, much more important is the fact that these third-tier suppliers are charged with production of large quantities of standardized goods produced on a well-known technology. Consequently, these firms are not expected to come with any sort of innovation except for cost-saving measures (i.e. "process upgrading") (Csank, 2010). Therefore, even if these third-tier suppliers are integrated into GPNs orchestrated by high-tech (or medium-tech) lead firms, and even in case there is nearby a research institution (e.g. a university) focused on the potentially relevant topic, the space for mutual cooperation between research institution and the firm as envisaged by triple helix or regional innovation systems theory is fairly limited. Consequently, given narrow profit margins of these lower-tier suppliers as well as provided their limited prospects stemming from their low-road competitive strategy, the concept of upgrading is of key relevance for these firms.

However, while there is a vast amount of literature on various aspects of GPNs/GVCs in both highly developed and developing countries, there is only limited number of studies applying these theories to less developed European countries and regions, such as those in Southern Europe or in the former command economies (for exceptions, see e.g. Pavlínek, Ženka, 2011, Smith et al, 2008). Nevertheless, even more limited is the number of studies, which would be exploring various types of upgrading in case of firms located in less developed European regions and, especially, which would be deriving potential policy implications. Likewise, according to available knowledge, there is just a single article dealing with complexities of upgrading in case of firms nested in highly developed country (Isaksen, Kalsaas, 2009 on the case of Norway). Nevertheless, while this article succeeded in a provision of a detailed anatomy of upgrading in the case of particular company, it did not forward specific policy implications. Consequently, in the literature, there is considerable gap, which closing is, moreover, offering huge potential for design of supportive policies.

However, what is clear from the existing research, is the fact that there exists a variety of types of governance of these global production networks from quasi-hierarchical (or captive) to network (or modular) each offering different opportunities for upgrading - see e.g. Gereffi, et al (2005) or Humphrey, Schmitz (2002). The type of governance varies not only among different GPNs within the same industry (Glogar, 2013), but even among particular firms integrated within the same GPN (Isaksen, Kalsaas, 2009). In addition, Ponte (2014) argued persuasively that while much of the existing literature has conceived GPNs as unipolar governance systems (i.e. driven by lead firms) and only few scholars moved to bipolar conceptualisation of GPNs, Ponte suggested to reconceptualise GPNs´ governance as a continuum between unipolarity and multipolarity. Multipolar conception of governance of GPNs proved helpful in explanation of evolutionary dynamics of GPNs and, especially, for taking-in strategic actions of powerful actors outside the chain such as governments, standard developers, international NGOs, certification agencies, labour unions, consumer associations (Ponte, 2014).

[4] These data were provided during a meeting with entrepreneurs, which was held in Prague in December 2013 in conjunction with a drafting of the Czech smart specialisation strategy.

Moreover, recently, it was shown, how the power asymmetry within the GPN can be not only moderated, but even completely reversed by a joint action of firms and the regulator (Patel-Campillo, 2010). Moreover, Isaksen and Kalsaas (2009) have recently shown that the power asymmetry between the lead firm and its suppliers may change even during the production phase of a given product. Namely, while during the phase of product development the relationship can be characterised as network, during the production phase the governance shifts to quasi-hierarchy mode, when the lead firms for example requires open-book approach concerning the cost-structure during the negotiation of contracts (Isaksen, Kalsaas, 2009). All these examples pervasively show that the existing power asymmetry should not be considered as a pre-given and ever-lasting, but rather as a point of departure. From this observation follows an important argument. In particular, it can be expected that if firms would be able to pursue a suitable upgrading strategy and provided that companies would be supported in their efforts by a targeted public intervention, there is a reasonable chance that limitations following from unfavourable mode of their integration into GPNs can be overcome. Hence, the issue of upgrading comes to the forefront.

Even more surprising gap in current understanding of challenges of regions with less developed research and innovation systems is the fact that there is no information available about the extent and type of integration of particular regional economies into different types of GPNs (according to governance structure, type of production (high-/medium-/low-tech), country of origin, and, most importantly, the structure of suppliers according to tiers etc.). According to the best of our knowledge, there is only one study, which authors at least tried to estimate the extent to which a particular economy is engaged in GPNs (Novotný et al, 2014). On the case of the Czech economy they estimated that up to 75% of the value added by manufacturing industry is produced by firms integrated into GPNs. Even though investigation of the extent to which particular national and regional economies are incorporated into GPNs is beyond this smart specialisation project, the information about the scale and type of integration of particular regional economies at least into basic types of GPNs would represent a significant advancement of existing knowledge, moreover, with important policy implications. Without such knowledge, the strategies and policies are running a substantial risk of being misguided. Likewise, innovation strategies on both national and regional levels would be much more realistic if understanding of the different forms of upgrading (and their preconditions) would be enhanced.

While these gaps in understanding of the role of GPNs and of particular challenges and opportunities of various suppliers are hindering comprehension of innovation strategies across various regions, this lack of knowledge is particularly painful in case of the former command economies in Central Eastern Europe. This is due to lock-in of a sizeable part of theses economies within the lowest tiers of GPNs due to their specific evolutionary path, which will be briefly outlined in the next paragraph.

In particular, the collapse of state-socialism in Central Eastern Europe, and subsequent economic transformation resulted *inter alia* in fundamental alteration of evolutionary trajectories of the former stated-owned companies, but impinged also upon the opportunities of newly established private firms. First, the existing original equipment manufacturers (OEMs), which were shielded against competition by the command economy and by restrictions of foreign trade, suddenly, after the economic liberalisation, become uncompetitive. Subsequently, they were privatized and the new owners were searching for a possible survival strategy. One of these strategies have been

to narrow the production portfolio to products (often components) where the firm felt itself most competitive. Therefore, instead of production for end market, these firms shifted their production towards particular components. Such a strategy has been frequent for example in electro-technic industry (Csank, 2012). From GPNs/GVCs perspective, such a process represents a sort of economic downgrading. Second, numerous suppliers of components (for example, for the automotive industry) faced a challenge to enhance the quality of production significantly, while keeping the cost at the same level. This was often achieved by a combination of process and product upgrading. Obviously, numerous suppliers were not able to sustain the market pressure and were forced either into bankruptcy or to switch into a new – often less sophisticated – market segment. In contrast, number of cases when the firm was able to shift towards the activities with higher value added was severely limited (Pavlínek, Ženka, 2011). Third, in many cases, the newly established firms have been lured by a strong demand for simple components emanating from foreign firms (located either in abroad or operating in a given country). This demand, according to Csank (2010), represented a sort of "low-hanging fruit", i.e. a relatively easy business model based on those days low-cost advantage. However, this model proved to be hardly sustainable due to rising input costs as well as due to growth of production capabilities and resulting sharp competition from newly industrialized countries.

Therefore, despite certain variations in their evolutionary paths, one of important transversal features of a large number of European regions with less developed research and innovation system in Southern Europe, but especially in Central and Eastern Europe, is the fact that an important segment of their economies is formed by local firms operating as lower-tier suppliers to various global production networks.

Consequently, in case of regions, which economic structure is densely dotted with third-and second-tier suppliers, the concept of upgrading is of key relevance. For that reason, the next section will be devoted to concepts of upgrading and downgrading, which constitute key processes of internal evolutionary dynamics of global production networks.

Upgrading and downgrading – the evolutionary dynamics within the global production networks

In this section, effort will be made to enrich the discussion on concepts of economic upgrading as well as on downgrading. This discussion would emphasise the internal evolutionary dynamics of GPNs and underline the multiplicity of potential strategies of firms engaged in GPNs. Therefore, first, established types of upgrading will be briefly introduced. Second, several types of functional upgrading (arguably the most desirable type of upgrading as it is closely related to distribution of gains from globalisation - see Humphrey, Schmitz, 2004) will be distinguished and argued that each type offers different opportunities for the firms concerned. Third, relevance of particular types of upgrading according to a position of a given firm within the GPN hierarchy will be scrutinized. Fourth, a special attention will be paid to downgrading, which has so far remained rather under-researched. In particular, several types of downgrading will be distinguished and argued that one-sided negative connotation of this concept should be avoided.

Upgrading has been recently briefly defined as a shift „to higher value added activities in production, to improve technology, knowledge and skills, and to increase the benefits or profits deriving from participation in GPNs" (Barrientos et al, 2011, p. 323). Upgrading is one of key

concepts firmly established within GVC/GPN framework, and, so far, several different types of upgrading have been introduced. Three types of upgrading achieved nearly general acceptation by the GPNs/GVCs researchers. These are: i) process upgrading representing esp. various cost-saving measures to enhance efficiency of production, ii) product upgrading, which is achieved by manufacturing of more sophisticated products, and iii) functional upgrading – a shift towards the activities with higher value added such as developing own brand or abandoning existing lower-level functions (Humphrey, Schmitz, 2004). However, while process as well as product upgrading has been documented as frequent by the GVC/GPN research, there is less agreement in the literature upon a prevalence of functional upgrading as it might be constrained by buyers´ resistance eager to protect their core competence as well as by resource requirements and associated risks (ibid.).

In addition, several other types of economic upgrading have been identified in the literature as well. In particular, intersectoral upgrading occurs in case the firm is using its technology and know-how gained due to its engagement within the GPN for production of goods for end market where the company is able to enjoy higher profit margin (Humphrey and Schmitz, 2004). In contrast, (inter)chain upgrading, represents a shift to another GPN, where the firm can reach better and/or higher position for example in case the GPN is more technologically advanced and/or is oriented upon production for higher status buyers (Barrientos et al, 2011). Needless to say, however, that chain upgrading is by some authors considered as more or less identical to intersectoral upgrading (Rabellotti, 2014). Moreover, chain upgrading as evolutionary process from low end market to more sophisticated market segments (Humphrey and Schmitz, 2004) has been called organizational succession by Gereffi (1999). Importantly, organizational succession can apply not only to individual firms, but even to the whole GPN in case the whole network is able to move to higher market segment or to a more sophisticated production. (Automaker Škoda can be a good example of such a case as it was able to shift from lower to medium market segment over the last approximately 15 years). A special sort of upgrading strategy can be short-term strategic decoupling and subsequent recoupling in case the detrimental effects of engagement in GPN outweigh the contribution to value creation (Horner, 2013). In that case, strategic decoupling can be considered as "a temporary and sequential strategy to improve value creation, enhancement and capture for development objectives, and may be followed by recoupling with the same or, usually, other GPNs." (Horner, 2013, p. 5-6). Finally, a particular type of upgrading has been provided by Patel-Campillo (2010), who analysed intriguing evolutionary trajectory of the Dutch cut flower agro-industry from buyer-driven to producer-driven chain achieved by coordinated endeavour of flower growers and of the government.

Towards the typology of functional upgrading

Functional upgrading is considered as one of the most desirable, yet, especially in quasi-hierarchical GPNs, most challenging type of upgrading (Humphrey and Schmitz, 2004, Isaksen, Kalsaas, 2009). Therefore, unsurprisingly, there is a controversy among the experts upon the extent to which prospects for functional upgrading can be turned into practice (Humphrey, Schmitz, 2004). Obviously, possibilities for functional upgrading are conditioned by a multiplicity of factors (type of governance, capabilities and ambition of the supplier concerned, the quality of national and regional innovation system in which the particular company is embedded, etc., see Humphrey, Schmitz, 2004). Nevertheless, one of key arguments of this paper is that the discussion on functional upgrading can be further enhanced by a more nuanced

approach towards this type of upgrading. Consequently, in addition to existing types of upgrading, several types of functional upgrading should be distinguished (see Table 1), differing in their plausibility as well as differing in their potential benefits (Table 2).

Table 1: Overview of types of upgrading options/strategies

Type of upgrading	Rationale	Example
Process upgrading	Cost-saving measures such as fine-tuning of technology, energy-saving measures, economising labour-costs etc	Common
Product upgrading	Developing new products with higher value for customers, however, new product can be developed often only upon a request of a lead firm (or higher- tier supplier).	Common
Functional upgrading - voluntary transfer of some high value-added functions by higher-tier firm	Transfer of higher-level function(s) can occur e.g. due to limited R&D capacities of a lead firm or higher-tier supplier, due cost considerations or due to cultural reasons.	Firm EGE has been charged with development of a technological subsystem as the lead firm narrowed its R&D effort only upon the key technological system.
- replacement of the higher-tier supplier	Unreliability, high-cost or limited innovation capabilities of existing higher-level supplier.	Infrequent
- developing new market	Identification and opening-up of a new market (e.g. integration of parking cameras into locking systems of cars)	Brano-parking cameras integrated within locks
- attraction of higher tier supplier into the region	Improved possibilities for employment of highly qualified workers including R&D employees, transfer of know-how, multiplier effect on endogenous lower-tier suppliers.	1. tiers suppliers followed new investment by Hyundai
Inter-sectoral upgrading (or even inter-sectoral shift)	Using know-how gained during production within GPN for manufacturing of own goods for final market. Inter-sectoral upgrading may eventually even lead to decoupling from GPN and a complete shift of production portfolio towards final market.	Firm PBS (aircraft industry) is capable of developing special

		appliances for final customers with much wider profit margins.
(Inter)chain upgrading (organisational succession – firm level)	A shift of a supplier to upper segments of the market offering larger profit margins	Czech automotive suppliers (Pavlínek, Ženka, 2011).
Chain upgrading (organisational succession – the level of the whole GPN)	Gradual shift of the whole GPN towards upper segments of the market offering larger profit margins.	Škoda, Hyundai, HTC.
Reversion of power hierarchy from buyer- driven to producer-driven GPN	Capturing a larger share of value created by transformation of buyer-driven to producer-driven GPN.	Dutch cut flowers producers (Patel-Campillo 2011).
Strategic decoupling (and eventual recoupling)	Developing production and technology capabilities and thus capturing a larger share of value created.	Case of Indian pharmaceutical industry (Horner, 2013).

Source: Blažek (2015)

From a supplier perspective, three types of functional upgrading might be identified. Therefore, the first type of functional upgrading can be defined/conceived as a replacement of existing higher-tier supplier by a lower-tier supplier. Nevertheless, this option is not only rather unlikely, but, even more importantly, such an option would offer only severely limited benefits for a new supplier as the attempt to replace the established higher-tier supplier would result in a fierce competition and the alternative supplier should offer significantly better conditions than the existing supplier (Glogar, 2013). In consequence, the potential profit margin for the new supplier is likely to be less than modest and, therefore, this type of functional upgrading is probably the least desirable one.

However, there are two other, much more favourable types of functional upgrading. In particular, the second type of functional upgrading might occur in case that the lead firm or higher-tier supplier would voluntarily transfer some higher value added functions, for example development and/or production of some sophisticated technical (sub)system to its lower-tier supplier. Four main motives for such a transfer might be contemplated. Firstly, the major impetus for such voluntary transfer of higher-level functions could be provided by the lack of own technical capacities of higher-tier supplier given the increasing global competition and shortening of the production cycle (Duchêne et al, 2013). These pressures may force the higher-tier supplier to

focus upon the development of the core technology and to transfer the development of linked technical (sub)systems to another company. The second reason for voluntary transfer of some higher level functions can be a shift of higher-tier supplier to still higher position within GPN (e.g. to a Tier 0.5 supplier –see Pavlínek, Žížalová, 2014) or even an establishment of its own brand (OBM) and consequent move to high value added downstream activities such as branding, marketing and customer services (Rabellotti,2014). This accords with observation by Yeung (2009), who identified a trend of lead firms "towards market control via product and market definitions, rather than leadership in manufacturing processes and technologies" (p. 330). The third motive for such a voluntary transfer might be the cost-considerations as the new supplier could, esp. in case that it is located in a less developed region with lower price level, offer lesser price. Finally, the voluntary transfer of some higher level functions can be induced by cultural differences between the country of origin of a lead firm and the network of its suppliers located in a different continent (Glogar, 2013).

Practical experience of the authors shows that this can be quite realistic and, therefore, relatively frequent type of functional upgrading, provided that the lower-tier supplier commands sufficient capacities and capabilities, and, ideally, is embedded within supportive institutional framework. This type of functional upgrading might be highly beneficial for the company concerned as it would result in improving its production as well as technological capabilities (Pavlínek, Žížalová, 2014).

The third type of functional upgrading occurs in case when the lower-tier supplier is able to develop a new market. As an example of this type of functional upgrading could serve a new technical solution to a given problem or a new combination of existing products, such as development of new types of airbags under the car boot to protect pedestrians or installation of parking cameras into the car locks. This type of functional upgrading is bound to be rather infrequent as the number of lower-tier suppliers capable of making such a breakthrough is limited.

Finally, from a regional perspective, the fourth type of functional upgrading might be the attraction of higher-tier supplier into the region. Localisation of a higher-tier supplier could have a multiplier effect upon local companies, especially via enhanced contracting opportunities as well as due to several spillover effects like production and technology learning (see Pavlínek, Žížalová, 2014). According to these authors, production and technology learning can be particularly intensive in case the local company becomes directly engaged in particular global production network(s). In addition, in case that higher-tier supplier would open its R&D centre in the region, this might result in augmenting R&D capacities in the region and resulting enhanced offer of highly-qualified job opportunities.

Obviously, any enhancement strategy, including varying sorts of functional upgrading, is conditioned by numerous factors. Nevertheless, the key among those factors is the strategic intent of owners and/or of plant managers (Humphrey and Schmitz, 2002). Second fundamental factor influencing upgrading prospects of a given firm is the type of governance. As has been extensively argued in the literature, some forms of GPNs´ governance provide better opportunities for particular types of upgrading than others (see esp. Humphrey and Schmitz, 2004). Therefore, consideration of type of GPN governance (network, modular, quasi-hierarchical, see - Humphrey and Schmitz, 2004 or, for alternative typology, Sturgeon et al,

2008) the particular supplier is subjected to represents an important starting point for consideration of possible upgrading strategies. Importantly, in reflection of varying modes of GPNs´ governance, diverse combinations and/or successions of types of upgrading can be foreseen. Let's take for example the company, which is integrated into a rigidly governed quasi-hierarchical type of GPN, with sharply restricted possibilities for functional upgrading (Humphrey, Schmitz, 2004, Pavlínek, Ženka, 2011). Moreover, in some GPNs, the lead firms might be even co-owner of some of their first-tier suppliers, which undermines chances for acquiring higher functions by other suppliers even further (Glogar, 2013). Therefore, possible upgrading strategy of firms engaged in such type of GPNs might involve, first, connect with another GPN with less asymmetric power relationships (chain upgrading) and, second, some sort of functional upgrading can be attempted. Obviously, a range of other mixtures of various types of upgrading can be contemplated as well.

According to Glogar (2013) other important factors underpinning chances for upgrading are ability of firms´ managers to establish trustful relation to managers of first-tier suppliers or even of lead firms and the complex of external influences such as the overall quality of respective national and regional innovation systems (including policy framework – taxes, support policies, political stability, quality of education etc.).

Therefore, to sum-up, clearly, the power of lead firms and of higher-tier suppliers over the firms at the bottom of the hierarchy depends strongly upon the powerlessness of their suppliers. Consequently, empowering these third- and second-tier suppliers (e.g. via supplying several GPNs or, esp. in case of more capable suppliers, even by producing their own product for end market) seems to be a promising strategy. Moreover, chances for upgrading of local firms can be enhanced by targeted effort of public authorities to remedy at least the major barriers within the existing institutional framework, such as imperfections in legislation, educational system and by designing a proper incentive system for mutual cooperation among actors such as firms and R&D institutions, etc. Given, the above-mentioned fundamental role of strategic intent of management to embark upon challenging upgrading strategy, a mentoring initiative for "sleeping" local companies can be considered.

Table 2: Differentiated probabilities and potential benefits from upgrading according to position of companies within GPN.

Type of upgrading	Lead firm Probability	Lead firm Potential benefit	First-tier Probability	First-tier Potential benefit	Second-tier Probability	Second-tier Potential benefit	Third-tier Probability	Third-tier Potential benefit
Process upgrading	XXX	X	XXX	X	XXX	X	XXX	X
Product upgrading	XXX	XX	XXX	XX	XX	X	X	X
Functional upgrading	X	XX	X	X	X	X	X	X

- replacement of existing higher-tier supplier								
- developing new product/market	XX	XX	XX	XX	XX	XX	X	XX
- voluntary transfer	X	X	X	XX	XX	XX	X	XX
Inter-sectoral upgrading	X	XX	X	XX	XX	XXX	X	XX
Chain upgrading/ organizational succession	X	XX	XX	XX	XXX	XX	XX	XX

Source: Blažek (2015)

Downgrading – condemnation or blessing?

In contrast to upgrading, the concept of downgrading has received relatively much less attention within the GPN/GVC literature and remains clearly conceptually under-developed (for exceptions see Barrientos, 2011, Rabellotti, 2014). This is twice unfair. First, the number of cases of downgrading can be in practice surprisingly high (lets recall the well documented truncation of higher-level functions in plants after their takeover by transnational companies massively proceeding for example in Central Eastern Europe after the fall of state-socialism (see e.g. Pavlínek, 2008, Barrientos et al, 2011). It can be argued that elimination of some higher functions can be in fact conceived as one of special modalities of much broader concept of downgrading. Secondly, in contrast to upgrading, which is widely referred to in the literature with a quite positive connotation (though multi-dimensionality of the concept of upgrading has been recently underlined - see concept of social upgrading – Barrientos et al, 2011), the concept of downgrading requires a more fine-grained approach. In particular, it should not be taken for granted that the undertone connected with the notion of downgrading is exclusively negative.
To start with, while product and functional downgrading as the most obvious parallels to basic types of upgrading came to a mind (process downgrading seems to be unlikely), in case of downgrading a more substantial is to elaborate the intentions behind such shifts. This would allow not only better understanding of the evolutionary dynamics of suppliers within GPNs, but it would form also preconditions for formulation of some policy implications. Therefore, in the following text, several types of downgrading based on the varying motivations of such moves will be introduced and their negative and/or positive effects upon the company in question will be outlined.

The first type of downgrading (hereafter called “passive downgrading”) represents an involuntary move towards the bottom of the supplier hierarchy induced by a decision of higher-tier supplier.

This shift "to the bottom" might be induced by a change of strategy of the main customer (i.e. higher-tier supplier) such as development of its own capacities for manufacturing of a given product, for example, in order to tighten the control over the production or due to various sorts of cost considerations. Otherwise, higher-tier supplier can be motivated to internalize the production performed by its lower-tier supplier also due to dissatisfaction with the product supplied or its delivery. In these cases, for example, the higher-tier supplier does not require production of intermediate goods from its supplier anymore, but just the supply of raw materials (this type of downgrading has been documented by Kaplinsky et al, 2010 on the example of Chinese import of logs instead of processed wood products from Gabon). Needless to say that this type of downgrading is unwelcome by affected supplier as the positioning near the bottom of the hierarchy of a given production network offers only minimal profit margin and, moreover, undermines its technology capacities.

Another type of passive downgrading is a case when the existing supplier is excluded from the production network either partially or even completely, for example, when the demand for one or more types of its products has been dropped by a decision of higher-tier supplier. This type of downgrading is arguably rather frequent as it can be – *inter alia* - the result of a well-documented recent tendency to consolidate and globalize the supply base by narrowing the extent of the production network, esp. due to a number of managerial reasons (Sturgeon et al, 2008, Pavlínek, Žížalová, 2014). This type of passive upgrading is bound to be the most challenging one as it might easily endanger the very existence of the excluded supplier unless it finds quickly an alternative business model.

Finally, from a regional perspective, a special case of passive downgrading represents a decision of higher-tier supplier to move out of the region. Such a decision is likely to have the opposite effects to the above-given type of functional upgrading consisting in attraction of higher-tier supplier into the region. Therefore, retreat of a higher-tier supplier from the region might result in decline in R&D capacities and in negative multiplier effects upon the regional lower-tier suppliers.

The second type of downgrading - active downgrading - in not induced by a decision of key customer as in the previous case, but occurs in case the firm is not able to sustain competitive pressure on its current market and, therefore, is forced to refocus either on lower or smaller market segments or on production of components instead of the product for the end market. Later type of active downgrading has been relatively frequent in Central and Eastern European countries after their re-integration into global economy after the fall of Iron Curtain. Since the reintroduction of the market economy, many of the former state-owned companies found themselves suddenly uncompetitive and one of the options available was to specialise on production of some of components for which the firm disposed know-how and technology and, fundamentally, was quickly able to secure the demand. Therefore, active downgrading represents a mixed blessing for the firms concerned. On the one hand, the firm has been forced to retreat from its existing market; on the other hand, an increased specialisation upon a specific market segment or component opens a possibility for concentration of its human as well as financial resources upon corresponding products and thus to secure a better position within this new - even though more confined and perhaps even more fragile - market.

Third, strategic downgrading might arise as a result of change of business strategy of a well-performing supplier dissatisfied with its current profit margin within the GPN. In consequence, this supplier might – along a number of other options such as functional and inter-sectoral upgrading - opt for downgrading by refocusing on component or a market segment where the firm could make the best use of its core competence and thus to increase its profitability.
Like is previous case, also this strategy has its fundamental pros and cons. First, it is quite likely, that if a well-performing firm decides to concentrate upon provision of only lower value added services or upon production of some of key components of hitherto produced product it can take the advantage of its market or technological supremacy and achieve better position at the market. Second, however, the major danger connected with this type of downgrading might be the difficulty or even impossibility of finding the way back if the strategy fails.

Obviously, as a result of this trinity of main downgrading motivations, various sorts of product and functional downgrading can be considered. However, it should be stressed that the impact of particular cases of product or functional downgrading would be to a large extent dependent upon the rationale for such a shift. Therefore, in case of downgrading, the type of motivation seems to be of primary relevance, while the form (product or functional downgrading) comes only second.

Table 3: Types of downgrading according to main motivation

	Rationale	Prevalence	Potential loss or benefit	Example
Passive downgrading	Involuntary shift towards the bottom of the supplier hierarchy due to a decision of higher-tier supplier (change in its demand or expulsion of supplier altogether)	Frequent	Strongly negative impacts	Shift of China´s demand to import only unprocessed timber from Gabon (Kaplinsky et al, 2010)
Active downgrading	The firm was not able to sustain competitive pressure on its market and was forced to focus on lower/smaller market segments or on production of components instead of final product or on provision of lower level services.	Frequent	Both options possible contingent upon circumstances	Cosmetic firm Lybar has decided to move from the final market to manufacturing of some low-volume substances produced for global players.
Strategic downgrading	The firm moves to specific market segment to make a maximum use	Infrequent	Beneficial, but risky	To be provided.

	of its core competence and thus to increase its profitability.			

Source: Blažek (2015)

Conclusions

The aim of this Research Working Paper has been to deepen the understanding of multiplicity of possible evolutionary trajectories of firms embedded within GPNs. This is of a particular relevance for regions with less developed research and innovations systems as these regions usually suffer from weak endogenous sector and resulting branch-plant syndrome as well as lock-in of a sizeable part of their economies as lower-tier suppliers within GPNs. However, while the branch-plant syndrome and its repercussions have received considerable attention, the impacts of lock-in of local firms into the lowest tiers of GPN remains under-researched. Therefore, the issue of upgrading seems to be a priority for these types of regions. However, while the issue of upgrading has received considerable attention in the literature, so far, a predominate focus of scholars was a perspective of suppliers from developing countries. Therefore, the relevance of these studies for lower-tier suppliers located in European regions with lesss developed research and innovation system seems dubious.

Consequently, the paper tried to contribute to existing literature by two distinctive streams. First, in the GVCs/GPNs literature there seems to be a controversy about possibilities of suppliers to embark upon the most desirable, yet the most challenging type of upgrading – functional upgrading. It has been argued that at least part of the existing dissonance over functional upgrading can be attributed to the fact that functional upgrading represents in fact a rather diverse category. Therefore, several different types of functional upgrading should be distinguished as these subtypes vary not only in their probability, but also in their potential benefit for a given supplier. Consequently, the following major types of functional upgrading have been introduced: i) voluntary transfer of some higher level functions from higher-tier supplier e.g. due to lack of its R&D capacities, ii) developing new product and market, iii) replacement of existing higher-tier supplier.

The second major argument of this paper rests in assertion that while the concept of upgrading received substantial attention, the concept of downgrading received only short shrifts. This is unfortunate. First, it can be reasonably expected that the number of cases of downgrading can be in practice rather high (even though not as frequent as upgrading as, for example, process upgrading, does not seem to have a practical downgrading parallel. Secondly, in contrast to upgrading, which is widely referred to in the literature with a quite positive connotation, the concept of downgrading requires a more fine-grained approach. In particular, it should not be taken for granted that the undertone connected with the notion of downgrading is exclusively negative. In particular, it has been argued in the paper that while the product and functional downgrading as the most obvious counterparts to basic types of upgrading came to a mind, in case of downgrading a more substantial is to elaborate the intentions behind such shifts. Therefore, in the text above, several types of downgrading based on the varying motivations of such moves have been introduced (i.e. passive, active and strategic downgrading), and their negative and/or positive effects upon the company in question were outlined.

The subsequent step in the research should be to attempt to derive sound policy recommendations reflecting such a diversity of evolutionary trajectories of suppliers of various tiers within GPNs. Currently, at least the basic point of departure can be proposed, namely, that in case of provision of public support to GPN suppliers should be carefully distinguished what sort of achievement the project intents to deliver. Consequently, projects aiming at various forms of desirable shifts within GPN might receive a certain priority.

Clearly, when dealing with this challenge, the concept of smart specialisation can be a powerful tool (see esp. Foray, 2009, 2013), particularly, in transforming predominately asymmetric relationships within GPNs into more balanced ones, provided a suitable domain for future specialisation of local firms is selected based on existing knowledge and potential and if the relevant authorities or intermediaries facilitate the implementation of a properly designed strategy consisting both from desirable types of upgrading and downgrading

4. Challenges and opportunities facing regions with less developed research and innovation systems - the role of governance and strategy design: RIS3 governance and regional upgrading RIS3 governance and regional upgrading

Introduction

One of the three sets of key research issues identified by Blažek et al (2014) with respect to RIS3 in regions with less developed research and innovation systems refers to those challenges explicitly related with implementation. In particular, the first steps towards an effective cooperation among firms and other quadruple helix agents (government, research and civil society) that will generate new governance processes which can feed a smart specialisation strategy are recognised as critical. Governance in this sense goes well beyond 'government', and refers to the involvement of a broad range of quadruple helix stakeholders in the processes of 'entrepreneurial discovery' that should underpin RIS3, leading to decisions with regards the activities that should be prioritised in the regions and their ongoing coordination and evolution. While such governance is challenging in any context, it raises specific challenges in the context of regions that lack the base of a well-developed innovation system in which firms, government and other agents are to some extent used to interacting in networks for innovation and research. Challenges thus stem fundamentally from a general lack of capacity and capabilities among the private and public agents within such regions to engage in such processes (Walendowski *et al.*, 2011; Charron *et al*., 2012; McCann and Ortega-Argilés, 2013; Blažek *et al*., 2014), a feature that also raises the spectre of capture of regional strategic processes by one or a few strong interests (where the region is heavily dependent on the activities of a large MNC or a very strong science based university, for example).

The lack of a well-functioning innovation system in a region usually goes hand-in-hand with a strong presence of local firms operating as lower-tier suppliers in global production networks, where they are squeezed on cost from both above and below and have limited space/scope for innovation. As has been argued elsewhere in this paper, such a scenario highlights the relevance of the concept of upgrading, which in its different forms is likely to provide a cornerstone for RIS3 in such regions. Yet while a RIS3 geared towards upgrading is a desirable strategy because of the nature of the economic structure of the region, the possibilities for upgrading are also conditioned by that very structure and the conditions associated with it (Humphrey and Schmitz, 2004). The weak, fragmented nature of the innovation system implies greater dependence on hierarchical structures and presents severe limitations when it comes to engaging the regions' firms in governance processes oriented towards 'discovering' prioritizations that will mark a regional strategy oriented towards upgrading. On the other hand, however, the lack of existing capacity and capabilities in regions with less advanced innovation system can also present advantages in terms of developing new and innovative governance settings, given the absence of the institutional inertias that tend to characterise regions with more advanced research and innovation systems.

Blažek *et al.* (2014) highlight the potential role of already-established cluster initiatives in regions with less-developed research and innovation systems as a tool for embedding the interests of the region's MNCs in a wider context of production and innovation relationships, rendering the typically uneven bargaining relationship between government and MNC less critical and

opening up governance processes. More generally, cluster initiatives can be pre-cursors in fostering the types of governance relationships necessary for the flourishing of entrepreneurial discovery processes (Aranguren and Wilson, 2013), a role that can be particularly important in regions with weak and fragmented innovation systems where there is typically little history and culture of cooperation for innovation. Above all this reflects the need to identify and motivate *people* who have interdisciplinary knowledge and proven experience in interacting with different types of agents; these 'boundary spanners', in the language of Foray *et al.* (2012), are the key to catalysing the broad-based governance on which RIS3 should be based.

This focus on the human element is beginning to be felt and acknowledged both in debates around clusters, cluster policy and cluster management (Wise, 2014) and in debates around RIS3 (Aranguren *et al*., 2014), amidst a widespread perception that the human element of how policies are designed has been neglected in general in regional studies (Collinge and Gibney, 2010; Gibney, 2011; Sotarauta, 2005; Stimson *et al.*, 2009). However it is impossible to better understand the human factors that appear to be critical for entrepreneurial discovery processes without analyzing real live cases. Indeed, a key feature of the design of the Smartspec project is the presence of regional 'living labs', the study of which should help us to look inside the black box of the dynamic, evolving and ultimately human process of RIS3. Analysis of these cases is at an early stage, but the remainder of this part of the paper aims to draw some early reflections through comparing what we have uncovered about the RIS3 process to date in two Spanish regions with different levels of development and sophistication in their research and innovation systems.

Reflections on emerging practice in Navarre and Murcia

Spanish regions or autonomous communities have among the highest levels of policy autonomy in Europe, and the processes of preparing RIS3 for the European Commission have been led at the regional level (rather than at the national level, as is the case in some countries). Navarre is an industrial region, with relatively strong economic performance, a relatively well-developed innovation system, and its own tax-raising powers. In terms of its political situation, it is currently governed by a regionalist party in minority in the regional assembly. Murcia is a region in the south of Spain with quite different fundamental characteristics, in economic (a low presence of industry, less developed innovation system, and weaker economic performance), administrative (no tax-raising powers, which fall under the general Spanish regime), and political (the ruling political party is a national one, in a majority at the regional assembly) terms.

Data for analysis of the cases come from an analysis of secondary sources surrounding their RIS3 alongside around a dozen in-depth interviews with key players in the RIS3 process of each region that were conducted during June/July 2014. Early reflections on these cases are organised following the explicit structure that was proposed by the European Commission for the development of RIS3 in their *Guide to Research and Innovation Strategies for Smart Specialisation* (Foray *et al.*, 2012). This guide proposes six steps for the development of a RIS3: (1) analysis of the regional context and potential for innovation; (2) governance and ensuring participation and ownership; (3) elaboration of an overall vision for the future of the region; (4) identification of priorities; (5) definition of coherent policy mix, roadmap and action plan; and (6) integration of monitoring and evaluation mechanisms. As the guide highlights, the six steps "should not be thought of as separate and autonomous stages in the process, but as interacting components of a comprehensive design scheme whose implementation pattern depends on the

specificity of the regional context" (*Ibid.*: 18). Some reflections on the broad regional context are therefore worthwhile as a starting point.

Regional context

Navarre has a more advantageous context than Murcia in terms of overall economic performance and the development and level of sophistication of its innovation system, and the size characteristics of firms are quite different (higher presence of MNCs in Navarre and of smaller firms in Murcia). From Table 1 we can also identify significant differences between the regions related to space and demography (region's size, geographic concentration of the economic activity, immigration, etc.), governance and politics (regional competences, decentralization within the region, legacy and quality of government, political stability, etc.), productive structure (sectoral specialization, kind of firms, internationalization, etc.) and innovation system (prevalent actors, innovative performance, etc.). These result in different degrees and combinations of complexity for the construction and development of RIS3. Regional complexity in this sense largely reflects the governance reality that characterises the region due to certain fundamental features of its geography, history, industrial structure, etc. Greater complexity should not therefore be judged as either positive or negative *per se*: there are cases when complex structures are necessary to govern complex realities; and also cases where unnecessary complexity is created, for example in the proliferation of intermediate institutions without clear functions.

Table 1. Regional Context in Navarre and Murcia

	NAVARRE	**MURCIA**
Population (size)	Small (0.6 million)	Small-medium (1.6 million)
Density and urbanization	Very low density, but urban concentration	Low density, but urban concentration
Population growth	Dynamic, linked to immigration	Very dynamic, linked to immigration
Decentralization	Highest (including taxes). Regional government with elected assembly.	Very high. Regional government with elected assembly.
General quality of government*	Medium-low (below Spanish average)	Medium-low (Spanish average)
Regional organization	Provincial and regional governments coincide. No noticeable economic strategies in the capital city & counties.	Provincial and regional governments coincide. No noticeable economic strategies in the main cities & counties.
Political stability	UPN (regionalist, right-wing) in power since 1996, but currently has a minority in the assembly. Until 2011 consensus among the two main parties; afterwards severe institutional and political crisis, that affects even the management of the RIS3.	PP (national, right-wing) has a large majority in the assembly.
Sectoral specialisation	Very high specialisation in industry (automobile & agri-business) & health	Very high specialisation in agriculture and water-related business, & to a lesser extent in petro-chemistry & tourism
Export orientation	Medium-high (double Spanish average), due to industrial specialisation	Low (1.1 times Spanish average), but high in specialised sectors (agri-business…)
Firm Size	Medium-high (double Spanish average, due to industrial specialisation). High presence of MNCs.	Low (similar to Spanish average). Endogenous firms, in consumer-end production, are smaller. External (national) firms, in basic and heavy equipment, are bigger.
Innovation system	Innovation follower (RIS2014). Strong business R&D & universities. High educational level of population.	Moderate innovator (RIS2014). Reasonable universities & public research centres, but weak business R&D & innovation. Low educational level of population.
Economic performance	High productivity, medium labour participation, high unemployment (but second lowest in Spain) & very high per capita GDP (second highest in ES)	High productivity, low labour participation, very high unemployment & low per capita GDP (84% of EU average; "transition region")

Source: Own elaboration based on secondary sources and interviews.
* Classification of general quality of government from Charron *et al.* (2012).

Alongside the general context from which the region develops its RIS3, it is important to understand something about the type of strategy that the region envisages when embarking on the RIS3 process. To gain insight on this question we can analyse the legacy of each region in planning and strategy-making and the frames of reference for the current RIS3 process (questions around the focus of the RIS3, its integration with other regional plans/strategies, and whether it is understood as a plan, process, or both) (see Table 2). Regarding the legacy of plans and strategy-making, it could be argued that those regions with a longer experience in STI plans, in fostering public-private collaboration, and in bottom-up or participatory strategic approaches are likely to possess more of the capabilities needed to develop the types of processes and prioritizations required by a RIS3. In this aspect Navarre has a longer experience in government-led planning and strategy-making, developed with a strong presence of bottom-up processes. More generally, what each region understands about RIS3 will be reflected to some extent in the scope and approach to its development. For instance, in the case of Navarre, the Moderna Plan, which is considered their RIS3 strategy, has wider scope as a socio-economic development strategy than in Murcia, where the focus of RIS3Mur is on R&D and innovation. This is also reflected in the different relationship between the RIS3 and other plans and strategies in each case.

Table 2. Type of Strategy in Navarre and Murcia

	NAVARRE	**MURCIA**
Short name	Moderna	RIS3Mur
Scope	Socio-economic development strategy	R&D & innovation strategy
Legacy of plans	Long history of plans & strategies, without thematic priorities until 2010. Less direct role of government & more presence of bottom-up processes.	Moderate history of plans & strategies, including vertical choices. Less direct role of government in emergence of economic activities.
Integration with other regional strategies/plans	Moderna ranks highest in the region. Moderna is being developed, in determined areas, by more specific plans (e.g. plan for S&T). But these plans are under Moderna's framework.	RIS3Mur is under the IRIS-2020 general strategy. There were other plans (on S&T, Industry, vocational training…), some of them expired, and it is not clear their integration with RIS3Mur
RIS3 document	The existing Moderna (passed in 2010) has been presented as the Navarre RIS3.	The RIS3Mur is an entirely new plan, passed in 2014.

Source: Own elaboration based on secondary sources and interviews.

The message here is that all of these (and potentially other) contextual characteristics of the region will in different ways condition the development of RIS3 processes; while they are asked to follow a similar 'six-step' process, regions do not begin the strategy process from an identical playing field. Bearing in mind that these two regions have quite different contexts and prior understanding of what a RIS3 should look like, we now turn to analyse the development of their RIS3 in terms of the six steps proposed in the *RIS3 Guide* (Foray *et al.*, 2012), with a particular focus on Step 2 (governance).

Step 1: Analysis on the regional context and potential for innovation

The first step is to have a diagnosis of the region's unique and distinctive capabilities around which the strategy should be constructed (see Table 3). Statistical availability is critical for this step, and in both cases this availability is very high. In contrast with some other European countries, there is abundance of regional data available in Spain and regional agents respond positively to information requirements from regional governments. Both regions have statistical institutes (IEN in Navarre and CREM in Murcia), which mainly collaborate with and diffuse data

collected by the national office, and there are a large number of administrative records in the hands of the regional governments (including tax records in the case of Navarre).

Table 3. Comparing Step 1: Analysis of Regional Context and Potential for Innovation

	NAVARRE	MURCIA
Statistical availability	Very high	Very high.
Analysis conducted by regional agents	Sufficient number of studies published by the government or quasi-governmental organisations, and some also by more independent organizations (e.g. Institución Futuro)	Sufficient number of studies published by the government or quasi-governmental organisations, and fewer and less in-depth studies carried out by independent organizations
International analyses of the region	Although the Navarre case is mentioned as a case of good practice in several EC & OECD documents, the only complete documents available are the RIM report on Navarre (2011) & the assessment of the RIS3 by the European expert V. Harmaakorpi (2013). Navarre is taking part as a living-lab in the EU SmartSpec project, & Orkestra (2014) has elaborated a report on it.	Although a European expert assessed the elaboration process of RIS3Mur, there is no publicly available report. Murcia is taking part as a living-lab in the SmartSpec project, & Orkestra (2014) has elaborated a report on it.
Regional benchmarking	Studies and visits to some regions and countries.	Planned in-depth analysis of some reference regions.
Type of analysis	Very complete SWOT, specialisation (in industry/cluster, science and technology) & trends analysis relying on opinions of local experts, but lack of analysis on the entrepreneurial environment	Very complete SWOT, specialisation (in industry/cluster, science and technology) & trends analysis relying on opinions of local researchers and business people, but lack of analysis on the entrepreneurial environment

Source: Own elaboration based on secondary sources and interviews.

Alongside the availability of data, it is important to have access to good analysis conducted by regional and/or international agents. In the case of Navarre analyses are published by government, by quasi-governmental agencies and by independent organizations such as the Institución Futuro. However, while Navarre has a good consultant in innovation policy, an active think-tank on competitiveness and departments of economics and business at the universities, they lack either the academic profile, or the orientation, resources or structures to assist properly the process. Indeed, the well-designed process of the Moderna Plan was partly conducted with non-local consultants. In the case of Murcia there are no research organizations or relevant consultants specialised in competitiveness and territorial strategy analysis, and despite having reasonably good universities in the region, they also don't meet that need. The presence of international analysis mirrors that of regional analysis, with Navarre in a more advanced stage, and both regions are lacking in analysis that benchmarks against other regions. In Navarre some regions and countries with successful development models were studied and visited, even though they did not share structural conditions with Navarre; and in Murcia the diagnostic included in the RIS3Mur has been carried out without comparing Murcia with regions sharing similar structural conditions, although the analysis did identify potential reference regions for Murcia for the future.

Finally, regarding the content of the diagnostics there are strong similarities between the cases that we suggest are probably symptomatic of how Step 1 has been applied in most regions. The analysis has been based on a very complete SWOT analysis, with detailed specialisation analyses, analysis of the science, technology and industry/cluster fields, and studies of the impact of international trends and societal challenges. Yet analysis on the dynamics of the regional entrepreneurial environment is lacking.

Step 2: Governance and ensuring participation and ownership

This second step highlights the relevance of ensuring participation and ownership among different actors of the quadruple helix in the development of RIS3. The emergence of this governance is likely to be more complex if there are more departments in the government, many agencies and different levels of government operating in the territory. Navarre and Murcia both present similar scenarios in this regard, and also with regard coordination with neighbouring regions, the national government and EU institutions. All Spanish regions are members of the national IDI (Research, Development and Innovation) network, which was established in 2010 to generate synergies between regions in their R&D and innovation policies and has organised a series of meetings for exchanging experiences in the building of RIS3.[i] Apart from potential interactions with neighbouring Spanish regions that are included in these groups, in neither case have we detected explicit attempts to coordinate RIS3 with one of their neighbouring regions. In the case of Murcia, however, there are some signs that this is seen as a challenge for the future (at least in terms of generating funding), with plans to collaborate with neighbours (Valencia, Balearic Islands) to apply for ERDF multi-regional funding. In terms of coordination with national government, it could also be argued that the connection is stronger in the case of Murcia, due to a national party being in power in the regional assembly as opposed to a regionalist party in Navarre. Each of the regions has an office in Brussels, which is significant for coordination with EU institutions, although they both struggle to attract funds from EU programmes, with the proportion in Murcia well below what would correspond to them according to their regional R&D and innovation expenditure.

Regarding coordination with non-governmental agents, the mechanisms are different in each region, with a more inclusive approach in Navarre perhaps reflective of the greater degree of experience and sophistication in existing collaborative relationships. The Board and Permanent Committee of the Moderna Plan are composed of members of the regional government and political parties, of business associations and firms, of universities and technological centres, and of trade unions. For the elaboration of the Moderna Plan there was a broad participatory process, which included civil society, and for the implementation and monitoring there are several "Moderna teams" composed of the type of agents mentioned above. In Murcia the RIS3 process is much more government-centric: the steering committee of RIS3Mur and the Evaluation and Monitoring Committees are composed of representatives of the government, the public universities, the business association and the technological centres; and there is no direct representation of firms, entrepreneurs or agents of civil society.

Table 4. Comparing Step 2: Governance

	NAVARRE	**MURCIA**
Regional government	8 departments with R&D competences quite concentrated & a small number of agencies and intermediary organizations. Easier informal coordination.	7 departments with R&D competences very concentrated & an average number of agencies and intermediary organizations. Easier coordination.
Sub-regional levels	Almost all the competences linked to economic promotion are in the hands of regional government	Almost all the competences linked to economic promotion are in the hands of regional government, but clear local productive systems and some agents are organized locally
Coordination with neighbouring regions	Scarce coordination with neighbouring regions	Scarce coordination with neighbouring regions

Coordination with national government	Decisions in the regional government but communication with the national one; participation in IDI network	Decisions in the regional government but fluid communication with the national one; participation in IDI network
Coordination with the EU institutions	An office in Brussels, participation as living lab in Smartspec & not many funds from EU programmes	An office in Brussel with much less noticeable presence, participation as living lab in Smartspec & scarce funds from EU programmes
Coordination with non-governmental agents for the general strategy	The Board and Permanent Committee of the Moderna Plan (members of regional government & political parties, business associations, firms, universities, technological centres & trade unions). Board participation for the elaboration, implementation and monitoring of the Moderna Plan, including the civil population.	The steering committee of RIS3Mur (representatives of the government, the public universities and the business association). Monitoring and evaluation committees (members of regional government, the business association and the technological centres).
Leadership of the strategy	Change in leadership, but 'collaborative leadership' not generated	Change in leadership, but 'collaborative leadership' not generated
Entrepreneurial discovery processes	Entrepreneurial discovery processes designed and in development, mainly through clusters	Design/characteristics of entrepreneurial discovery processes not yet explicit
Innovation agencies for participation	The government's institutional and political crisis currently affects negatively Moderna's capacity to perform this role	Not an agency with this role

Source: Own elaboration based on secondary sources and interviews.

The last two rows of Table 4 comment on the *entrepreneurial discovery processes* from which prioritization decisions should theoretically emerge in RIS3. In Murcia there is not yet an explicit formulation of these entrepreneurial discovery processes that is linked to the current strategy document. RIS3Mur made a great effort to identify new activities, related to existing or potential strengths of the region and to unexploited appealing fields. This was more of a theoretical exercise, however, and it is explicitly acknowledged as a starting point that is currently lacking of entrepreneurial discovery processes oriented to action among the region's firms and other agents. This is also reflected in the current lack of a permanent space, such as that might be provided by an innovation agency or the like, for interaction between the government and the main components of the quadruple helix. Some intermediary organizations depending from the regional government keep connections with those agents, but those relations are more of an informal nature and the behaviour of firms, universities, research centres, etc. is quite reactive. The Moderna Plan of Navarre, on the other hand, has explicitly set out entrepreneurial discovery processes from the beginning, to be developed mainly by clusters. For each cluster or transversal priority working roundtables were set up, which operate with a similar method and develop action plans that feed into the overall strategy. However, while the attempt to create a new public-private organization – the Moderna Foundation – to develop the RIS3 can be seen as quite successful, since 2012 the functioning of Moderna has been hindered by the severe economic, institutional and political crisis in Navarre.

Step 3: Overall vision of the future of the region

The third step – generating shared vision – forms the basis from which a truly territorial strategy can emerge. Building a shared vision requires interaction between different agents, and in that sense it goes hand-in-hand with much of the discussions around governance in the previous sub-section. Like the entrepreneurial discovery processes, the notion of shared vision can be made more or less explicit. In the case of Murcia, for example, the RIS3Mur has tried explicitly to set a shared vision, linked to the one included in the more general IRIS-2020 plan for Murcia's development. Objections around this vision, however, include it being too general, applicable to any Mediterranean region, and too optimistic and detached from reality, comments that would

suggest that the vision is not so much 'shared' as was 'established'. Navarre has also worked explicitly towards a shared vision, but in this case through the engagement of a wide range of agents in the process of developing the Moderna Plan. The thrust of the vision is around the necessity to change the existing economic model of Navarre and, in a participatory way, to identify the "roots and the branches" of the new model. As a consequence of such a broad participatory process, it could be argued that the vision has lacked focus, but it has been a good starting point that could be fine-tuned in subsequent steps. Unfortunately, this shared vision has been negatively affected by the aforementioned economic, institutional and political crisis.

Step 3: Identifying priorities

The thematic or vertical priorities in both cases are based on assessment of scientific, technological and economic strengths, as carried out in the diagnostic step, as well as on the market opportunities opened by societal challenges. In Navarre thematic priorities refer to capabilities both existing (mainly in the so-called green and health economies) and emerging (the talent economies), but the general perception is that there are too many thematic priorities included in the plan. In the case of Murcia, the degree of thematic prioritization is low in practice, because instead of focusing on those areas where Murcia actually has unique advantages, priorities include many activities in which Murcia doesn't stand out or cannot be expected to be a leader in the future.

Policy mix and action plan

The fifth step in the RIS3 guide refers to configuring a policy mix and action plan to support the strategy. Both regions are in the early stages of articulating the policy mixes that will support their strategies. In Navarre, the Moderna Plan had a very well-designed process to arrive from the chosen priorities to concrete actions. But since there was neither budgetary projections for the deployment of actions nor mechanisms that would ensure the alignment of regional government's policies and measures with the ones that stemmed from the plan, when the institutional, political and economic crisis shook Navarre the action plan was strongly affected. Thus in the last two-three years many regional R&D and innovation programmes (which constituted the main source of public finance) have been on hold due to budgetary constraints. In Murcia, the unfolding process from strategic lines and objectives to actions has been orderly developed in the RIS3Mur. As a result, there is a list of actions, and for each of them a card with basic points (challenges, targeted groups…). The only budgetary data contained in the RIS3Mur, however, refers to estimated funds coming from each source (public, private and abroad), but not to the allocation of them among thematic priorities and strategic objectives.

Monitoring and evaluation

If policy mix design is in its early phases in both regions, then monitoring and evaluation is even more so. In the case of Navarre the Plan Moderna incorporates a defined set of indicators to measure the degree of advancement of the Plan and periodically request the opinion of the beneficiaries. However, at present there is a sincere recognition that through these mechanisms it is impossible to measure or know the actual contribution of the Moderna Plan to the established goals. Moreover, the organization responsible for the evaluation of the contribution of the Moderna Plan to the established goals is also responsible for the management of the plan, which goes against of the RIS guide's recommendation. Finally, the set of indicators established to measure the degree of advancement of the Plan are very general and not easy to change by means of policies in the short run. Alongside those general targets it can be argued that there should be

objectives and indicators more manageable in the short-medium term. In Murcia, following the RIS3 Guide, the RIS3Mur tries to differentiate monitoring and evaluating. For the first, it distinguishes among three kinds of indicators: execution, result and context indicators. Execution indicators measure the progress in the implementation. Result indicators (which could also be named as "output indicators"), measure changes produced as a consequence of the implemented actions. Context indicators are related with the objectives and vision of the strategy. As for evaluation, RIS3Mur doesn't pinpoint how this will be done, and it is doubtful that in fact it is going to measure the real contribution of each of the levels of the RIS3Mur (agents, instruments or programmes, priorities and the whole RIS3Mur) to the objectives established for each of them. On the other hand, evaluation is, again, expected to be conducted by the same organization responsible for the management of the RIS3Mur (the technical secretariat), and it seems that the RIS3Mur overlooks enquiries to beneficiaries as a complementary source of quantitative indicators and analyses.

Concluding comments

The above comparison of recent practice in the implementation of RIS3 in the Spanish regions of Navarre and Murcia provides some input for reflections on the specific challenges facing regions with less developed research and innovation systems. Firstly, it reveals a general issue regarding the importance of regional context in influencing the development of the governance processes that underlie RIS3. This is not so much an issue of regions with more or less developed research and innovation systems, but has to do rather with various geographical, structural and institutional factors that interact with one-another in different ways, and with the significance of path dependencies that mark the very vision of what a RIS3 might mean for different regions. The implication is that there are no single recipes for developing the right processes that will set in motion entrepreneurial discovery and lead to the appropriate identification of priorities that are then supported by ideal policy mixes and bolstered by effective evaluations. Each region has to find its own way, based upon its own context and history.

However the comparative analysis also reinforces the general hypothesis that regions with less developed research and innovation systems face certain specific barriers in developing RIS3 related to a general lack of capacity and capabilities among private and public agents. This can be seen, for example, in the differences in the structure of firms between the two regions, reflecting different requirements in terms of upgrading, and the different degrees of involvement of firms and other elements of the quadruple helix in the governance processes surrounding RIS3. That Navarre has a much longer experience in STI plans, in fostering public-private collaboration, and in bottom-up or participatory strategic approaches is evident in the differences between the way in which the two strategies have emerged to date. In particular, the Murcia RIS3 is more of a government-led plan and has fewer roots in bottom-up processes with other quadruple helix agents. Differences are also evident, for example, in terms of the degree of diagnostic analysis (step 1), whereby Murcia lacks research organizations or relevant consultants specialised in competitiveness and territorial strategy analysis. On the other hand, however, there are some hints that Murcia has taken issues of inter-regional and regional-national coordination more seriously. This could reflect different reasons, including those based on political relationships and necessity, but is nevertheless in line with the argument that regions with less developed research and innovation systems can present certain advantages in terms of the absence of institutional inertias, which can lead in more advanced regions to certain to inward-facing behaviours.

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[i] See www.redidi.es for more information.