SMARTSPEC

SMART SPECIALISATION FOR REGIONAL INNOVATION

Regions with Less Developed Research and Innovation Systems

Reflection Paper: Work Package 3

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Contents

1. 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

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

This section provides a brief overview on traditional and current approaches to identify regions with less-developed research and innovation systems. We look at both conceptual and empirical approaches that figure prominently in the current debate and we also add a short note on low-tech industries as there is still a tendency is some parts of the literature to equate innovation with R&D and high-tech industries.

2.1 Conceptual Approaches

A well-known conceptual approach to identify regions with less-developed research and innovation systems draws attention to various types of system deficiencies or system failures that result in low levels of research and innovation activities at the regional level. Tödtling and Trippl (2005) have suggested a typology that distinguishes between three forms of system deficiencies, i.e., organisational thinness, (negative) lock-in, and fragmentation. This constitutes the basis for identifying three main types of less-developed regional innovation systems:

- *Organisationally thin regional innovation systems* are systems in which essential elements are missing or only weakly developed. Examples include the lack of a critical mass of innovative firms, a weak endowment with other key organisations and institutions and low levels of clustering.
- *Locked-in regional innovation systems* are characterized by an over-embeddedness and over-specialization in traditional, declining sectors and out-dated technologies.

- *Fragmented regional innovation systems* suffer from a lack of networking and knowledge exchange between actors in a system, leading to insufficient levels of collective learning and systemic innovation activities.

Organizationally thin regional innovation systems 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 regional innovation systems often prevail in old industrialized areas. These regions feature an overspecialisation in traditional sectors undergoing decline, a focus on out-dated technological trajectories, and weak firm capacities to generate radical innovation. Various forms of lock-in (functional, cognitive and political ones) keep these regions in ancestral development paths (Grabher, 1993; Trippl and Otto 2009; Hassink, 2010). Finally, fragmented regional innovation systems can frequently be found in metropolitan areas (Blazek and Zizalova, 2010; OECD, 2010). In this type of region fragmentation is frequently the outcome of too much diversity and a lack of related variety, resulting in relatively low levels of regional knowledge exchange and innovation.

Several other typologies of system failures exist (see, for instance, Lundvall and Borras, 1999; Klein Woolthuis et al., 2005), enabling one to identify various dimensions of regional research and innovation systems that might be less-developed or not working adequately. 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, research and 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 S3 as the promotion of sustainability and social innovation are often seen as one of the aims of such strategies.

The literature on differentiated knowledge bases (Asheim et al., 2011) 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. 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, low-tech industries cannot automatically be categorised as less-developed ones (see also Hansen, 2010; Hansen and Winther, 2011). What does "less-developed" then mean, if one adopts a knowledge base perspective? Martin and Trippl (2013) claim that analytical, synthetic and symbolic knowledge bases require very different networks[1] (actors involved, spatial reach), research and education infrastructures, forms of innovation support, mobility and attraction schemes and anchoring projects. An innovation system can be considered as "less-developed", if one or more of the above mentioned elements are missing or if the existing ones are not fine-tuned to the knowledge bases that dominate in the region. However, a too strong focus on prevailing knowledge bases can lead to lock-in, curtailing the region's capacity to transform its industrial structures over time, i.e. to break out of existing paths and embark on new ones. This would reflect a reflexivity failure, following Weber and Rohracher (2012). Asheim et al. (2013) argue convincingly that it is the combination of knowledge bases that is crucial for processes of path renewal (branching of existing industries into new but related ones) and new path creation (emergence of entirely new industries). The attribute "less developed" could then apply to those regional innovation systems, which exhibit a weak capacity to nurture regional transformation. This might be due to i) lacking assets for path renewal and new path creation (Tödtling and Trippl, 2013) or ii) failure to overcome various forms of distance that characterise combinatorial knowledge dynamics (Strambach and Klement, 2012).

To summarise, the system failure approach and the knowledge base concept enable us to be more precise regarding what exactly might be less developed in regional research and innovation systems. A regional innovation system 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 S3 aims at initiating regional transformation, it is the latter aspect that should deserve due attention in future research.

[1] See Martin and Moodysson (2013) for a comprehensive discussion of how network characteristics differ among analytical, synthetic and symbolic knowledge bases.

2.2 Empirical Approaches: The Regional Innovation Scoreboard

The innovative performance of regions is measured in the European Union through the Regional Innovation Scoreboard (RIS). The latest Scoreboard (European Commission, 2012a) has been completed in 2012 drawing mainly on CIS data from 2008 and on data from Eurostat. The RIS has adopted a similar methodology as the Innovation Union Scoreboard, which measures the innovation performance of nation states. This methodology distinguishes three main groups of variables: i) enablers of innovation, ii) firm innovation activities, and iii) outputs of regional innovation systems.

Three types of enablers are considered, namely human resources; open, excellent and attractive research systems; and finance and support. In the RIS, enablers are not well covered. Only one indicator for human resources is included covering the percentage of the population aged 25-64 having completed tertiary education. Also finance and support is only coverd with one indicator measuring the R&D expenditure in the public sector as % of GDP. There is no indicator in the RIS measuring research systems. R&D expenditures clearly relate to analytical knowledge. While tertiary education can cover different types of knowledge, including synthetic and symbolic knowledge, the main focus is on transferring analytical knowledge. Hence, synthetic or symbolic knowledge is clearly underrepresented in the measurement of enablers of innovation.

As regards firm activities, indicators have been selected for firm investments, linkages and 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. The latter indicator is based on the Community Innovation Survey from 2008 (CIS2008). R&D expenditures measure analytical knowledge while non-R&D expenditures can relate to various activities and it remains rather obscure which types of knowledge are measured. The section on linkages and entrepreneurship looks at two indicators of the CIS2008: SMEs innovating in-house as % of SMEs as well as % of innovative SMEs collaborating with others. As regards the second indicator, it is important to note that this data is only provided for SMEs that have undertaken technological product or process innovation activities. This implies that the share relates to the number of SMEs that have been innovative and not to the total number of SMEs. The third indicator covers public-private co-publications per million inhabitants. As regards intellectual assets the patent applications to the European Patent Office per billion regional GDP is considered. It follows, therefore, that many of the

indicators relate to technological innovations and analytical knowledge, while other knowledge types are underrepresented.

The indicators related to innovation outputs aim at measuring innovative outputs of firms as well as regional effects on the economy. At the firm level, two indicators are included, namely the share of SMEs introducing technological product or process innovations in % of SMEs and the share of SMEs introducing marketing or organisational innovations as % of SMEs. These two indicators are based on the CIS2008. While not clear from the methodology report, it is assumed that the indicator on technological product or process innovations include innovations new to the world and new to the firm. Possibly even improvements can be considered. The more radical innovations (new to the world) are assumed to require a larger share of analytical knowledge. However, as also less radical innovations are covered, this indicator can also cover synthetic knowledge. Marketing and organisational innovations relate more to symbolic and synthetic knowledge. As regards the economic effects, the RIS considers the share of employment in knowledge-intensive services and in medium-high and high-tech manufacturing as % of the total workforce. This indicator measures sectors in which analytical knowledge plays an important role. Additionally, one indicator measures the sales of new to market and new to firm innovations as % of turnover. This measure can in principle cover innovations that rely on all three types of knowledge.

Despite these methodological problems, the Regional Innovation Scoreboard can be used to characterize European regions as falling into one of four categories, in a descending order of innovation performance (Figure 1).

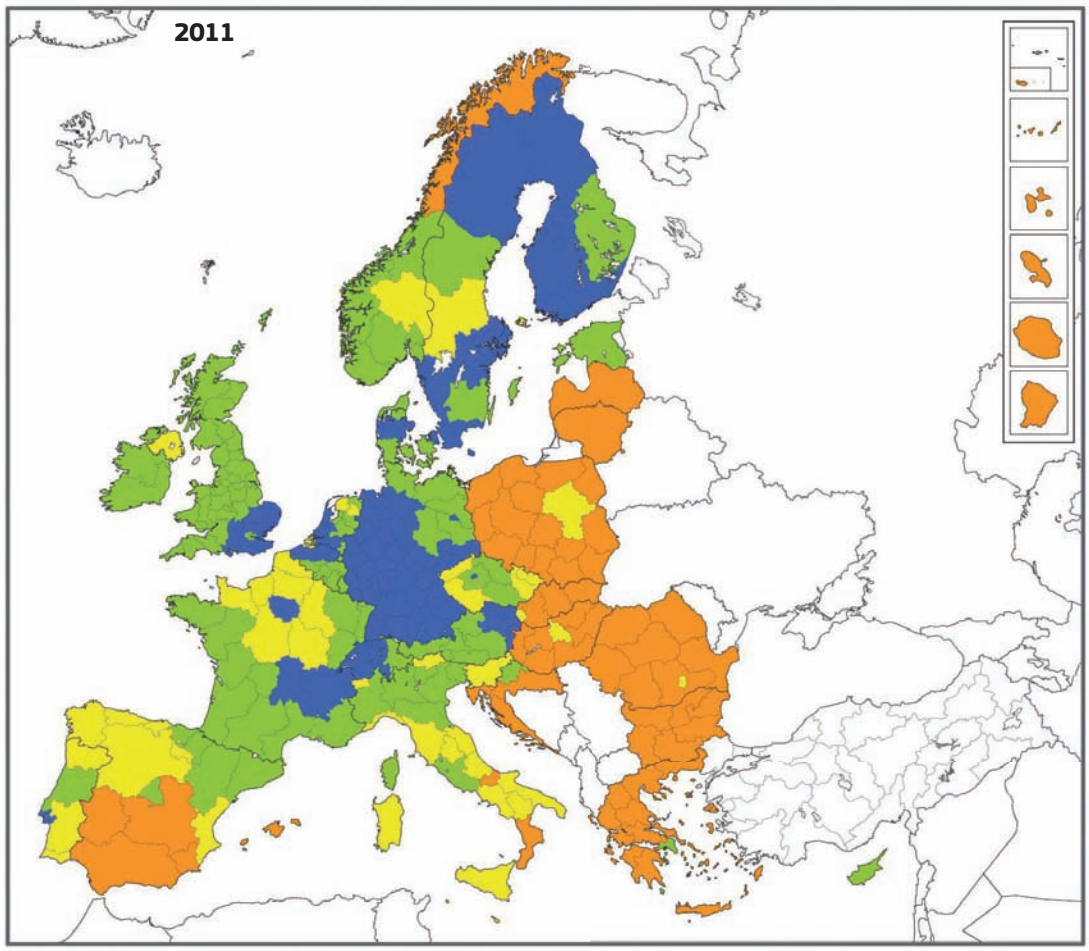
- Innovation Leaders
- Innovation Followers
- Moderate Innovators
- Modest Innovators

Each of these categories is further subdivided (into a High, Medium, Low categorisation) to provide a greater level of granularity (Figure 2).

From Figure 1, the regions and Member States with the least developed research and innovation systems are largely to be found in the post-Socialist transition economies. Other groupings of modest innovators are to be found in Greece, the outermost and overseas

territories, southern and central Spain and in two Italian provinces. Moderate innovators are more broadly distributed across the EU, with significant groupings in southern European Member States but also in France (surrounding Ile de France) and the Czech Republic. There are then pockets of moderate innovation performance in Member States that generally exhibit higher levels of innovation performance, such as in the UK, the Netherlands and Sweden, but also in wider geographical areas that exhibit higher levels of performance, such as northern Italy.

Figure 1. Innovation Performance across the EU, Norway and Switzerland



Source: European Commission (2012)

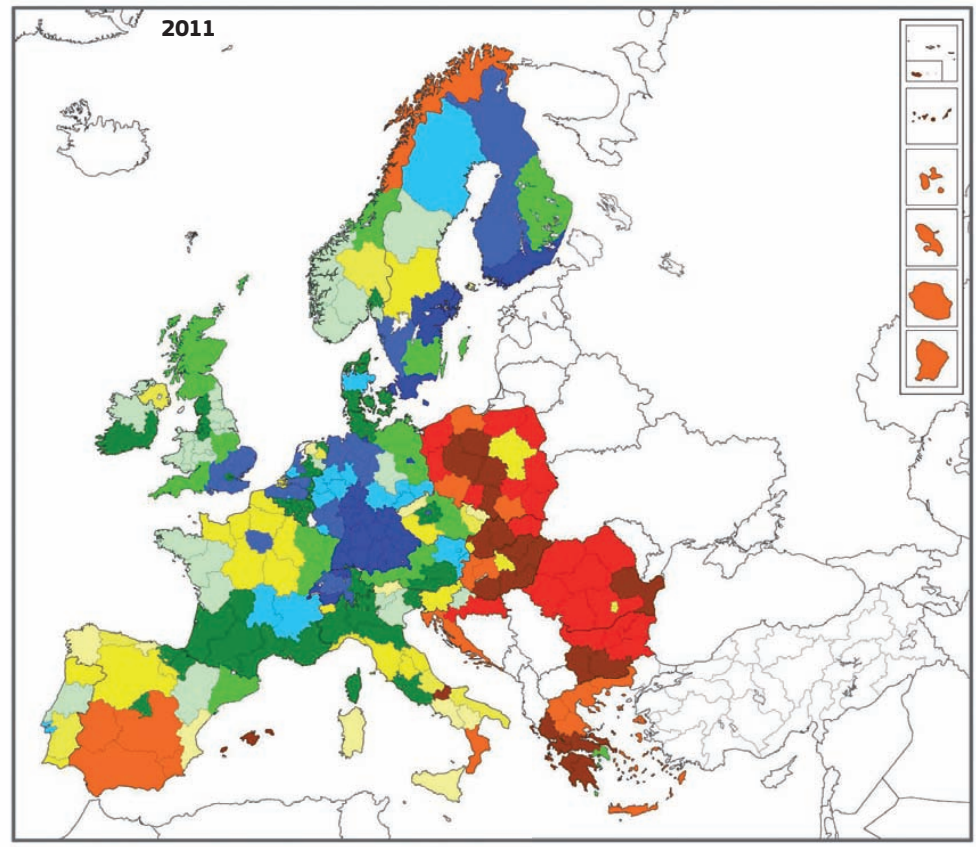
Innovation Leader
Innovation Follower
Moderate Innovator
Modest Innovator

Whilst the features that characterize less-developed research and innovation systems will vary

across regions and between Member States, we suggest that the patterns illustrated in Figure 1 provide four key groupings:

- Firstly, regions and Member States experiencing post-socialist transitions
- Secondly, regions and Member States located in southern Europe
- Thirdly, outermost and overseas territories
- Fourthly, regions underperforming their surrounding context

Figure 2. Regional Innovation Sub-divisions



Source: European Commission (2012)

Leader – High
Leader – Medium
Leader – Low
Follower – High
Follower – Medium
Follower – Low
Moderate – High
Moderate – Medium
Moderate – Low
Modest – High
Modest – Medium
Modest - Low

Figure 2 vividly illustrates the lower level of research and innovation performance present in

many of the post-socialist transition economies and Greece. It also highlights the variable performance between regions within Member States. Whilst our study will, rightly, focus on the challenges facing the least-developed research and innovation systems, we will also give some consideration to those that are relatively less-developed in their national context.
In summary, compared to the Innovation Union Scoreboard, the RIS considers fewer indicators and has to deal with missing values for many regions. Hence, it is weaker than the Innovation Union Scoreboard. Another problem is that the RIS sometimes relates to NUTS1 and sometimes NUTS2 regions. Some indicators use survey data and some register data. While some indicators are relatively broad and can thus include different types of innovations, the RIS still has a bias towards innovations driven by an analytical knowledge base.

For instance, the regions with the lowest innovation performance have been found to have a relative strength in innovation outputs, while the regions with the second lowest innovation performance have been found to have a relative strength in enablers of innovation. The policy recommendation is ”regions wishing to improve their innovation performance should thus pursue a more balanced performance structure.” (European Commission, 2012a, p. 23). First, it seems interesting that regions with the lowest innovation performance are strong in output measures. It is quite interesting that regions with relative strength in output indicators cover large parts of northern Italy, Tirol and parts of Upper Austria, Bavaria and Baden-Würthemberg. Could it be that enablers and firm activities relevant for these regions' innovation performance are not adequately measured? Could it be that these regions are more innovative than expected? Second, why can it be that regions with the second lowest innovation performance are strong as regards the enablers? It remains obscure what is lacking so that these enabling factors translate into innovative output. Norway is relatively strong as regards innovation enablers but also Greece and parts of Bulgaria. Does it relates to public funding for R&D (maybe in Norway) or does it relate to high eduational standards but lacking support structures (maybe in Bulgaria and Greece)? Also, there are regions that belong to the innovation leaders but are located in a national setting that is not very innovative (e.g. Prague). Hence, what does this mean for regional policy? Would a measurement of the knowledge types available in regions contribute more to policy making?

Table 1: A comparison of the indicators included in IUS and RIS	
Innovation Union Scoreboard	**Regional Innovation Scoreboard**
ENABLERS	
Human resources	
1.1.1 New doctorate graduates (ISCED 6) per 1000 population aged 25-34	No regional data available
1.1.2 Percentage population aged 30-34 having completed tertiary education	**Percentage population aged 25-64 having completed tertiary education**
1.1.3 Percentage youth aged 20-24 having attained at least upper secondary level education	No regional data available
Open, excellent and attractive research systems	
1.2.1 International scientific co-publications per million population	No regional data available
1.2.2 Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	No regional data available
1.2.3 Non-EU doctorate students as a % of all doctorate students	No regional data available
Finance and support	
1.3.1 R&D expenditure in the public sector as % of GDP	**Identical**
1.3.2 Venture capital (early stage, expansion and replacement) as % of GDP	No regional data available
FIRM ACTIVITIES	
Firm investments	
2.1.1 R&D expenditure in the business sector as % of GDP	**Identical**
2.1.2 Non-R&D innovation expenditures as % of turnover	**Similar (only for SMEs)**
Linkages & entrepreneurship	
2.2.1 SMEs innovating in-house as % of SMEs	**Identical**
2.2.2 Innovative SMEs collaborating with others as % of SMEs	**Identical**
2.2.3 Public-private co-publications per million population	**Identical**
Intellectual assets	
2.3.1 PCT patent applications per billion GDP (in PPS€)	**EPO patent applications per billion regional GDP (PPS€)**
2.3.2 PCT patent applications in societal challenges per billion GDP (in PPS€)	No regional data available
2.3.3 Community trademarks per billion GDP (in PPS€)	No regional data available
2.3.4 Community designs per billion GDP (in PPS€)	No regional data available
OUTPUTS	
Innovators	
3.1.1 SMEs introducing product or process innovations as % of SMEs	**Identical**
3.1.2 SMEs introducing marketing or organisational innovations as % of SMEs	**Identical**
3.1.3 High-growth innovative firms – indicator not yet included	No regional data available
Economic effects	
3.2.1 Employment in knowledge-intensive activities (manufacturing and services) as % of total employment	**Employment in knowledge-intensive services + Employ¬ment in medium-high/high-tech manufacturing as % of total workforce**
3.2.2 Medium and high-tech product exports as % total product exports	No regional data available
3.2.3 Knowledge-intensive services exports as % total service exports	No regional data available
3.2.4 Sales of new to market and new to firm innovations as % of turnover	**Similar (only for SMEs)**
3.2.5 License and patent revenues from abroad as % of GDP	No regional data available

Source: European Commission (2012a, p. 10)

2.3 Low-tech industries

As mentioned above, a further important issue to consider is the degree of alignment between the economic composition of the region and the focus of regional innovation policies. The relative absence of innovation policies targeting the needs of low-tech industries is in particular a critical issue, as public policies tend to favour high-tech industries (Turok, 2004; Hirsch-Kreinsen, 2005; Hansen, 2010). This focus is also evident in EU policies, as the included measures in The Regional Innovation Scoreboard also points to.

Thus, we can suggest that an important aspect of a well-functioning regional innovation system is the proper consideration of the needs of low-tech industries, *if* these industries are of economic importance to the region (which is however the case in most instances). The following aspects appear to be of particular importance to include:

1. Investments in machinery and other advanced production equipment are crucial to the competitiveness of low-tech firms. While such investments are not job creating, they are often job preserving as they prevent extensive outsourcing. However, the growing sophistication of advanced machinery makes it increasingly challenging for low-tech firms to take informed decisions on investments; thus, policy has an important role to play here.
2. Secondly, user-producer interactions are central to low-tech innovation strategies. Low-tech firms are more market oriented in their knowledge linkages than high-tech firms and the effect of collaboration with customers on innovativeness is significantly higher in low-tech manufacturing. This highlights the importance of regional innovation policies to go beyond firm-university linkages and also focus on facilitating knowledge exchange along value chains.
3. Thirdly, human capital is increasingly important in low-tech firms (Hansen et al,. 2013). The accelerating substitution of machinery for labour reduces employment of unskilled labour, and the operation and maintenance of advanced machinery require increasingly higher skill levels of employees. However, employees with both academic and practical skills are often in short supply, thus, emphasising the importance of regional innovation policies to, firstly, extent the efforts made to attract highly skilled labour in high-tech industries such as biotech and ICT to low-tech industries and, secondly, consider the links to policies focusing on vocational education.

3. The state-of-the-art of research of regions with less developed research and innovation systems

In line with the available analyses, especially the EC Regional Innovation Scoreboard (EC 2012), the four main types of regions with less developed research and innovation systems have been identified: i) regions experiencing post-socialist transitions, ii) regions located in southern Europe, iii) outermost and overseas territories, iv) regions underperforming their surrounding context (see section II.1 for more). However, available evidence suggests that the regions with the research and innovation systems that are by far the most legging behind are those located in Central Eastern Europe with post-communist heritage. The second distinctive category, which is howerer, significantly less represented among Eurpean underperformers than the first type, represent several regions in Southern Europe (esp. Greek regions and some regions in Southern Spain). Consequently, it is suggested that the research focus of this project would focus primarily upon the regions with the least developed research and innovation systems, which is in addition the most frequent type among European underperfomers. It it is easy to believe that this type of regions is in the same time the most challenging from all four categories of laggards.

3.1 Limited awareness and readiness to employ the state-of-the-art concepts in regions with less developed research and innovation systems

There is a vast literature testing the relevance of the state-of-the-art theories and concepts such as learning regions, clusters, global production networks, triple/quadruple helix, regional innovation systems, related variety and knowledge bases in the sphere of research of regional development and of innovation processes and systems. However, this is much less so in the case of less developed regions, especially those with the post state-socialism heritage. The detail scrutiny of factors why this is so is beyond the focus of this paper, nevertheless, at least the major reasons should be given as these have important implications for the way the concept of smart-specialisation could be further developed and applied in these regions.

First, and most obvious, there is a limited knowledge of the state-of-the-art concepts among local experts due to generally low level of capacity of local knowledge institutions, which is in cases even multiplied by still limited access to scientific literature due to resource

constraints. Therefore, the number of local experts (both academics and practitioners) that are able to follow the state-of-the–art debate or even to be directly engaged in such a debate is very limited. Consequently, sizeable part of limited body of existing literature on research and innovation systems in less developed regions has been elaborated under the orchestration of western experts eager to test existing concepts in specific environment of post-communist countries. While these contributions might be useful from conceptual as well as from empirical point of view, these can hardly induce any impacts upon studied regions such as a change in the way of thinking among local academics, decision-makers and/or entrepreneurs as these authors are not deeply embedded in local networks.

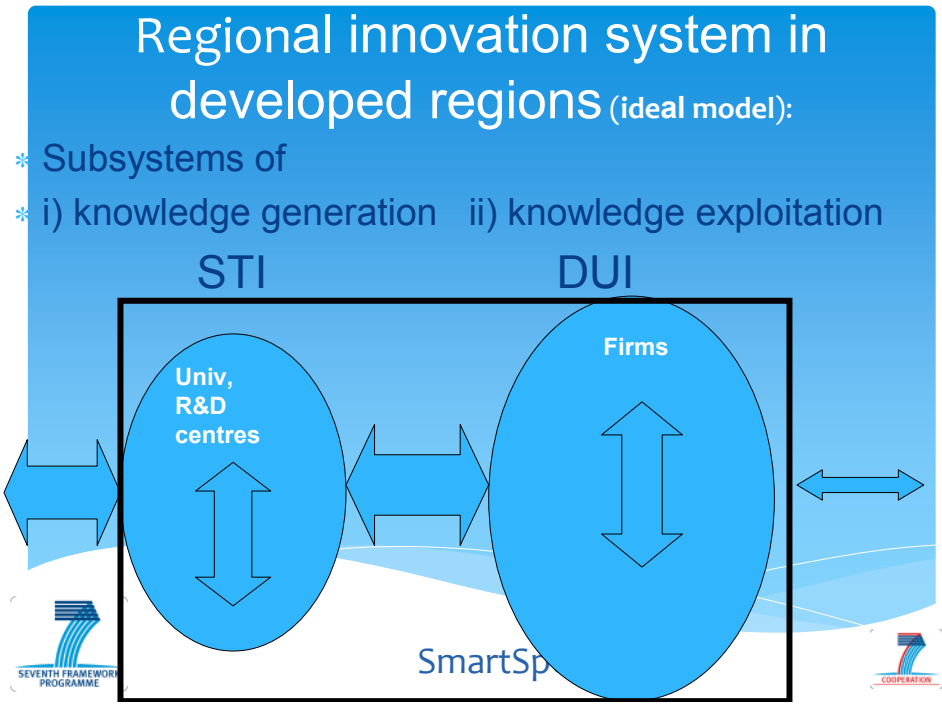
However, the second reason seems to be much more important. Namely, it is the wide-spread scepticism about the relevance of modern theories and concepts as these were developed in different socio-economic context. Therefore, research papers elaborated by academics in post-communist countries are frequently empiricistic or descriptive, lacking serious engagement with existing theories. Moreover, many of the recent theories stress the role of both formal and informal institutions, which sharply contrast with under-developed institutional and cultural framework in weaker regions, especially those with a post-communist heritage. In particular, while the existing theories stress the role of factors such as trust, reciprocity, responsibility, partnership and shared leadership (see e.g. Sotarauta, 2010), the existing institutional framework of these countries and regions can be characterised rather as over-bureaucratic, over-politicised, unprofessional, unstable, non-responsive, non-transparent, lacking any strategic vision, etc. This also translates into a significant tension between the entrepreneurial and public sectors. Moreover, there exists a deep cleavage of mistrust and misunderstanding among the entrepreneurs and academics as different value systems evolved among these remaining two subsystems of the triple helix. This was aptly expressed by one entrepreneur at the meeting facilitated by intermediary organisation in one of the Czech regions *„We (firm) would cooperate with universities provided the sphere is not vital to our competitiveness“*.

Therefore, there is a wide-spread individualistic behaviour among the key regional development actors (entrepreneurs, knowledge and even intermediary institutions) and existing platforms and networks are considered and used as a *prima facie* vehicle for lobbying for external support. For a schematic comparison of internal structure of the research and

innovation system in well developed and less developed regions see Figure 3 and 4. To put it shortly, the institutional framework is rather inhibiting than enabling. Consequently, the discrepancy between the envisaged and existing institutional framework is of such a scale that the "western" theories and concepts are frequently considered among both academics and (especially) among decision-makers as unrealistic and even naïve and hence are seldom tested in policy practice.

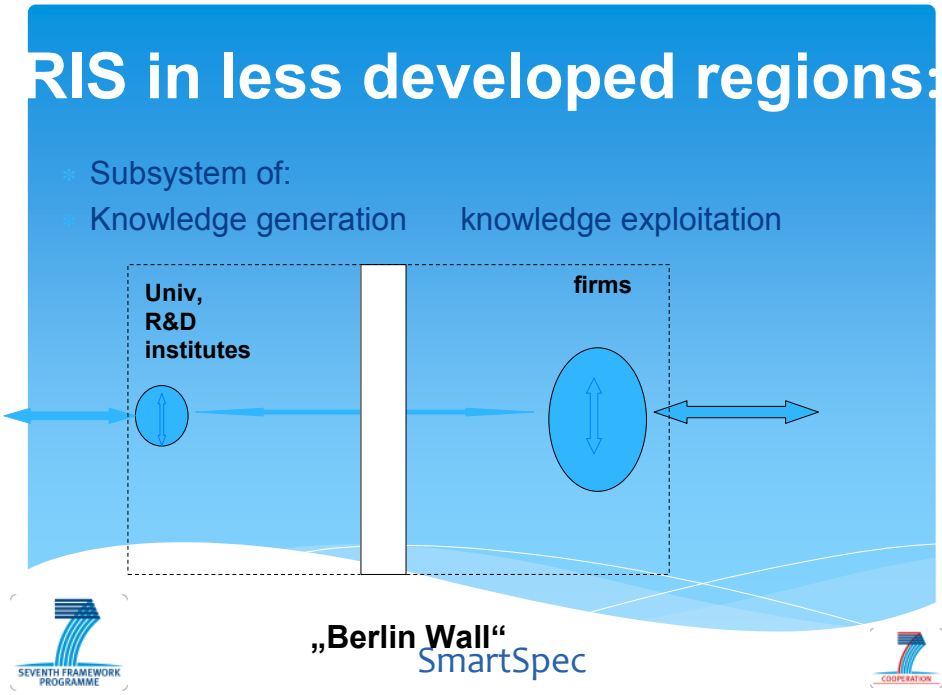
Third, even in rare cases when the "new" concepts such as clusters have been applied in policy practice, these policy initiatives were soon discredited among entrepreneurs and other actors due to their improper design and widely spread rent-seeking behaviour, moreover embedded within a generally unfavourable institutional and socioeconomic context (lack of useful technological know-how, lack of market knowledge, weak performance of educational system, non-existing or weak intermediary and knowledge institutions etc.).

Figure 3: Schematic structure of research and innovation system in advanced regions



Source: own elaboration based upon Cooke, Asheim (2006)

Figure 4: Schematic structure of research and innovation system in less developed regions



Source: own elaboration

This critical assessment should not be definitely over-generalised as even among these regions do exist cases (although infrequent) of a remarkable commitment of all key triple helix actors to a genuine endogenous strategy based on the state-of-the-art concepts (for analysis of evolutionary trajectory of innovation policy within one of such regions see Blažek et al, 2013). Existing successful cases prove that a sophisticated strategy can be prepared and implemented under a difficult socioeconomic situation and even under the conditions of an unfavourable national framework provided there are at least a few committed and knowledgeable personalities who are persistently able to spread their enthusiasm and vision among other regional actors. Importnatly, the positive experience gained in one such region (South Moravia in the Czech Republic) shows that the state-of-the-art-concepts in less developed regions can:

1) improve understanding of real challenges of particular regional development actors (e.g. position of local firms within GVCs/GPNs, fragmentation of RIS or prevailing type of knowledge base)
2) provide inspiration for new approaches (e.g. related variety or entrepreneurial search process)
3) help to design better (i.e. more realistic) strategies and tools/incentives
4) in case of regions with limited or missing competence over R&I can help to raise the awareness of public authorities about this sphere and even to justify the public support into this non-traditional sphere provided that these expenditures are shortly followed by tangible results attractive for decision-makers (e.g. new quality jobs created and/or increasing the number of start-ups and their further growth) (Blažek et al, 2013).

Existing successful cases from within the less developed countries can provide inspiration not only for other regions but even for the relevant national authorities ("lighthouse function"). Such a learning process can be stimulated for example by proper networking mechanisms, which can be designed as a vehicle supporting implementation of smart specialisation strategies in the regions.

To sum-up, the distance between the "ideal" situation and the reality is in case of the least developed regions frequently far too large and hence is not stimulating but leads rather to passivity or even to a hostile attitude towards "imported" concepts. Importantly, this context has to be taken into account in an effort to put the concept of smart specialisation into policy practice in these types of regions.

The diagnosis: existing assessments of regional innovation systems in less developed regions

Surprisingly, given the early stage of formation of innovation systems in countries and especially in regions with less developed research and innovation systems, there are already several studies, which are policy oriented and which aim at the evaluation of emerging regional innovation systems and strategies and at forwarding policy recommendations.

Nevertheless, according to our knowledge, in post state-socialism countries, there is only a

single study, which aims at a thorough assessment of existing regional innovation systems across the whole country (Poland) - see Plawgo et al (2013). Luckily, this study based on combination of quantitative and qualitative data (interviews, Delphi method etc.) is very up-to-date and is highly relevant. There are several important conclusions emanating from this study:

i) the authors confirmed a statistically significant correlation between the level of innovativeness potential of individual Polish voivodeships and their general level of development measured by GDP. However, importantly, from this, according to authors, follows that in such case, it is difficult to draw any conclusions on the effectiveness of pro-innovation policy in individual voivodeships based on an analysis of statistical data itself.

ii) a general tendency was identified by the authors, namely, that the higher the level of innovativeness of a region, the greater is the decision-makers knowledge about all aspects of regional innovation systems and at the same time the higher decision makers readiness to take actions to strengthen regional innovation system even further. (This kind of cumulative mechanism has been observed also in other countries, though with important exceptions. For example, Prague has relatively high level of innovativeness which, however, contrasts with rather passive approach of city authorities towards implementation of city innovation strategy (Blažek, Uhlíř, 2007).

iii) the management structures of RIS are applied in most voivodeships, although often in a different organisational form than initially envisaged. The organizational structures do not always fulfil the four basic management functions (planning, organising, motivating and controlling). In most cases, only the functions of motivating and controlling are fulfilled.

iv) Finally, according to the authors, voivodeship's self-governments have so far failed to develop coherent innovation systems in their regions. Instead, individual institutions, documents and measures can be identified, but these do not make a complete system of innovation.

Brief, but insightful and highly representative also for other countries and regions with post state-socialism heritage, is the report on innovation prepared by Gorzelak et al (2010). The

authors start by arguing that „all (Polish) regions have regional innovation strategies, however not that vividly implemented“ (p.3). The same observation can be found for most of countries and regions with a post state-socialism heritage. For example, in case of Bulgaria, Stefanov and Mineva, 2010 argue that regional innovation strategies remained largely “on paper” (p.5), for Romania, Ranga (2010) argues that “the RIS provide a good description of regional strengths, weaknesses and opportunities, and highlight ambitious objectives that are most relevant and necessary to the respective regions, but they do not provide an operational basis for action, since they don’t have own funding sources” (p.10).

These observations point well to one of general weaknesses of countries and regions with post state-socialism heritage, which is a reserved attitude towards the strategic documents as they are still often seen either as a sort of reincarnation of discredited central planning or as a nuisance imposed from “above” without any practical relevance or added-value. Moreover, designing the high-quality strategies in addition with a proper involvement of key partners is a challenging task for which know-how is not readily available in regions with less developed research and innovation systems. In addition, partners themselves could be frequently, especially at the regional level, non-existent or pursuing only rent-seeking strategy. Consequently, involvement of partners into the programming process often results in melting the strategic focus into broad all-encompassing strategies satisfying needs of all partners involved, which is the exact opposite of smart specialisation principles. Finally, strategic documents are sometimes considered by the decision-makers as unwelcome constraint over their competence (Blažek, Vozáb, 2006).

However, importantly, there is one more fundamental obstacle for more pro-active approach towards the sphere of research and innovation in case of regions in most post-communist countries and this is missing competence of regional authorities over this sphere. Moreover, in some countries, such as Hungary, the regions are mostly strategic-planning entities, not real actors of innovation policy (Bartha et al, 2010). Therefore, the central government had to establish a network of regional innovation agencies (RIÜs) operating in every region to stipulate the role of regional authorities.

Hence, the regional authorities are preoccupied with fulfilling their own competence while any “excursion” into the sphere of research and innovation support might be questioned even

from a legal point of view. In addition, in several countries (e.g. the Czech Republic) the system of financing of regional governments is designed in such a way that the tax revenues paid by firms are flowing into the state budgets, so there is no direct reward in case of a more pro-innovation approach of a given region whilst the costs born by such activities and support schemes are real and immediate. Consequently, even though the number of regions that adopted their regional innovation strategy is not small, with few exceptions are these documents of a purely formal nature (for case of Slovakia, see e.g. Frank, 2010). All these factors result in a poor pace of implementation of strategic documents and to practically non-existing culture of evaluation of the impacts of supported interventions as well as to missing policy learning tradition and hence "policy intelligence" (for more on these issues see WP4).

There is significant variation in "regionalisation" of research and innovation policy in case of small countries such as the Baltic States and Slovenia. While for example in Slovenia there are no (micro-) regional initiatives to promote research and innovation (Kavaš, Bučar, 2010), the situation in Estonia is different. Even though Estonia represents a single NUTSII region, there are attempts to design innovation policy support measures at the local (city) level, but implementation of these regional innovation strategies in practice has been so far limited (Kalvet, 2010). Moreover, from a smart specialisation perspective, it is questionable if such micro-regions can achieve a required critical size.

According to Gorzelak et al (2010), the major deficiencies in implementation of the innovation projects are too schematic procedures and risk-avoiding attitudes, which in many cases do not allow for promising, though risky innovative projects to be undertaken. This risk-avoiding approach is neatly supported by another observation of the authors, namely, that investment in research establishments and enhancing research potential, concentrated in major academic centres in the largest cities, seems to be the most successful direction of intervention in the sphere of research and innovation support in Poland (Gorzelak et al, 2010). However, these large investments into the state-of-the-art research infrastructures were in fact driven by a liner model of innovation, which is being traditionally biased towards supply-side infrastructures. Due to lack of organizational learning competences and absorptive capacity these policies are frequently less effective than envisaged (Boeckhout, 2004). While this statement is of a general relevance, it is particularly relevant for less developed countries and regions, as these regions and even countries often suffer from a mismatch between economic

structure and a few hotspots of scientific excellence. Moreover, according to Boeckhout (2004) innovation policy needs to be properly linked with research policy, which is mostly managed from the national level. Therefore, under these conditions, innovation in only rarely based on cooperation between scientific institutions and enterprises as foreseen by science, technology, innovation (STI) model of innovation. Consequently, doing, using, interacting (DUI) model of innovation dominates, nevertheless, no systemic measures have been so far taken to spur the innovation within the enterprise sector.

Consequently, Gorzelak et al (2010) concluded, that „Attempts to make innovation and research-oriented projects one of the leading dimensions in development of the less-developed regions has not, as yet, proved to be successful“ (p. 12). This is however, not surprising, given the number of deficiencies of both broad and narrow innovation system on national as well as regional level. Among those deficiencies, „soft“ institutional factors such as lack of professionalism, commitment, trust, reciprocity and of shared leadership seem to be of largest importance. This accords with one of the final observations of Gorzelak et al (2010), in particular that the readiness for co-operation of different agents is still too low, which decreases the level of co-ordination and integration. It should be added that changing attitudes and values and modes of operation of particular actors and institutions is much more cumbersome than for example construction of modern infrastructure. While this might seem as obvious statement, this view is only rarely shared by population and by the decision-makers of less developed regions, who strongly prefer tangible investments.

3.2 Academic literature on regions with less developed research and innovation systems

As explained above, the academic literature on emerging regional innovation systems and policies in less developed regions is rather scarce. Nevertheless, there are several important exceptions, which will be elaborated in this section.

The latest generation of institutional theories of regional development - the theory of regional innovations systems - can be in a nutshell, according to Phil Cooke defined as “interacting knowledge generation and knowledge exploitation subsystems linked to global, national and other regional systems” (Cooke, 2004, p. 3). This approach has been recently extended by Lengyel and Leydesdorff (2011) in their case study on Hungary, who coined a three-dimensional model of innovation systems consisting of the following knowledge functions:

knowledge exploration, knowledge exploitation and organisation control. Within this model, organisation control is conceived as "the institutional and organisational elements of innovation system" such as economic policies, cluster programmes, etc. (ibid, p. 680). Importantly, these authors argued that while "knowledge exploitation is connected to locations only when there exists some synergy within an innovations system: the local pool of suppliers, qualified labour", in contrast, knowledge exploration can be considered as a place dependent rather than market-dependent mechanism because tacit knowledge is essential in creating new knowledge and relates significantly to places" (ibid p. 680). Finally, the authors arrive at the conclusion that it is the synergies across these three dimensions, which mark the quality of innovations system (Lengyel, Leydesdorff, 2011).

In their research on regional innovation systems in Hungary, Lengyel, Leydesdorff (2011) observed that the national innovation system is decomposed into smaller subsystems, which operate under different dynamics. In particular, the contribution of R&D to the knowledge synergies proved to be strongly differentiated among the various regional innovation systems. More generally, foreign-owned firms have been found to exert a restructuring effect on the synergy of the three knowledge functions, esp. via privatisation of R&D facilities and greenfield investment in both knowledge exploration and exploitation. A prime example given by the authors is automotive manufacturer Audi, which is leading not only the local automotive cluster and commanding its extensive value chain, but also owning the research institute at the regional university. Consequently, three main types of regional innovation systems have been found in Hungary: the metropolitan system of Budapest, the north-western Hungary well integrated into European market, and, finally, southern and eastern parts of the country, where innovation system is relying mostly on public R&D. Generally, internal linkages within the Hungarian innovation system have been weakened and external linkages asynchronously reinforced. Consequently, Lengyel and Leydesdorff (2011) conclude that "Hungarian system may have lost control of its political economy" (p. 691).

Moreover, at another place, Cooke argued that regions can be important players of regional development provided they command i) sufficient competence, ii) adequate financial resources and iii) relevant know-how (Cooke, Asheim et al, 2006). Importantly, in the context of post state–socialism countries, which are typical by a low level of trust and by an individualistic mentality developed as a response to a forced collectivism under the

communism (see Blažek, Uhlíř, 2007), further important conditionality to Cooke's triad should be added. Namely, the mutual respect between the regional (self-) government bodies and the other relevant regional players such as those conceptualised by triple/quadruple helix metaphor. Moreover, this factor (or conditionality) is in line with recent advances in understanding of the role of leaders and of (shared) leadership in regional studies (see Sotarauta, 2010). Therefore, the mutual respect and shared leadership can be conceptualised as other key conditionalities enabling a more proactive role of regional governments in the sphere of research, development and innovation.

The role of "indigenous" innovation systems in innovation output under the current period of globalisation has been recently investigated by econometric model by Srholec (2013). His main finding is that the capacity of firms to build on domestic linkages is what affects most their innovation output. This confirms the notion that international business does not undermine the role of domestic innovation systems. In particular, even if firms invest and cooperate abroad to tap into foreign knowledge, their strategic capabilities remain embedded in indigenous innovation systems. These results concord with the literature on geography of innovation by Bathelt et al. (2004) on the key role of interactions between learning processes taking place among actors embedded in the "local buzz" and knowledge obtained by building "global pipelines" to sources outside of the local milieu because exactly the co-existence of high levels of buzz and many pipelines provides firms with a string of particular advantages not available to outsiders. Therefore, foreign external linkages are valuable, but only in combination with the domestic ones (Srholec, 2013).

Instead of developing their own strategies based on thorough understanding of key challenges and opportunities of key R&D&I actors orchestrated by respected leader(s), according to Blažek et al (2013), in many instances, regions with less developed research and innovation systems have been found to design only imitative regional innovation strategies, based on copying foreign best practices. This was often done without a comprehensive understanding of underlying preconditions and without a proper adaptation of such practices to the specific features of the particular region. It is only now that one can begin to observe more intensive, on-going discussions about the need to reform R&I systems, both at national and regional levels, and of more strategic and more "fine-tuned" approaches in designing innovation and competitiveness strategies at the regional level (Blažek et al, 2013). Therefore, from this point

of view, the concept of smart specialisation conceived as a special sort of policy process based on entrepreneurial discovery has arrived in due time.

Srholec and Žížalová (2013) recently proved by a detailed analysis performed on a micro-regional level that there is a significant difference between the spatial pattern of distribution of public R&D institutions (much more concentrated) and private R&D facilities (more dispersed). Moreover, according to these authors, there is only seldom coherence between the spatial pattern of distribution of R&D capacities and existing administrative borders. Therefore, Srholec and Žížalová (2013) plea for coordination of innovation policy across multiple regions and for multi-level system of governance promoting closer cooperation between various layers of government. However, even the authors themselves admit that this is easier to be said than done. Neverthless, a search for proper innovation policy coordination mechanism (perhaps including the selection and operation of entrepreneurial platforms spanning several regions for selection of priorities) might be useful.

Recent econometric analysis of efficiency of systems of innovation in Eastern Europe[2] has been performed by Kravtsova and Radosevic (2012). The authors distinguish between production and technology capabilities: "The production capabilities are resources used at given capital-embodied technology, labour skills, product and input specifications and the organisational methods used. Technological capabilities are those that generate and manage technical change, including skills, knowledge and experience, and institutional structures and linkages" (Kravtsova and Radosevic, 2012, p. 110). There are several important conclusions that emerged from their study. The main conclusion of their study is that Eastern European countries have lower level productivity than might be expected from their R&D and production capabilities and lower levels of S&T outputs (papers and patents) given the number of their researchers. Therefore, inefficiencies in both broad and narrow innovation systems have been identified. These authors also discovered a negative relationship between patents and high-tech exports, which indicates global integration of these countries via low value added segments in high-tech sectors.

According to Kravtsova and Radosevic (2012) there are three main challenges for these countries. First, the East European countries lack the vision related to its learning

[2] Their analysis includes all transition economies, i.e. countries of Central, Eastern and South-Eastern Europe, but also the post-soviet countries.

(educational/training) systems. Second challenge is how firms can make transition from mastery of production to technological (R&D and innovation) capabilities as this process is not automatic and requires changes not only within firms but also within both narrow and broad innovation systems. Third, a re-orientation of R&D systems in Eastern Europe from focus on knowledge generation to knowledge diffusion and absorption is suggested.

The authors conclude that in Eastern Europe there is a gap between the production and technology determinants of productivity. Therefore, policies should not be confined only to narrow innovation system or oriented only towards the generation of new knowledge, but they should also embrace the knowledge absorption and diffusion functions of R&D systems and assist the integration of narrow and broad innovation system via effective-demand-oriented measures (Kravtsova and Radosevic, 2012).

3.3 Key implications and challenges for application of smart specialisation concept in regions with less developed research and innovation systems

All these observations and arguments have important implications for a suitable design of smart specialisation process in regions with less developed research and innovation systems.

Most importantly, due to above explained specific features of these regions, the rigid application of smart specialisation concept should be avoided. In particular, given the number of systemic failures and barriers within both broad and narrow innovation systems[3] in these countries and regions (see Kravtsova and Radosevic, 2012) it seems to be highly desirable to fix at least the major ruptures within institutional framework, i.e. within broad and narrow innovation system first. Otherwise, the evolutionary trajectory of less developed regions will not be altered.

Moreover, in weaker regions, there is frequently a mismatch between the economic structure of the region and the research focus of its knowledge institutions. Therefore, given the immature institutional framework and a general lack of networking culture and capabilities in

[3] The concept of broad and narrow system of innovation stems from understanding "that technical change is inextricably linked to the overall institutional fabric of society rather than only to narrowly defined R&D/S&T system" (Kravtsova and Radosevic, 2012, p. 110). According to these authors, narrow innovation system encompasses institutions that are directly and explicitly involved in R&D, while broad innovation system embraces the social, economic and political contexts of technical and organizational innovation.

these regions, these discrepancies would swiftly result into a bitter battle between academia and businesses over the selection of domains of potential specialisation thus further exacerbating existing cleavages among them.

Therefore, it could be suggested that the process of smart specialisation in these regions should *not* start with selection of priorities conceived as domains of future specialisation by however well designed, transparent and bottom-up process, but by fixing at least major deficiencies of broad institutional framework (e.g. transparency and professionalism of public sector, educational system, enhancement of trust between academia and businesses via incentives for mutual cooperation). Consequently, distinguishing between horizontal and vertical priorities seems to be particularly useful for these regions. Horizontal priorities could be defined as priorities (or as "areas of change" to use the business terminology as encouraged by smart specialisation architects - see Foray et al, 2012) aiming at strengthening of the overall institutional environment and innovation system at both national and regional levels. On the other hand, the perspective domains for future specialisation could be called vertical priorities. Starting the entrepreneurial discovery process by a search for horizontal priorities would not only allow to avoid further fuelling of existing tensions among various actors within emerging and fragmented innovation system by forcing them to make "tough choices", but rather bringing them to the table for searching what are the most pressing horizontal/transversal issues to be fixed first and how this could be achieved.

Consequently, a search for a proper timing and a suitable balance between the horizontal and vertical priorities in case of less developed regions is an important research challenge.

Moreover, while it is clearly proposed that the perspective domains for future specialisation should be searched for via discovery process performed within the entrepreneurial platforms (Foray et al, 2012), there is little guidance how and who should identify and select these platforms. This is a crucial issue especially in case of immature governance system, where there is a danger of a capture of the process by strong actors, which is typical for regions with a post-communist heritage. Likewise, there is so far no indication of a suitable number of platforms, which should be established in a region or a country. Therefore, these are issues which proper operationalisation would enhance implementation of smart specialisation concept in policy practice.

Another pressing and related issue concerns the "width" of priorities. So far a wide range of smart specialisation priories have been forwarded within the European countries and regions ranging from very narrow ones, such as "nanotechnologies in paper mill industry" to very broad ones such as " productive technologies" or even „social sciences and humanities". While the requirement to select only limited number of priorities tends to support rather selection of broad priorities, from a policy perspective, highly specific niches of potential specialisation might be more desirable. In case that narrow priorities would be preferred, it remains unclear what number of such domains of a potential future specialisation would be needed to achieve a desirable shift in economic and employment structure of the region or even of the whole country. Clearly, these are important issues concerning the policy process of smart specialisation that are still open and need to be addressed appropriately.

4. State-of-the-art regarding the challenges and opportunities facing regions with less-developed research and innovation systems to maximise the impact of their smart specialisation strategies: the role of economic structure

The regional economies of less developed regions are integrated into European economy due to their following key strengths: relatively cheap labour (often offering good qualification) available in close geographic proximity to the vast West European market, in case of some regions also strong industrial tradition, and frequently also the existence of basic infrastructure. Therefore, these regions were able to attract a large amount of foreign capital either in the form of greenfield investment or, esp. in case of regions with post-communist tradition, during the process of privatisation of the former state-owned companies. Consequently, these regions were, on the one hand, able to benefit from the transfer of know-how, but on the other hand, they became to a significant extent dependent on decision-making process pursued within the large foreign firms. For example, in Hungary, the share of registered capital of companies controlled by foreign capital is higher than 50% (Lengyel and Leydesdorff, 2011).

Likewise, in a majority of former state-socialism countries, the banking sector has been to a large extent taken-over by the multinational financial groups (Smith and Swain, 2010) and consequently "subsidiarised" (Blažek, Bečicová 2014). Smith and Swain forwarded an

argument that 'geo-economic and geopolitical integration undertaken during their post-socialist transition have contributed to economic vulnerabilities exacerbated by the global crisis', as their development model has been 'based on internationalisation of the financial sector, cheap credit, and increasing reliance on exports to compensate for energy resource imports' (Smith, Swain, 2010, p.1). Drahokoupil and Myant (2010) have argued equally and, moreover, offered a typology of potential vulnerabilities stemming from several forms of integration of different transition economies. In the case of CEECs, the export demand has been identified by these authors as a principal vulnerability.

Obviously, there is a considerable variety of economic structures of particular regions with less developed research and innovation systems. Nevertheless, at least three broad categories of regions should be distinguished, namely, metropolitan regions with diversified economic structure, old industrial regions, and, thirdly, economically weak regions (mostly peripheral or rural regions). However, despite a significant variance in economic base among particular regions, there are several features of economic structure of these regions, which are of a transversal nature. The following three transversal issues are the most relevant.

4.1 Branch-plant syndrome

The first transversal feature of regions with less developed research and innovation system is the branch-plant character of their economic base. In the literature, there is already a well established concept of spatial divisions of labour (Massey, 1984) arguing that instead of traditional sectoral differences in economic structure between developed and less developed or lagging regions, currently, more relevant is the functional division of labour among the regions within a single industry. While this theory was originally developed in order to explain interrelation between the industrial structure and labour markets in the regions within developed countries, currently, due to the advanced level of integration of the European market, this theory is highly illuminating on transnational level as well.

In particular, Massey (1984) argues that large firms tend to allocate their high-level functions such as headquarters or research and development centres into metropolitan regions, production of new or top-class products into highly developed industrial regions, and, finally, the production of standardised goods is being assigned to less developed regions. This sort of

functional division of labour within large firms but in the same time among the various regions is having numerous important implications. First, as indicated above, the most important impact of this sort of spatial division of labour is a strong dependency of branch plants upon the decisions made by headquarters of these large firms, which are often located in distant (mostly metropolitan) regions.

Second, these differences in economic base of the regions are having important consequences for the type of labour force, which is demanded in different types of regions. These differences result in profound disparities in social (and educational) structure of particular regions. Low-qualified and low-paid labour force used for production of cheap standardized goods in less developed regions commands only low purchasing power, which in turn translates into only modest opportunities for development of other sectors. Therefore, low purchasing power of local populations is one of important factors that inhibit the possibilities for regional entrepreneurs.

Third, from this sort of spatial division of labour follows that the potential for mutual collaboration between enterprises ("cathedral in the desert") and academic sector collocated within the less developed region (as envisaged by state-of-the-art theories such as triple helix or regional innovation systems) is difficult if not impossible due to two main factors. Namely, (i) branch-plants usually do not perform any R&D activities and, in addition, (ii) have very limited autonomy when dealing with actors outside the firm. Therefore, the potential for their engagement with nearby R&D institutions (if any) as well as with other actors, such as local SMEs, is rather limited.

Even more importantly, according to Massey (1984), this type of spatial division of labour represents a sort of a genetic code based predominately upon socioeconomic profile and consequent image of particular regions, which to a large extent replicates the fortunes and misfortunes of particular types of regions.

However, obviously, one should also acknowledge positive spillovers of these branch-plants even though they might be rather weak as the term "cathedrals in a desert" coined by D. Massey (1984) for these branch-plants suggests. Nevertheless, it should be also imagined what would be the situation within these regions in case the large firms would not invest into

these regions at all. In addition, there is a well documented trend in functional division of labour, namely, while in most cases the less developed regions attract activities requiring low-qualification, there are numerous cases when the branch-plants have gradually improved their position within the firm's hierarchy (see e.g. Blažek, Uhlíř, 2011). In particular, while, originally, usually only basic production functions were performed by TNCs in this type of regions, if the plant performs well and provided there was a favourable regional institutional framework, the branch plant can gradually acquire higher level functions such as design, or even some segments of R&D. Consequently, branch-plants, which succeeded in acquiring some higher level functions exert wider and stronger spectrum of spillover effects than the classical branch-plant oriented exclusively upon assembly of standard goods. Obviously, this sort of evolutionary trajectory should be actively promoted not only by the management of this branch, but also by a proactive policy of the region. To achieve such a mission, the regional authorities should strive not only at provision of various after-care services, but also to cultivate the overall environment in the region in a broad sense (institutions, education system, intermediary bodies etc.) and to activate and engage all actors of triple/quadruple helix).

4.2 Global production network perspective

Second transversal issue applying to a large number of regions with less developed research and innovation systems is the fact that large number of local firms operate as lower-tier suppliers of various global production networks/global value chains. Global production networks are mostly commanded by lead firms, which are mostly large transnational corporations able to penetrate the global market. These lead firms command the whole networks of suppliers, however, due to managerial reasons, in most cases, the lead firms are directly dealing only with limited number of 1.tier suppliers, which are providing them with key components or most sophisticated (sub)systems. First-tier suppliers then command their own suppliers of a second or third tier (Humphrey, Schmitz, 2002). Especially, the 3.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). The cost pressure is definitely not unique to 3.tier suppliers, nevertheless, 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 plastic granule, steel etc.). Therefore, bargaining power (and hence, the potential profit margin) of these lower-tier suppliers is really limited.

However, much more important is the fact that the 3.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 ("process upgrading") (Csank, 2010). Therefore, even if these 3.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, of key relevance is the concept of upgrading.

Nevertheless, while there is a vast amount of literature on various aspects of GPN/GVC in both highly developed and developing countries, there is only limited number of studies applying these theories to the former communist countries (e.g. Pavlínek, Ženka, 2011, Smith.A. et al, 2008). Even more limited is the number of studies, which would be addressing the challenging issue of policy implications stemming from various types of upgrading for less developed European regions. According to available knowledge, there is just a single article dealing with complexities of upgrading in highly developed country (Isaksen, Kalsaas, 2009). Nevertheless, while this article succeeded in a provision of detailed anatomy and of various mechanisms of upgrading, it does not forward any specific policy implications. Consequently, in the literature, there is considerable gap, which is moreover having huge potential for practical application.

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) - see e.g. Gereffi, et al (2005) or Humphrey, Schmitz (2002). Moreover, recently, it was shown, how the power asymmetry within GPN can be moderated or even completely reversed (Patel-Campillo, 2010). 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, enhancing the power of these 3. and 2. tier

suppliers (e.g. via supplying several GPNs or even by producing their own product for the end market) seems to be a promising strategy. Moreover, Isaksen and Kalsaas (2009) have recently shown how the power asymmetry between the lead firm and its suppliers is changing 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 shift to quasi-hierarchy, when the lead firms for example requires open-book approach concerning the cost structure during negotiation of contracts (Isaksen, Kalsaas, 2009).

Therefore, importantly, existing power asymmetry should not be considered as a pre-given and ever-lasting, but rather as a starting point. Clearly, when dealing with this challenge, the concept of smart specialisation can be a powerful tool, esp. in transforming these asymmetric relationships 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.

Even more surprising gap in our current understanding of challenges of regions with less developed research and innovation systems is the fact that there is practically no information about the extent and type of integration of particular regional economies into different types of GPN (according to governance structure, type of production (high/medium/low-tech), country of origin etc.). Even though this sort of investigation is beyond the scope of smart specialisation project, knowledge about the type and scale of integration of particular regional economies into at least basic types of GPNs would represent a significant advancement of existing knowledge, moreover with important policy implications.

Likewise, improving understanding of the different forms of upgrading (and their preconditions) would help to design more realistic innovation strategies based on smart specialisation concept on both national and regional levels.

4.3 Weak endogenous sector

Third common feature of most of the regions with less developed research and innovation system is their weak endogenous sector (Csank, 2013). These regions have long-lasting

propensity for exhibiting low level of entrepreneurship and innovativeness. Alternatively, in case of once highly developed regions with post-communist tradition, the entrepreneurial tradition has been interrupted for about two generations.

Low level of entrepreneurial culture in these regions is due to a complex plethora of interrelated issues, ranging from traditional unresponsive education system, unfavourable institutional framework (for example bureaucratic procedures when setting-up or doing business, low availability of external finance, esp. the modern forms such as the venture capital) to low prestige of entrepreneurs in the society and low ability and willingness to take-up the risk. For example, among the university graduates is deeply encoded "employment culture" and not "entrepreneurial culture" as their prime aim is to get into a well paid job in large TNC and not to start their own business (Csank, 2013).

Consequently, there is a generally low level of entrepreneurial activity. This is especially true for manufacturing, where entrepreneurs need to command with higher amount of capital and with more sophisticated know-how than for example in segment of basic services. Moreover, existing endogenous firms (mostly SMEs) operating within manufacturing sector are facing difficulties with identification and penetration of new markets (both in terms of products and territories) and in cases also with the lack of available labour. Most of the endogenous firms are not able to keep the pace neither with technological development nor with managerial and business models of their larger counterparts from highly developed countries.

However, one has to stress that endogenous sector is extremely heterogeneous, as along with rather passive firms (with low ambitions, such as to set up a family business), there are also highly dynamic local firms. These "gazelle" type firms are especially frequent within industries, which generally require relatively limited starting capital (esp. ICT). As explained above, the number of highly successful firms operating in manufacturing industries is limited, but they do exist despite all the imperfections within both broad and narrow innovation system. Moreover, these rare successful firms usually operate in various sectors and, consequently, can hardly find a space for mutual cooperation (e.g. running of a joint service network on European scale or cooperation in the sphere of R&D), which would further enhance their competitiveness. Therefore, again, the concept of smart specialisation seems to be a promising avenue to explore as it might help to reap the benefits from various sorts of

potential synergies.

4.4 A way forward on the road of smart specialisation: related variety and knowledge bases?

Important vehicle for achieving such a mission, both in case of both branch-plants and 3. tier suppliers, could be a sensitive application of concepts of related variety and knowledge bases. Both these concepts proved to be highly illuminating for tracing evolutionary trajectory of economic strccture in highly developed regions, nevertheless, their practical application for the case of less developed regions requires further conceptual and empirical effort. The concept of related variety, elaborated within the evolutionary economic geography literature, pervasively shown not only that the firms operating in industrial branch that is according to the knowledge used related to the knowledge base of other industries nested in the region perform better, but also that that new industries evolve in the region by "branching" from existing industries using related knowledge (Boschma et al 2009, Boschma 2010). Such "branching" can be an important mechanism for transforming economic structure of the less developed regions provided suitable and targeted effort of relevant actors is exerted.

However, it remains to be investigated, what is the proper geographic level upon which the largest synergies as foreseen by related variety concept might be reaped (Boschma, 2013). Unfortunately, given the geographic variation among the regions within Europe (i.e. the differences in socioeconomic, institutional and other factors) it seems likely that there will be not only important differences in the role, which the distance (or proximity) plays in particular industrial branches, but even that this might differ among the particular types of the regions. Moreover, as there are many dimensions of proximity (see Boschma, 2005), it seems likely that there might be also various dimensions of relatedness. Therefore, the relevance of key factors as conceptualised by related variety approach should be tested across the whole spectrum of European regions, i.e. including those with weak economic base and less developed research and innovation systems.

The key argument forwarded by the concept of knowledge bases is that the innovation process varies significantly in different sectors. Currently, the literature identifies three knowledge bases: analytical (focusing on discovery of natural laws, e.g. biotechnology), synthetic (primarily aiming at effective recombination of existing knowledge to construct a new

product, e.g. engineering) and symbolic (e.g. fashion, media, marketing etc.) (Asheim, Gertler, 2005). Importantly, the innovation process differs among the knowledge bases according to many important dimensions such as type of knowledge used (tacit versus codified, see Polanyi, 1967), methodology (deduction and formal models versus induction and testing), the need for spatial proximity among research partners, prevailing type of innovation process (science, technology, innovation - STI or doing, using, interacting – DUI) etc. for more, see e.g. Moodysson, Coenen, Asheim (2008).

Nevertheless, application of this concept into a policy practice is hindered by several problems. First, recently, Moodysson et al (2008) shown on the case of a particular biotechnology product not only that different knowledge bases blend together within a single industry and even within a single firm, but yet that the nature of the innovation process shifts over the course of research and development process from one knowledge base to another and back. The Moodysson´s et al findings definitely can not be interpreted as a proof of irrelevance of the concept of knowledge bases, but rather as a plea for further refining of the concept and for its sensitive application.

Secondly, and even more importantly, the types of knowledge bases, which have been conceptualisaed so far, do not cover well ever growing knowledge intensive service sector such as banking (or financial sector more generally), legal advice, human resource recruitment and various other types of advanced business services and consultancies. This is surprising as this sector represents not only a sizeable share of employment in developed countries, but also contributes significantly to GDP formation. Therefore, extending the concept of knowledge bases to cover a broader set of knowledge intensive activities as well as unravelling the complexities of innovation process and variation of its nature according to research phase and other dimensions seems to be a huge challenge.

5. The role of knowledge institutions

'Knowledge institutions' should be an integral part of any regional research and innovation system. This broad term encompasses a range of different types of organisation. Hamdouch and Moulaert (2006) argue that the core agents of research and innovation systems are a range of organisations that *together* form the 'knowledge infrastructure' of a region: "universities

and other higher education institutions, research and technology organizations (RTOs), industrial firms' internal research departments, service providers – especially knowledge-intensive service (KIS) firms and business services (KIBS) – and increasingly, 'collaborative organizations' such as networks, consortia and various forms of alliances, partnerships and associations" (p.26). Importantly, this definition does not just include knowledge producers and applicators, but also 'intermediary and hybrid institutions' including "innovation centres, knowledge 'circles' or 'houses', international, national or regional science and technology conferences, technical communities, technological forums, university associations, research councils, industrial and business associations, academic or industrial liaison offices and gatekeepers" (p.34).

Notwithstanding this broad definition universities (or more generally Higher Education Institutions (HEIs)) are perhaps the principal knowledge institutions in almost all European regions. HEIs are *potentially* important actors in regions with less developed innovation systems because of the range of activities they undertake as part of their normal 'core' business, embracing the contribution of teaching to human capital development and research to innovation and the so-called 'third mission' of contributing to society (OECD, 2007). The OECD reviews of the role of higher education institutions in the development of 28 regions spread across most OECD member countries reveal universities as being a key component of the regional knowledge infrastructure in almost all regions, contributing to many of the knowledge institution activities referred to by Hamdouch and Moulaert

The European Commission's Guide Connecting Universities to Regional Growth (which builds on the OECD work) reviews a range of mechanisms through which universities can fulfil a multitude of knowledge institution roles. It draws an important distinction between 'transactional' services and 'transformational' interventions where the latter have the potential to change the direction of a regional economy (see Table 1) (European Commission, 2012b). The key question here is whether an individual university or a regional grouping of HEIs[4] can rise to the challenge of being a transformative actor or actors addressing the shortcomings of a

[4] Where there is more than one HEI in the region we can refer to the regional higher education system with different institutions bringing different competences to the area – for instance universities of applied science or their equivalents focussing on skills and low tech SMEs that need upgrading, for example by the adoption ICTs, and traditional universities with global and high tech research links that need to be translated to regional relevance, possibly by the attraction and/or anchoring of mobile investment.

less developed regional innovation system referred to earlier – more specifically directionality failure, demand articulation failure, policy co-ordination failure and reflexivity failure (Weber and Rohracher, 2012).

Table 2: Transactional vs. Transformational interventions of HEIs in the regional innovation system

	'Transactional' services	Transformational activities
Type of need / demand	stated need or demand	latent or unstated needs
Type of approach	*output* driven approach	*outcome* driven approach
Type of objectives	clear objectives	less explicit objectives
Link to time	usually time bound	less clear timelines

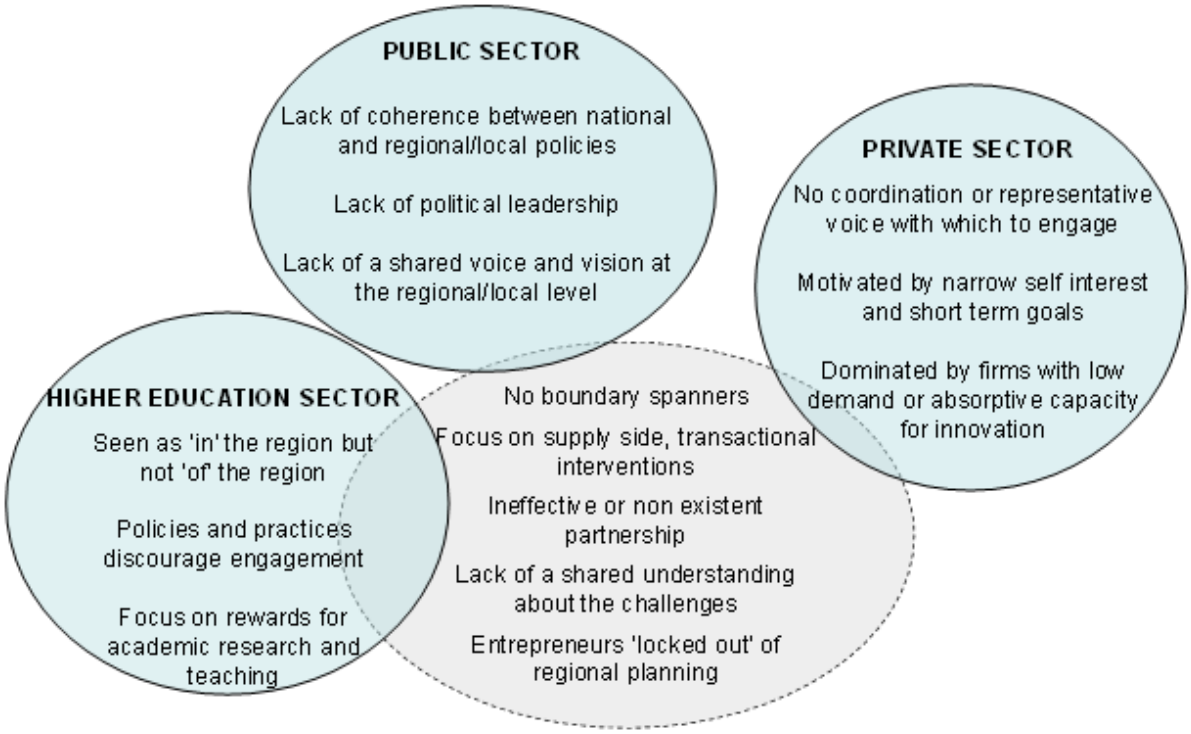
Source: European Commission (2012b)

The OECD reviews reveal a large number of *generic* barriers to HEIs fulfilling this transformative role, barriers which may be critically important if they are to act as transformative agents in regions with less developed innovation systems (Goddard and Puukka, 2008). These include: the territorial 'blindness' of national higher education and science policy and its disconnection from regional policy in most countries; weak internal management structures in traditional universities (particularly in post communist and post fascist countries); fragmented local governments with limited understanding of or influence over higher education; and limited capacity to absorb new knowledge in regional businesses. As noted, earlier, weaker regions may be characterised by 'over bureaucratic, over-politicised, unprofessional, unstable, non-responsive, non-transparent institutional frameworks' and lack any strategic vision. HEIs may be part of the problem and be disconnected from the regions in which they are located (Figure 5).

These barriers to knowledge institutions playing a transformative role in the economic development processes through smart specialisation strategies in regions with less developed research and innovation systems may be particularly high. In terms of smart specialisation the *specific* barriers can be divided into those that relate to the two main functional sub-systems of a regional innovation system that have been identified by Autio (1998): the knowledge generation and diffusion subsystem (consisting of public research institutions, educational

institutions, and related intermediary organisations supporting the dissemination of technology or regional labour markets) and the knowledge application and exploitation sub-system (consisting of commercial firms and the collaborative, competitive or supply chain networks between them).

Figure 5: The disconnected region



Source: European Commission (2012b)

In relation to the knowledge generation and diffusion subsystem the main barrier in less developed innovation systems is simply a lack of scientific research and development capacity relative to more advanced regions. This, to a certain degree, reflects well documented disparities in regional innovation performance within Europe that have already been discussed. Capello (2013) provides a more fine-grained analysis of these disparities by separating out different knowledge economy functions relating to scientific activities, technologically advanced manufacturing or advanced service sectors, and knowledge networking with other European regions. Relating to the first of these, she identifies 74 'scientific regions' which have both "a higher than average scientific activity and a higher than average quality of human capital" (using measures of R&D, patenting, Framework Programme funding, percentage of population with a university degree, and employment in

the education sector). These 74 regions are overwhelmingly concentrated in EU15 member states (only three are in New Member States and 12 from European Free Trade Association members); they are overwhelmingly competitive regions (only three are convergence regions and one a transition region). By contrast, 126 regions are identified that are not specialised in either scientific activity or levels of human capital, which "are mainly located on the peripheral territories of Europe" (p.20). In central and eastern European countries this picture can in part be understood as a failure to recover fully from significant restructurings of the R&D systems and dramatic cuts in public funding during the transition from a socialist economy in the 1990s (Balázs et al. 1995; Meske, 2000). Also notable in terms of the possible role of universities as transformative agents in regional economies is the failure of a widespread culture of academic entrepreneurship and scientific spin-off firm formation to develop in these countries along the lines of that now established in the USA and UK (Tchalakov et al. 2010; Erdős and Varga, 2013).

In relation to the knowledge exploitation and application system, a low number of private sector firms with an existing advanced knowledge or technology base means that the region will struggle to develop the 'absorptive capacity' to be able to take advantage of any new knowledge or technology that may emerge from knowledge institutions either within the region or outside. Liagouras (2010) argues that the main reason for the past failures of technology and innovation policies in peripheral European countries is a "lack of domestic demand for technology" which reflects wider structural issues of the dominant organisational forms in these economies. In southern European countries (such as Greece, Spain, and Portugal), he argues, the main issue is that "the business sector is specialized in low- and medium-tech segments and is not in a position to benefit from the results of the public research system" (p.344), whereas in central and eastern European countries, by contrast, the bigger issue is an overreliance on foreign direct investment (see above) that does not develop effective links with indigenous knowledge institutions. The policy implication of this argument is that these countries and their regions should not continue the approach of attempting to imitate technology and innovation policies followed by territories with more advanced innovation systems (Liagouras, 2010).

This line of policy thinking is close to that promoted in the original formulation of the smart specialisation concept by Foray et al. (2009), which relied on the division of Europe between

'leader regions' that should "invest in the invention of a General Purpose Technology (GPT) or the combination of different GPTs" and 'follower regions' that are "better advised to invest in the ... development of the applications of a GPT in one or several important domains of the regional economy" (p.3). One possible reading of this is that, for most regions, smart specialisation implies a shift away from innovation policies focused on endogenous technological development that are driven in-part by scientific strengths in local knowledge institutions such as universities (Goddard et al. 2013). Camagni and Capello (2013) criticise the oversimplified, dualistic nature of the scheme used by Foray et al., and propose a more nuanced taxonomy of European regions with different innovation patterns that can inform the smart specialisation debate. However, the implication is basically the same: that, to maximise returns, investment in R&D is the correct policy goal only in regions with "a sufficient critical mass of R&D endowment already present in the area" (p.377). In such regions beneficiaries of public investment will be universities, other public research centres and the R&D laboratories of large firms; in other regions the focus should be less on endogenous innovation and more on technological application or imitation, and innovation polices should be focused to a greater degree on local firms and entrepreneurs (p.381-382).

Notwithstanding the concerns raised by these perspectives, universities and HEIs more generally are now regarded as key institutions in the Europe 2020 agenda of smart, sustainable and inclusive growth. Can those located in cohesion regions play a role in reducing regional disparities through contributing to the transformation of their regional innovation systems? While there is a case for investing in the knowledge supply sub-system in universities to upgrade this to the highest international standards in terms of research production and institutional leadership and management, if this investment is not matched by investment in the knowledge application and exploitation sub-system then new knowledge generated in the region will just leak out. More specifically, in relation to the role of universities in the design and implementation of smart specialisation strategies there is a danger of 'capture' by vested scientific interests in universities and the neglect of regional needs and opportunities. Here the role of teaching and learning, for example student placements in SMEs for work based learning, can contribute to establishing the social relations to underpin the local knowledge exchange process. But where the knowledge gap remains great, particularly in areas where technology is changing rapidly, there may be a role for intermediate organisations such as Technology and Innovation Centres playing a key role

in the knowledge infrastructure of the region. But as Goddard et al. (2012) point out this will not necessarily fill the bridging role between universities and business within a region with an otherwise less developed regional innovation system.

Finally, in the context of smart specialisation strategies for regions with less developed innovation systems, is there a both generative and developmental role for HEIs? (Gunasekara, 2006). If it is only the latter is there a danger that such regions continue in a subordinate position in relation to more dynamic regions which are the home to internationally leading universities but where the innovation system may be fragmented and research inputs fail to generate downstream innovation? The answer to this question will be highly contingent on the specific circumstances prevailing in particular regions and higher education systems and needs to be the subject of investigation in the 'living labs'. Here the approach must move from analysis to suggesting interventions where universities play a role in developing boundary spanning people who facilitate collaboration across the knowledge infrastructure of the region. The extent to which such people can span horizontal boundaries within the region and vertically within national and international innovation systems will depend on the permeability or otherwise of multi-level governance structures, a subject to which we now turn.

6. The role of governance and strategy design

It is widely acknowledged that regions with less-developed research and innovation systems face specific challenges (and also opportunities) when designing and implementing smart specialisation strategies. Indeed, while early expositions of the smart specialisation concept were based on the idea that "the European Research Area will only benefit countries and regions with clear visions and strategies for developing distinctive, original and modern areas of specialisation for the future", they were also clear that "the economic importance of the region, combined with its scientific and technological development, will dictate how broad or narrow this specialisation should be" (Foray and Van Ark, 2008, p. 28). Nevertheless, as the concept has developed and started to be put into practice, it has tended to rely on inputs and analysis from the 'usual suspects' of regions with relatively well-established innovation systems. This is related to a more general concern that the dominant model of territorial development is based on the engine of innovation as applied predominately to high-tech activities, despite territories not all being on an equal footing in terms of existing activities, resources and expertise (Torre and Wallet, 2013).

There is therefore a strong imperative to better understand the specifics of smart specialisation strategies in less-advanced regions. Within this broad imperative, this contribution aims to reflect on the particular challenges that arise with respect to governance in the design and implementation of smart specialisation strategies in regions with less developed research and innovation systems. These challenges are related largely to a lack of capacity and capabilities among private and public sector actors. However, our reflections also highlight certain opportunities related to the benefits of being able to search for governance solutions from the starting point of less complex institutional systems with lesser degrees of embedded path dependence.

6.1 Smart Specialisation Strategies and Governance

Governance is a much-used but by no means straightforward concept. Often confused with the activities of 'government', it refers broadly to the emergence of some sort of 'order' for coordinating socioeconomic activities among a whole range of actors (and their associated interests) (Kooiman and Van Vliet, 1993; Jessop, 1998; Aranguren *et al.*, 2008). Yet the rise of governance as a concept of interest in the social sciences is relatively recent (Jessop, 1998),

in which respect Scholte (2000) argues that it is no co-incidence that its addition to the vocabulary of politics has occurred side-by-side with globalisation. Thus it is fair to say that as socioeconomic relationships have become more complex and 'layered' in the context of simultaneous globalisation and localisation processes,[5] concern with how socioeconomic activities are governed across this complexity has risen.

It is no surprise then that governance forms a central concern in the smart specialisation debate, as reflected in its inclusion as one of six 'key steps' in Foray *et al.*'s (2012) *Guide to Research and Innovation Strategies for Smart Specialisation*. As they highlight (p. 21), "the fact that RIS3 is based on a wide view of innovation automatically implies that stakeholders of different types and level should participate extensively in their design."The involvement of a broad range of different stakeholders in these processes of 'entrepreneurial discovery' is supposed to feed the emergent prioritizations made in the strategies of each region, and it is here where we can locate the real challenges for governance in the context of smart specialisation strategies. A key starting question is who should be involved in these processes. Foray (2009a and 2009b) initially held that the government should be just a facilitator of the process of entrepreneurial discovery, which should involve "firms, universities, higher education institutes, independent inventors and innovators" (Foray *et al.*, 2011, p. 7). However, there is an emerging consensus on the need for an active role of government in the discovery process given the risk of particular private interests having too large an influence on regional strategies and policies (OECD, 2011). Thus when analysing the governance challenges related to entrepreneurial discovery processes, our concern should not only be with the system of relationships among private agents but also with new ways of working across the public and private spheres.

6.2 Governance Challenges and Opportunities Specific to Less Advanced Regions

Following from the above, a starting hypothesis is that smart specialisation strategy design and implementation in general requires changes in governance towards more networked (and

[5] While the phenomenon of globalisation is commonly associated with a 'de-territorialisation' of socioeconomic relationships (Scholte, 2000; Sugden and Wilson, 2005), the globalisation of markets has in fact been accompanied by an increase in consciousness around the importance for innovation and competitiveness of proximity-based relationships that are firmly rooted in regional and local systems (Storper, 1997; Cooke *et* al, 1997; Cooke and Morgan, 1998; Scott, 1998; Morgan, 2004).

less hierarchical) forms that reflect the centrality of the entrepreneurial discovery process. While this 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. These challenges stem fundamentally from lack of capacity and capabilities among the private and public agents within such regions. In lagging regions it is often the case that private actors lack the abilities and/or interest to lead the process (McCann and Ortega-Argilés, 2011). Moreover, where a particular firm, technology centre or university, for example, does have the capacity to play a leading role, their isolation in the absence of a strong regional system creates certain dangers. They are more likely in this scenario to follow their own interest in interacting with similarly strong agents outside of the region, or, even more dangerously, lobby for a regional strategy that is aligned with their own interests but not necessarily those of other agents. This danger of capture in the governance process is particularly acute where the government lacks capacity and capabilities for playing a proactive role in developing regional strategy.

6.3 Capacity and capabilities among private agents

With regards to private sector capabilities, less advanced regions tend to be characterised by, on the one hand, a high concentration of micro and small firms, and on the other hand, a lack of medium and large firms with significant decision-making power within the region. Where medium and large firms are located in less advanced regions they are typically 'branch plants', engaged in lower-value activities and with limited decision-making capacity in the sphere of research and development. Indeed, while this pattern among Europe's regions is by no means unequivocal, we can observe a situation similar to that hypothesised by Hymer (1972) for the global economy, whereby many less advanced regions are dependent on the non-knowledge-intensive, 'Level III' (Chandler and Redlich, 1961) activities of large multinational corporations (MNCs). This situation creates severe limitations when it comes to engaging the regions' firms in governance processes oriented towards 'discovering' prioritizations that will mark a regional strategy for research and innovation.

In such weak and fragmented innovation systems there is typically therefore little history and culture of cooperation for innovation. Even the most innovative small firms usually suffer

from strong time constraints for engagement in cooperative activities beyond their immediate needs, and larger firms are subject to operating within decision-making agendas that are typically set outside of the region. In this context a key challenge lies in how to take the first steps towards an effective cooperation that will generate new governance processes which can feed a smart specialisation strategy.

As noted by Aranguren and Wilson (2013), there are lessons to be learned here from policy initiatives based around 'clusters', which are already well-established in most regions, including many regions with less developed research and innovation systems.[6] The governance of clusters tends to be narrower than that required for smart specialisation strategies in that it usually pays little attention to broader citizens' interests and/or social challenges. Thus it does not typically incorporate the fourth element of the quadruple helix perspective emphasised as important by Foray *et al.* (2012). However clusters do usually foster cooperative relationships between the other three elements (business, government and academia) in ways that provide clear learning potential for what works and what doesn't when articulating different interests in cooperative processes related to issues such as production, innovation and search for markets. Moreover, clusters can be an important 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. Where clusters are established (or are becoming established) in regions with less developed research and innovation systems, they can therefore serve as a springboard for overcoming the challenges posed by lack of capacity and capability among the regions individual firms for engaging in the governance processes central to smart specialisation.

The potential of clusters – in which individual 'cluster entrepreneurs' or 'cluster managers' often play the key role – as a base for the relationships required for new forms of networked governance also highlights the critical role played by certain people. Given the broad-based participation requirements of entrepreneurial discovery processes, people who have interdisciplinary knowledge and proven experience in interaction with different actors can help to bridge the boundaries between different agents. This role corresponds with what Foray

[6] The spread of cluster policy initiatives is illustrated by a report from Oxford Research (2008) for the European Cluster Observatory (www.clusterobervatory.eu) which identified sixty-nine distinct national cluster policy programmes in Europe alone, with regional programmes also found in seventeen European countries.

et al. (2012) refer to as 'boundary spanners', although Wenger (2002) classifies boundary spanners as one type of 'broker' between knowledge communities, other types being 'roamers', 'outposts' and 'pairs'.[7] In regions with less developed research and innovation systems, where there is little culture of bringing together different agents to explore synergies and complementarities between their activities, the identification of specific people who can initiate these roles would appear to be a key starting-point.

In this regard Mangematin *et al.* (2012) point to university principle researchers as being boundary spanners, which brings us to the role that might be played by academia in the governance of smart specialisation processes. Goddard *et al.* (2013) suggest that roles for universities in smart specialization include: participation in entrepreneurial discovery processes through knowledge generation and active engagement in regional networks of innovation and governance; academic support to governments and other regional agents in the definition of RIS3 strategies; and providing external connections and access to foreign sources of knowledge thanks to university links with global academic networks. This is in line with wider thinking on the role that academia can play as catalysts for regional competitiveness (Aranguren *et al.*, 2013; Drabenstott, 2008; Porter, 2006). While it is true that less advanced regions typically lack a leading university, many do have universities where there is potential for nurturing and supporting the role that their academics might play in entrepreneurial discovery processes. However, given the danger highlighted previously of individually strong agents being isolated and disconnected in the context of weak innovation systems, it is critical that this role does not come to dominate the entrepreneurial discovery process and orientate strategy towards a narrow set of interests that are not reflected in the region's productive structure more broadly.

6.4 Capacity and capabilities in the public sector

The challenges highlighted above are multiplied in cases where weak capacity and capabilities among private sector agents are mirrored by similarly weaknesses among government. Indeed, we shouldn't take for granted that local or regional governments possess the capacities to play a leading role in facilitating smart specialisation strategies

[7] Alongside these groups of *people* who act as brokers, Wenger (2002: 235) also identifies a role for "*artifacts* (things, tools, terms, representations, etc.)" and "forms of *interaction* between people from different communities of practice".

(Walendowski *et al.*, 2011). As we have argued above, this has consequences in terms of potential capture of the process by isolated strong private interests, particularly where the region is heavily dependent on the activities of a large MNC, for example.

We can identify two related dimensions to the argument around lack of capacity and capabilities in the public sector hindering the ability to engage effectively in the governance of smart specialisation strategies. The first dimension relates to the degree of policy competences that are present at regional level, something that varies widely from country to country. The second dimension is related to the quality of the institutions themselves, and their experience with engaging with the private sector and other agents around the types of strategic issues required of smart specialisation. Indeed, it is explicitly acknowledged by Foray (2013) that any prioritisation of vertical activities that favour certain technologies, fields, and therefore firms, is difficult. It is all the more difficult where the public sector lacks the policy competences to pursue such prioritizations and/or the experience and capabilities to engage in complex governance processes with other agents so as to do it well.

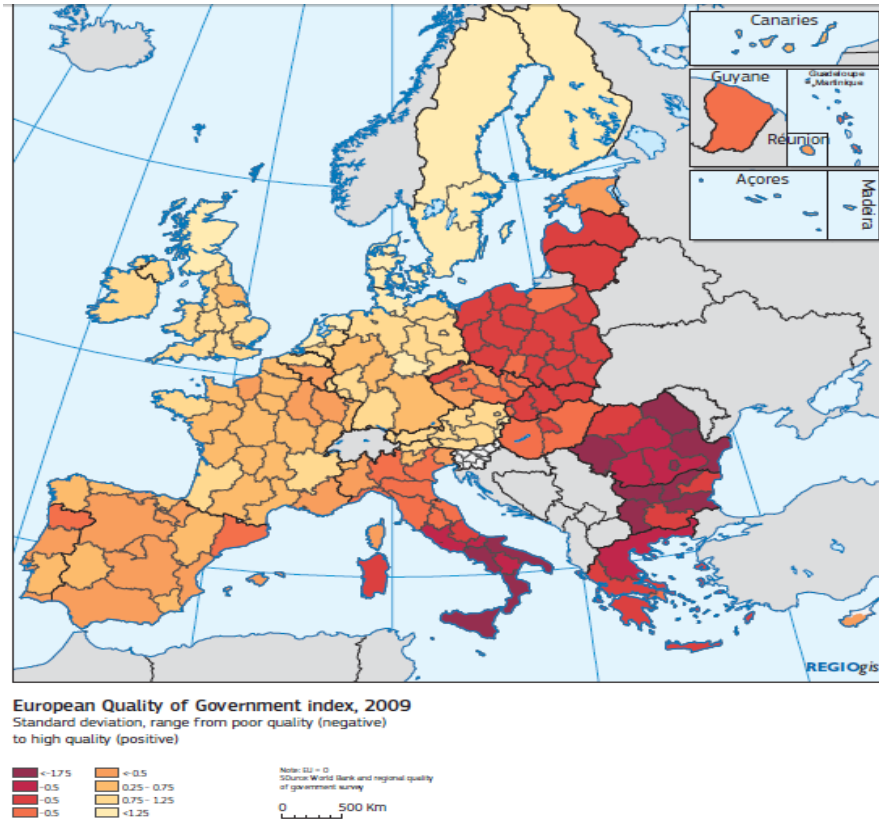
There is a strand of literature that deals explicitly with the distribution of competences and powers among different levels of government. Apart from distinguishing conceptually between different types of decentralization (political, administrative, functional, financial…), this literature has analyzed empirically how each European country is organised in different levels of government, the competences and public expenditure distributed among them, and what trends can be noticed in the evolution of the distribution of those competences and expenditures (Ismeri Europa and Applica, 2010; European University Institute, 2009; Klipp, 2009; Dexia, 2012). As noted by Rodriguez-Pose and Ezcurra (2010), the general worldwide trend has been towards increasing political and fiscal decentralization. However their empirical analysis of the relationship between decentralization and regional disparities finds a complete disconnection across a panel of 26 countries with a range of income levels. This leads them to suggest that "the question of whether decentralization matters for territorial disparities may not be the most pertinent, but rather under which circumstances is decentralization likely to enhance or reduce regional inequality" (639).

This brings us to the question of quality of regional institutions. Charron *et al.* (2012) have

mapped the differences in perceived levels of quality of government (QoG) for 172 EU regions (see Figure 1), and suggest that "a region with a low QoG in the EU will not be able to use the cohesion policy funds in an efficient and effective manner" (15). Given that institutional quality clearly affects the ability of those institutions to engage in governance processes, this also has strong implications for the development of smart specialization strategies. In particular, where regions have weak government institutions we should be aware of the dangers in simply transferring the smart specialization concept without proper consideration of the governance context into which it is being transferred from the European level. In this sense there are important lessons to be learned from the literature on policy transfer (Dolowitz and Marsh, 1996, 2000),[8] and these lessons would appear even more pertinent in more centralised countries where there is a further gap between national and regional level contexts in the design and implementation of smart specialisation policies. Indeed, Charron *et al.* (2012: 15) conclude that apart from existing transfer policies "a joint and targeted effort to improve QoG in those regions with lower levels could substantially improve the economic prospects of these regions and the lives of their residents".

Figure 1: European Quality of Government Index (2009)

[8] Dolowitz and Marsh (2000) define 'policy transfer' as "a process in which knowledge about policies, administrative arrangements, institutions, etc. in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place.



Source: Charron et al. (2012)

Finally, it is also important to recognise that the lack of existing capacity and capabilities in less advanced regions can also present opportunities in terms of developing the complex and innovative governance settings from which entrepreneurial processes will flourish. More advanced regions have institutions with a history and inertia that can sometimes inhibit the development of new forms of governance and in the worst cases generate processes of lock-in. They don't have the opportunities to design institutions from scratch. In this sense regions with less developed research and innovation systems have more 'space' to design and experiment with forms of governance that might be seen as 'ideal' for nurturing entrepreneurial discovery processes.

7. Conclusion

This critical examination of existing literature relevant to the application of the smart specialisation concept has revealed many important issues specific to the case of regions with less developed research and innovation system. These issues need to be addressed properly in order to facilitate efficient and effective application of smart specialisation strategies in such

regions. Even though many barriers for innovativeness were identified in the relevant literature, the unique feature of many of the regions with less developed research and innovation system is the scale of these barriers and the fact that many of these combine to create a negative synergy. For example, a usefull typology of imperfect innovation systems has been developed for the conditions of tradtitonal market economies, namely – fragmented, locked-in, and institutionally thin (Toedtling and Trippl, 2005). However, it may be possible for less developed regions to have the characteristics of all three imperfections, that is institutionally thin regional innovation systems, which are in the same time fragmented and even locked-in. This situation sharply contrasts with the fact that available human and material resources that could be mobilised to overcome all these systemic deficiences in such types of regions may be severely limited. Case studies of selected regions, where such a complex of unfavourable conditions can be found are important so as to identify transformative actions and derive specific lessons for regions with similar traditions and socioeconomic profile.

Three broad categories of research challenges can be identified: i) challenges and research questions related to identification of regions with less-developed research and innovation systems, ii) conceptual challenges for further refinement of the smart specialisation approach and associated concepts of related variety and knowledge bases and, most importantly, iii) challenegs related to the implementation of the smart specialisation concept. These research challenges will be addressed in turn in the text below.

7.1 Challenges and research questions related to identification of regions with less-developed research and innovation systems.

The review of existing conceptual and empirical approaches to identification of regions with less-developed research and innovation systems has pointed to several challenges for future research.

First, conceptual insights into potential sources of regional innovation problems are only partly reflected in existing empirical approaches. There is a need to consider in particular recent findings on the role of knowledge bases in empirical research that aims at revealing misconfigurations of regional innovation systems.

Second, both conceptual and empirical work (and the typologies that result from this work) tends to focus on failures of current innovation system (a static view). Too little attention has been given to the determinants of the transformative capacity of regional innovation systems and to factors that hamper regional renewal and change (a dynamic view).

Third, one can critically ask if existing approaches and typologies are well equipped to capture the heterogeneity of less-developed regions and their innovation systems. A key issue for future research is to identify and to gain deeper insights into the innovation and transformation problems that curtail development in a large variety of less-developed regions.

Fourth, 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.

7.2 Conceptual challenges for further refinement of the smart specialisation approach and associated concepts of related variety and knowledge bases.

The review of the literature has shown that there is a need for further conceptual refinement of the smart specialisation approach and, especially, for an enhanced theoretisation of the relation of this concept to existing state-of-the–art notions such as related variety and knowledge bases, but with particular focus on conditions in regions with less developed research and innovation systems. Concepts of related variety and knowledge bases can function as an important vehicle for changing the unfavourable status-quo of these regions. In particular, "branching" in line with the concept of related variety and reflecting properly the existing knowledge base of the region can be an important mechanism for transforming the economic structure of the less developed regions provided suitable and targeted effort of relevant actors is exerted.

Therefore, three conceptual research questions can be proposed:

First, the relevance of key factors as conceptualised by related variety approach should also be tested in case of regions with a weak economic base and less developed research and innovation systems.

Second, as there are many dimensions of proximity (see Boschma, 2005), it seems likely that there might be also various dimensions of relatedness. Therefore, the relevance of key factors as conceptualised by the related variety approach should be investigated across the whole spectrum of European regions, i.e. including those with a weak economic base and less developed research and innovation systems.

Third, in case of the concept of knowledge bases, extending this model to cover a broader set of knowledge intensive activities such as advanced business services is required. This will involve unravelling the complexities of innovation processes faciliatated by intermediate organisations and networks linking the science base, business and civil society and the possible absence or obstacles to their operation in weaker regions

7.3 Challenges related to policy dimension of smart specialisation concept

Despite the fact that there is a large variety of types of lagging regions in contemporary Europe and the rejection of a "one size fits all" approach from the onset of this research project, there are several fundamental issues of a more general nature, which merit further research.

In particular, there are many pressing issues directly connected with efforts to put this advanced concept into policy practice in regions where the socioeconomic and institutional fabric is rather unfavourable for this type of policy initiative due to limited tradition and/or capabilities of regional actors for this sort of intervention. The key issue is how to embark upon a process of forming a proper partnership that would be able to perform the envisaged entrepreneurial discovery search process given the non-existence or immaturity of all three or even four types of actors of triple/quadruple helix and where each may be pursuing a mere rent-seeking strategy.

Consequently, involvement of these "partners" in the programming process can result in melting the strategic focus into broad all-encompassing strategies satisfying needs of all

actors involved, which is the exact opposite of smart specialisation principles. The roots of these governance challenges can be found in the typical lack of capacity and capabilities among private and public sector actors in these regions. More specifically, less-advanced regions generally have less-developed innovation systems and are therefore more dependent on hierarchical structures. These in principle are not the most adequate for facilitating entrepreneurial discovery processes, the very basis for smart specialisation strategies.

Moreover, in cases, where most public and private agents in the region lack the necessary capabilities to engage effectively in entrepreneurial discovery processes, there is room for capture of these processes from one or a handful of more powerful actors (e.g. a MNC or traditional university), often with interests external to the region. Moreover, as the recent detailed study of Polish regional innovation systems proved, there is a mechanism of a cumulative nature in operation, namely, that the higher the level of innovativeness of a region, the greater is the decision-makers knowledge about all aspects of regional innovation systems and at the same time the higher decision makers readiness to take actions to strengthen regional innovation system even further (Plawgo et al, 2013).

Therefore, the lack of an established cooperation culture in the context of emerging innovation systems represents a problem for many less developed regions, and the key challenge lies in how to take the first steps towards an effective cooperation that will generate new governance processes which can feed a smart specialisation strategy.

Existing successful cases (although rare) prove that a sophisticated strategy can be prepared and implemented under a difficult socioeconomic situation and even under the conditions of unfavourable national framework provided there are at least a few committed and knowledgeable personalities who are persistently able to spread their enthusiasm and vision among other regional actors.

Consequently, the fundamental starting point seems to be how to identify and motivate people who have interdisciplinary knowledge and proven experience in interaction with different actors who can help to bridge the boundaries between different agents (‘boundary spanners’).

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