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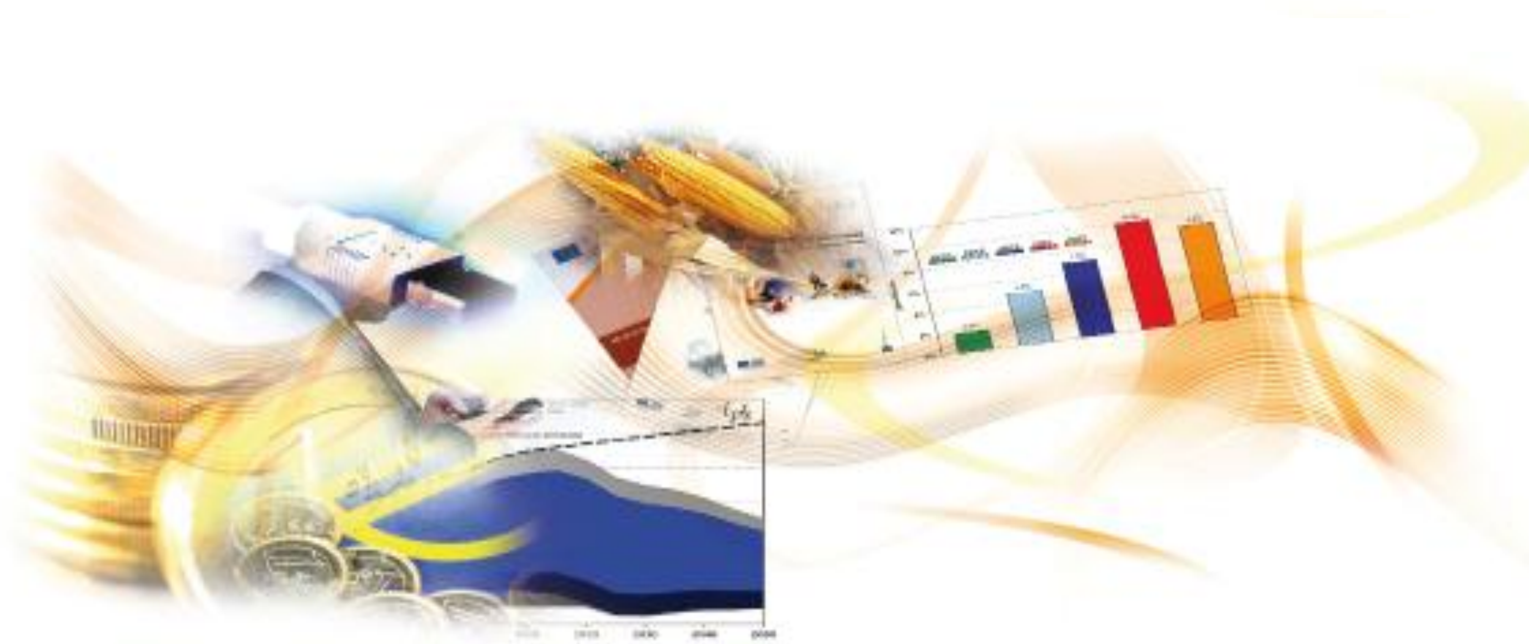

External dimensions of smart specialisation: Opportunities and challenges for trans-regional and transnational collaboration in the EU-13

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Slavo Radosevic and Katerina Ciampi Stancova

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Joint Research Centre
Institute for Prospective Technological Studies

Contact information
Institute for Prospective Technological Studies
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

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Abstract
The objective of this paper is to bridge a gap in the literature and contribute to a better understanding of trans-regional cooperation in EU-13, countries that joined the European Union (EU) after 2004, within the context of smart specialisation. It is argued that the relevance of fostering external dimension depends strongly on maturity of a particular national or regional innovation system. This is closely linked to the question of capacity building and exploration of synergies between European Regional Development Fund (ERDF) and Horizon 2020 in EU-13. This paper explores the issues of trans-regional and transnational collaboration in the context of smart specialisation in regions with the less developed research and development and innovation (R&D&I) systems, identified as the 13 countries (EU-13) that joined the European Union (EU) after 2004. The paper proposes a systematic methodological approach to trans-regional and transnational cooperation and discusses how this can be utilized to build innovation capacities and enhance innovation potential in selected regions. Specifically, the paper addresses the following questions: what is conceptual approach to trans-regional cooperation within the context of Smart Specialisation? What is the role of regional governments/national authorities? How regional authorities can deal with analysis of trans-regional opportunities, potential competitors and collaborators? Based on the analysis, what steps can policy-makers take to improve trans-regional cooperation? The discussion is grounded in the key 'stylized facts' related to EU-13 R&D&I activities, and the complex link between innovation and internationalization. Innovation systems in the EU-13 are fragmented and based on largely public R&D systems and innovation systems based on predominantly production oriented foreign direct investment (FDI). This structural weakness calls for stronger support for innovation oriented activities and for the integration of global value chains (GVCs) and FDI into local innovation systems. Internationalization does not seem to be a crucial component in the design and development of Research and Innovation Strategies for Smart Specialisation (RIS3), which is at odds with the strong dependence of the EU-13 on FDI and global value chains. In this paper we consider the following issues related to linking smart specialisation and GVCs: (1) how to match regions to global value chains, (2) how patterns of upgrading can be promoted by smart specialisation and (3) how to identify the preconditions for 'discovering' new value chains. We distinguish and discuss the main obstacles to the internationalization of smart specialisation and discuss ways to overcome them. We highlight the policy action areas related to providing support for technology upgrading in relation to the internationalization of smart specialisation. The paper thus concludes by offering a discussion of policies to improve trans-regional cooperation in less developed R&I systems in short and long term.

Keywords: Inter-regional collaboration, smart specialisation, innovation policy, transnational collaboration, (global) value chains, regional development

Content

1. Introduction

In a globalized economic environment, catching-up is about leveraging endogenous technology effort by exploiting foreign knowledge, technology and global networks (Fu et al., 2011). The EU-13 countries, the countries that joined the European Union (EU) after 2004, are catching up economies which need to combine different kinds of local and foreign knowledge to leverage their innovation capabilities. Up to 2008, growth in the EU-13 could be characterized as finance-dependent and debt-intensive, based on externally financed consumption (consumer durables) (Becker et al., 2010). In these countries, foreign direct investment (FDI) plays an important role in growth and, especially, export (IMF, 2013a). Post-2008, the challenge has been how to shift towards growth driven by investments and productivity improvements. This issue coincides with the aim of smart specialisation strategies, which is to ensure sustainable growth and convergence to EU income and productivity in these economies.

This Paper explores how the regions in the EU-13 countries could increase their trans-regional and transnational collaboration through the implementation of smart specialisation activities. We present this policy challenge in conceptual terms and in terms of the activities required for this process, which we see as the least developed part of the overall smart specialisation policy apparatus. This Paper defines the problems and makes some proposals about how to solve them; it does not pretend to be the complete, definitive guide.

We assume that in order to upgrade technologically, the EU-13 will need to grow, based on local Research and Development and Innovation (R&D&I) efforts, and on the acquisition of foreign knowledge via FDI and R&D networks. So far, FDI and global value chains (GVCs) have played important, but quite differentiated roles in the EU-13 economies. FDI has increased productivity and export activity, but the spill overs from FDI have not been fully realized and remain rather localized (Hanousek et al., 2010; Damijan et al., 2013; Johannes, 2006; Holland et al., 2000). Also, post-2008, there is a consensus that the EU-13, more than in the past, should draw on their local knowledge and skills and achieve market access via multinational enterprises (MNEs) and GVCs.

The optimal mix of local innovation and FDI differs among regions, countries, activities and levels of innovation (Fu and Gong, 2011). Within the group of world 'emerging economies', the EU-13 are small and very open economies which are also highly integrated into the EU and are export oriented. Technology upgrading in the EU-13 based on patents is similar to the patterns in Brazil, Russia and India (which, with China, constitute the BRIC countries) (Jindra, Lacasa and Radosevic, 2015). The EU-13 has very open innovation systems with high shares of co-inventions. In this context, smart specialisation strategies could become the drivers of technology upgrading and specialisation, which would provide unique competitive advantage for these countries and regions.

The approach to smart specialisation described in the *Guide to Research and Innovation Strategies for Smart Specialisations* (RIS3) by Foray et al. (2012), strongly promotes the international and trans-regional dimensions. In fact, internationalization is considered 'a crucial component of S3' (Foray et al., pp. 94). First, internationalization within smart specialisation includes not only export and FDI but also 'strategic alliances, joint research, co-development, outsourcing, relocation, mergers and acquisitions, licensing intellectual property rights (IPR), soft landing, technology showcase' (Foray et al., p. 94). Second, internationalization is a context within which regions should be able to identify 'niches' or specific domains for (present and future) competitive advantage, and relevant linkages and flows of goods, services and knowledge that reveal possible patterns of integration with partner regions. Third, the outward-orientation of a smart specialisation process is also considered a field of action alongside clusters, social innovation, research infrastructure, etc. For example, internationalization or outsourcing by technology companies must be an integral part of smart specialisation activities.

However, a review of smart specialisation strategies (S3) in the EU-13 suggests that internationalization is not seen as crucial for the design and development of S3. In this paper, we explore the causes of this unsatisfactory situation and suggest ways forward. Our argument can be summarized as follows. RIS3 outward looking process is perceived primarily in terms of internationalization of the design process, an international outlook in selection processes, and internationalization developed as a separate area of activity (cf. internationalization of technology companies). This is a view of internationalization as a process of 'growing links between essentially discrete national economies or societies' (McGrew and Lewis, 1992, p.5). As such, this view is at odds with the growing multiplicity of linkages and interconnections among regions, countries, firms and other organizations that characterize today's EU, including the EU-13, and the global economy. These linkages are at the level of very specific and narrow activities within business and R&D processes, not at the level of complete global value chains. Thus, each of activities within the S3 areas has an external, or international or global dimension.

Innovation value chain activities include knowledge gathering, knowledge transformation and knowledge exploitation (Hansen and Birkinshaw, 2007; Ropera and Arvanitis, 2012). In this respect, internationalization occurs in both upstream (R&D) and downstream (GVCs, FDI) innovation activities. So, this aspect of S3 needs further development - especially in view of the need for complementarities and leverage between regional R&D&I activities and foreign knowledge, in both upstream (R&D, R&D alliances) and downstream activities (FDI, outsourcing, subcontracting). The issue is how can smart specialisation support the processes of international linkages, leverage and learning (Mathews, 2002), focused on internationalizing individual implementation activities.

The optimal mix of local R&D&I efforts and acquisition of foreign knowledge via FDI and R&D networks, differs among regions, countries, activities and levels of innovation. Regions that operate close to the world technology frontier have a different balance between own R&D and other activities in innovation GVCs, and quite different internationalization requirements. These regions are much stronger in upstream activities in the innovation value chain, and have developed strategic partnerships in R&D, and production supply agreements in manufacturing. On the other hand, the EU-13 regions are integrated globally mainly through branch plants, and have subcontracting relationships with regional GVCs although they are unable to generate a critical mass of local technological expertise that could be offered to global players. Thus, the internationalization of regions, such as Baden Württemberg, a globally linked region at the technology frontier, is different from the internationalization process in peripheral Romanian regions, which are outside global production networks.

This paper is organized in five chapters. Chapter 2 discusses trans-regional and transnational collaboration in the context of the EU-13 and, in particular, how transnational collaboration is related to growth and technology upgrading in the EU-13. We discuss Research and Innovation Strategies for Smart Specialisation (RIS3) in EU-13 countries and transnational activities including patents and participation in EU Framework Programmes 6 and 7 (FP6 and FP7). We also provide a discussion of the policy issues and investigate upstream and downstream collaborations, focusing our attention on the least developed aspect, i.e., downstream collaborations. Chapter 3 discusses how smart specialisation can help technology upgrading via GVCs and 'why' and 'how' regional smart specialisation activities are linked to global value chains. Chapter 4 addresses the key policy challenges and areas of policy action related to 'internationalizing' smart specialisation. We first illustrate smart specialisation areas in EU-13 and discuss how opportunities for collaboration can be explored. Secondly, we outline the institutional preconditions for this process to be effective, and summarize some policy recommendation. Chapter 5 presents the major conclusions from this exercise.

2. Why trans-regional and transnational cooperation in smart specialisation? Key issues for the EU-13

EU-13 countries are losing competitive advantage built strategically around cheap production factors and qualified workforce to other fast-growing big economies such as China, India or Brazil. EU-13 countries find themselves unable to compete internationally for FDI on terms of low-cost labour force, and thus they are searching for new strategic approaches to ensure continues economic growth. One of the possible ways is through technological development, science-based innovation and capital involvement. This means in practice technological convergence, modernisation and upgrading as well as intensification of applied and technological research connected to business application. This is closely related to inter-sectoral and international cooperation as well as collaboration between scientific and business actors, and in consequence to smart specialisation.

Smart specialisation offers a unique opportunity for EU-13 countries to reinvent their R&I strategies while building on their national/ regional assets, strengths and potentials. At the same time EU-13 countries can improve international, inter-sectoral and private-public collaboration, as well as focus on niche activities to stimulate growth. By developing and implementing Research and Innovation Strategies for Smart Specialisation (RIS3),[1] EU-13 countries have opportunity to address challenges and bring expected growth in their regions.

2.1 Research and Innovation Strategies in the EU-13

Analysis of RIS3 strategies in EU-13 showed that the transformative Agendas prepared by regional and national governments are mostly inward looking and without strategic approach to trans-regional collaboration. Although the vast majority of EU-13 countries are open to internationalization, mainly through FDI and MNEs, they do not consider trans-regional and transnational collaboration as potential vehicles of innovation and growth. Information provided in RIS3 strategies is rather limited and presented in a form of a brief summary of current transnational Science, Technology and Innovation (STI) activities among the home and mostly neighbouring countries. Reasons are manifolds, i.e. little interest in developing structured trans-regional collaboration, poor understanding of opportunities and management of trans-regional cooperation or insufficient capacity to explore, analyse and support trans-regional cooperation in smart specialisation.

[1] RIS3 are policy-integrated, place-based agendas that aim at transformation of European economies by exploitation of R&I capacities and business potential while addressing global markets and European societal challenges.

The importance of GVCs for national economies in EU-13 is recognised by almost all EU-13 countries. Some EU-13 countries are aware that domestic businesses are insufficiently integrated in supplier chains of MNEs operating in the country. Therefore they intend to provide more support to domestic firm so as they can improve their R&D&I activities and thus become suppliers of MNEs. Those firms that already operate in GVCs will be supported to improve their products and services based on R&D, and thus enhance their position within the global value chains. In fact, one of common objectives of EU-13 countries is to move up in the production/GVCs that are associated with innovation, growth and development. Other objectives are: to increase productivity of businesses, to intensify innovation processes, to increase highly-skilled employment, to deploy advanced technologies, to synchronise and make more efficient supply of GVCs.

In order to move up in the GVCs, EU-13 countries have to become competitive internationally in terms of intangible assets, highly qualified workforce, intellectual property, research and innovation, etc. Competitiveness can be improved but it requires time, good strategy as well as political and economic support. Target investments have to be made in education and training, research and technology infrastructure as well as international collaboration in R&I. However, while national/regional authorities have been extensively mapping their strengths, weakness and opportunities in R&I, little has been done to understand potential competitors and collaborators in R&I outside the national/regional borders.

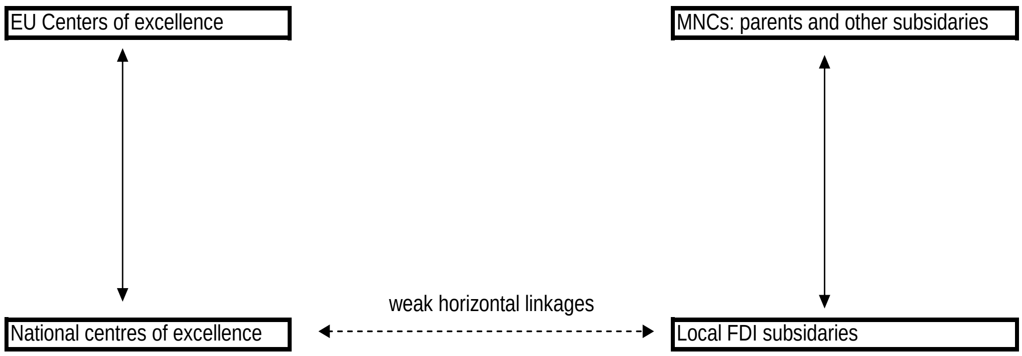
EU-13 countries understand international collaboration as collaboration in research and technologies, through international collaborative research projects, EU Framework Programmes, bi-lateral intergovernmental scientific and technological collaborative agreements, etc. Regarding participation in EU Framework Programmes, countries aim to increase participation per capita and funding received as well as gain access to significant and strategic roles and tasks. In case of bi-lateral intergovernmental scientific and technological co-operation agreements, the governments seek to strengthen integration of national research and technology institutions in the international research centres/programs of excellence such as CERN, EFDA-JET, ILL, EMBL, etc.

In the following sections we argue that innovation systems in EU-13 are *de facto* composed of two separate systems: FDI centred and domestic R&D based innovation systems focused around a handful of domestic new technology based firms (Radosevic et al., 2010). FDI oriented innovation systems are largely downstream or production oriented, while R&D based clusters of new technology based firms are upstream oriented providers of knowledge intensive services for local firms. The patterns of technology upgrading of the EU-13 economies reflect this duality, which is also their key structural weakness. Smart specialisation recognizes this duality, and support internationalization of innovation in the EU-13.

2.2 Dual innovation systems in the EU-13

The EU-13 countries and regions have grown based on FDI, but investment have often been unrelated to domestic R&D&I capacities. This dualism between FDI and domestic innovation efforts has created a structurally weak innovation environment, which, despite improvements in productivity and R&D, does not provide a basis for long-term growth. Upstream, R&D systems in the EU-13 have become integrated into EU R&D and Horizon 2020 networks, which gradually has led to improvements in research excellence, but not necessarily to improved local relevance (Radosevic and Yoruk, 2014; Radosevic and Lepori, 2009). Downstream, MNE subsidiaries have played an important role in integrating the EU-13 into international production networks. However, weak horizontal linkages between business sectors (foreign and domestic) and increasingly internationalized R&D, are evidence of structurally weak innovation eco-systems. In this context, smart specialisation has emerged as a unique strategic opportunity to strengthen regional innovation systems in the EU-13 by coupling domestic innovation efforts with foreign R&D&I networks. Figure 1 depicts this situation and highlights the need for vertical levers on both the upstream and downstream sides, and missing horizontal levers or mechanisms that would link unconnected upstream and downstream parts of the innovation value chain.

Figure 1: Building vertical levers and missing horizontal levers to promote growth



Source: authors

Figure 1 suggests that there are *de facto* two innovation systems emerging in the EU-13 that have not been formally recognized. One system is focused on upstream R&D activities and R&D based growth, exemplified by the group of new technology based firms supporting the public R&D system, providing knowledge intensive business services (KIBS) such as software, or niches of high tech manufacturing in the EU-13 (Radosevic, 2011). These activities have expanded based on support for Centres of Excellence and Centres of Competencies via the EU Structural Funds. The other innovation system is centred on FDI subsidiaries, which are plugged into MNE production networks.[2] There is a variety of dyadic networks that are centred on MNE subsidiaries and linked to a limited, but gradually increasing number of local suppliers (McGowan et al., 2004; Radosevic and Sadowski, 2004). There is some scant evidence suggesting that upgrading in these networks is still related largely to processes, and that functional upgrading is limited (Pavlinek et al., 2010; Pavlinek and Zenka, 2011), which does not promote technology upgrading by local suppliers and limits demand for local R&D&I.

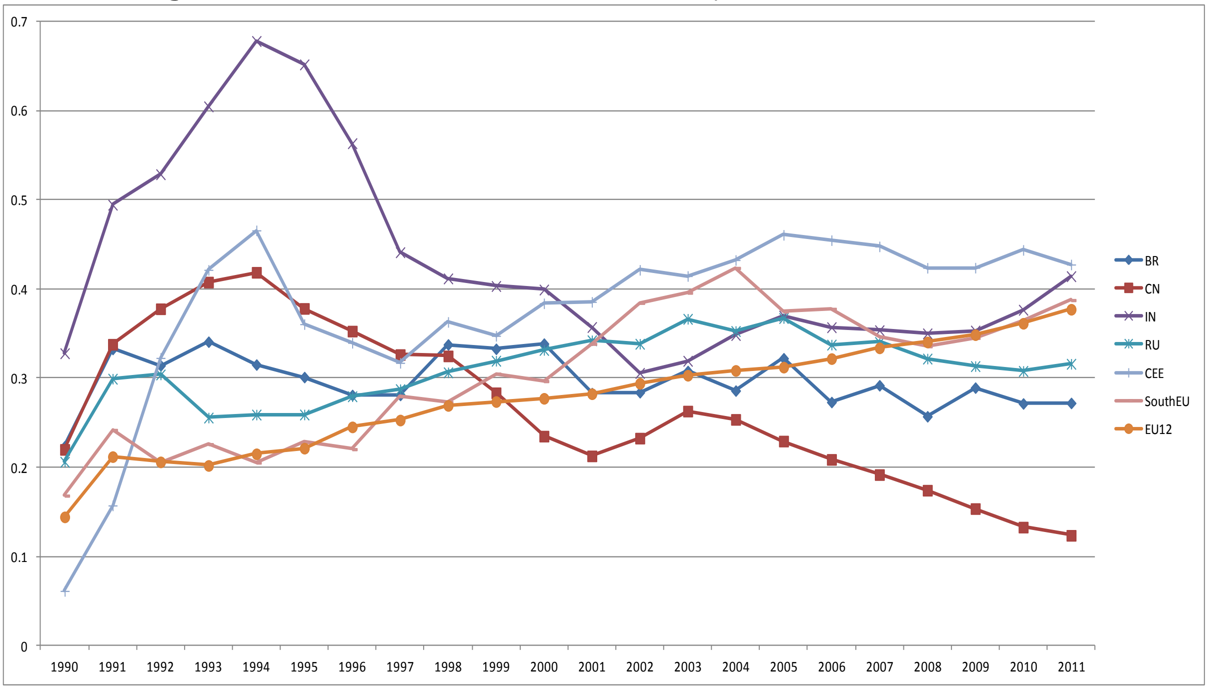
The FDI system is more influential in terms of technology upgrading and employment and productivity effects. The R&D based system is narrow and organized around a limited number of domestic technology intensive firms and public R&D organizations and universities. Business R&D is limited and concentrated in a few large firms, usually foreign owned R&D based companies. With a few exceptions (Slovenia and the Czech Republic where business R&D plays an important role) public R&D is vital for fostering R&D expenditure and scientific publication output.

The FDI and R&D based innovation systems also represent two areas of integration of the EU-13 in international R&D&I networks. Upstream, newly established national centres of excellence in the

[2] A similar innovation system feature can be found in the case of China. See Tang and Hussler (2013).

EU-13 are being plugged into the EU R&D networks. This integration is leading to joint R&D at the EU level and is reflected in the increased number of international co-inventions (joint patents) from the EU-13. Figure 2 compares the shares of co-inventions for the Central and Eastern European Countries (CEECs), the Brazil, Russia, India and China (BRIC), South EU countries (Spain, Greece, Portugal) and the EU-12 countries (other EU countries). It suggests that R&D processes in the CEECs, measured by transnational patents, are highly integrated into international patent networks. Around 43% of CEECs patents are the result of a co-invention process, an increase from almost zero registered 20 years ago. Also, there seems to be a convergence in the intensity of co-invention rates across the EU, with the EU-12 and the South EU countries achieving similar shares to the CEECs.

Figure 2: Ratio of transnational patent applications* with at least one national and at least one foreign inventor, to total number of transnational patents with national inventors



* Transnational patent applications are those registered at the European Patent Office and through the Patent Cooperation Treaty

Source: OECD REGPAT

Legend: BR (Brazil); CN (China); IN (India); RU (Russia); South EU (Greece, Portugal and Spain); EU-12 (other EU countries); CEE (11 states from CEECs that joined the EU after 2004)

On the other hand, improvements in participation of EU-13 countries in Framework Programme 7 (FP7) compared to Framework Programme 6 (FP6) are rather modest. Specifically, the number of participations in FP7 (8.04%) was higher in absolute terms but not in relative terms with respect to FP6 (10.37% of total). Participation rate thus decreased by 2.33% in FP7 compared to FP6. Similarly, total number of coordinations was higher in FP7 (1,011) compared to FP6 (585), but proportionally coordination registered a decrease by 1.77% (from 8.81% to 4.04%). Also, change in EC contribution can be described as positive in terms of total EC contribution to EU-13 countries, but from total 14,445 million Euro allocated through FP6, EU-13 received 5.8% of total allocations that is proportionally more than EU-13 received from FP7 (4.25%). On the contrary, EU-15 countries increased participation in FP7 compared to FP6 by 2%, but EC contribution decreased in relative terms by 1.68% and coordination rate by 2.54% (table 1).

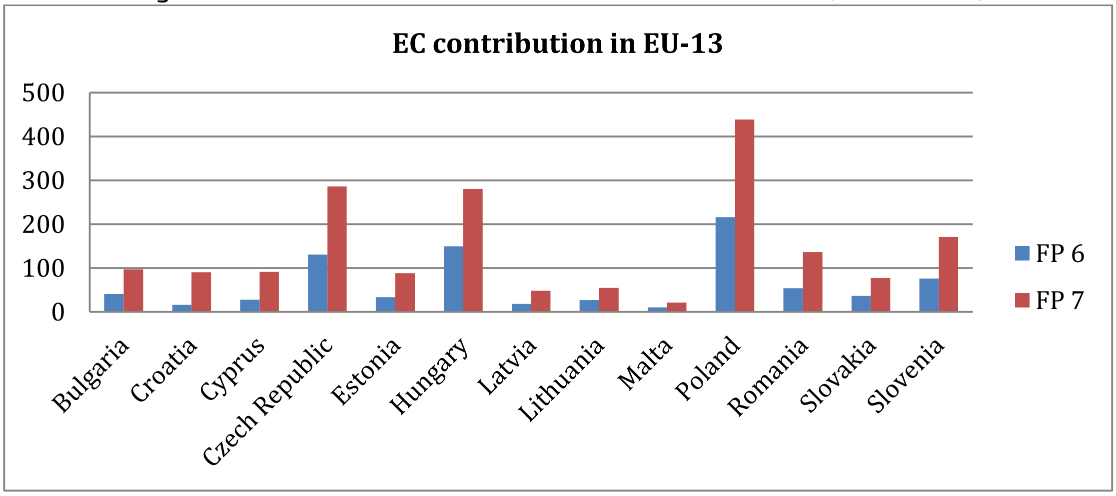
Table 1: Participation in Framework Programme 7

FP7	EC contribution		Number of participations		Number of coordinations	
	Contribution in Million Euro	% of total	Number	% of total	Number	% of total
EU-13	1,883.6	4.25	10,637	8.04	1,011	4.04
EU-15	37,852	85	105,731	79.87	21,301	85.03
Associate countries	3,617.4	8.15	8,697	6.57	n.d.	n.d.
Other countries	1,011	2.28	7,317	5.53	n.d.	NA
Total	44,364	100	132,382	100	25,052	89.07

Source: authors. Based on European Commission database

Figure 3 shows that Poland, the Czech Republic, Hungary and Slovenia are top FP 7 receivers. The same countries also improved best their performance in FP7 compared to FP6. Specifically, the increase in the EC contribution from FP6 to FP 7 in Poland was 222.97 million Euro, in the Czech Republic 155.35 million Euro, in Hungary 130.82 million Euro in Hungary and 94.42 million Euro in Slovenia. On the other hand, the countries that score best in terms of FP7 EC contribution per inhabitant are Cyprus (111.92 Euro per inhabitant), Slovenia (83.45 Euro per inhabitant), Estonia (66.17 Euro per inhabitant) and Malta (50.80 Euro per inhabitant).

Figure 3: FP6 and FP7 EC contribution in EU-13 countries (million Euro)



Source: authors. Based on European Commission database

2.2.1 Supporting R&D in the EU-13

In the EU-13, the upstream R&D based innovation system is supported significantly by EU programmes. There is a variety of tools available for inter-regional collaboration; in addition to Horizon 2020, the list below describes the major programmes supporting inter-regional collaboration in R&D&I:

- *European Territorial Cooperation* is a framework for the implementation of joint actions and policy exchanges between national, regional and local actors from different member states (Cross border cooperation, Transnational cooperation, Interregional cooperation, Cooperation outside the EU);[3]

[3] http://ec.europa.eu/regional_policy/index.cfm/en/policy/cooperation/european-territorial/

- *ERA-Nets* is an instrument under Horizon 2020 designed to support public-public partnerships in the preparation, establishment of networking structures, design, implementation and coordination of joint activities, and to top up single joint calls and transnational actions;[4]

- *Joint Technology Initiatives (JTIs)* used to implement the Strategic Research Agendas (SRAs) for a limited number of European Technology Platforms (ETPs);[5]

- *Knowledge and Innovation Communities (KICs)* are initiatives designed to fully integrate the three sides of the knowledge triangle (higher education, research and business) through the establishment of Knowledge and Innovation Communities (KICs);[6]

- *Joint Programming Initiatives (JPIs)* aimed at pooling national research efforts in order to make better use of EU public R&D resources and to tackle selected common European challenges more effectively. It is a structured and strategic process involving agreement among member states, on a voluntary basis and in a partnership approach, on common visions, and a SRA to address major societal challenges. On a variable geometry basis, member states commit to Joint Programming Initiatives (JPIs) aimed at joint implementation of SRA;[7]

- *European Innovation Partnerships (EIPs)* are challenge-driven and focused on societal benefits and rapid modernization of associated sectors and markets.[8] 'They act along the entire research and innovation chain, bringing together relevant actors at EU, national and regional levels in order to: (i) step up R&D efforts; (ii) coordinate investments in demonstrations and pilots; (iii) anticipate and fast-track necessary regulation and standards; and (iv) mobilize 'demand' - in particular through better coordinated public procurement to ensure innovations are brought quickly to market. Rather than acting independently, as is currently the case, the EIPs aim to design and implement these activities in parallel to cut lead times;

- *ERA Chairs*, enable participating institutions to attract top academics so that they can compete with centres of excellence elsewhere in the European Research Area;[9]

- *Teaming for excellence and innovation* is about creating new centres of excellence in low performing R&D member states and regions or significantly upgrading existing ones;

- *Twinning for excellence and innovation* aims at significantly strengthening fields of research in emerging institutions through links with at least two international leading institutions in a defined field.

There is a wide range of collaboration instruments available to the EU-13, focused on upstream areas with the aim of building excellence where currently it is lacking, and on the downstream side,

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[4] http://ec.europa.eu/research/era/era-net-in-horizon-2020_en.html
[5] http://ec.europa.eu/research/jti/index_en.cfm?pg=about
[6] http://eit.europa.eu/activities/innovation-communities
[7] http://ec.europa.eu/research/era/joint-programming-initiatives_en.html
[8] http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=eip
[9] http://ec.europa.eu/research/era/era-chairs_en.html

where EU level support mechanisms are either non-existent or more difficult to access. The most recent instrument includes macro-regional strategies, such as the Baltic or Danube strategies, which seek to address common challenges in these countries with the aim of further enhancing economic development through innovation, territorial cooperation and cohesion. These strategies have no clear upstream/downstream orientation; they are related to applied areas and require inter-regional collaboration.

A range of already existing instruments can be applied in the inter-regional context. Regions can invest jointly in R&D projects, in research infrastructure, in technology transfer infrastructure, in innovation support services and in clusters. Also, public procurement represents a new and untapped area for inter-regional collaboration (see Uyarra et al., 2014). In addition, there is a range of cohesion instruments targeting R&I oriented activities. They are agreed and applied at the country or regional level as part of smart specialisation activities, but are not necessarily collaborative. They are especially relevant in the EU-13 region, which is very dependent on inflows of FDI and European Structural and Investment Funds (ESI funds) as well as access to GVCs.

The EU-13 countries have been successful in R&D in relation to participation in the EU Framework Programmes, publications and patents (Radosevic and Yoruk, 2014; Płoszaj and Olechnicka, 2015; Jindra et al., 2015)., However, this has not led to 'breakthrough innovations', or R&D results having an impact on collaborations between the business sector and universities, new products and new services, or inclusion in GVCs. In other words, success in upstream areas (R&D) has not been coupled with innovation in the business sector. To be precise, firms in the EU-13 have a similar share of turnover from innovation as a percentage of total turnover to EU-15 firms. However, their innovation activities are more related to the adoption and acquisition of imported machinery and equipment than R&D and knowledge (Radosevic et al., 2015). As a result, innovation activities are fragmented and/or weak horizontal links exist among the innovation eco-systems of the EU-13 (see Figure 1).

2.2.2 Integration through global value chains

Global value chains can be understood as subsequent production activities that lead to final production and end use. "The idea of a global value chain is closely related to that of a supply chain, the total flow of physical goods from suppliers to ultimate users and the broad integration of business processes along the supply chain, such as logistics, inventory management, procurement, etc. Moreover, a value chain incorporates the idea of value being created (or added) throughout the chain and thus establishes a close link with economic performance" (OECD, 2013, p.17).

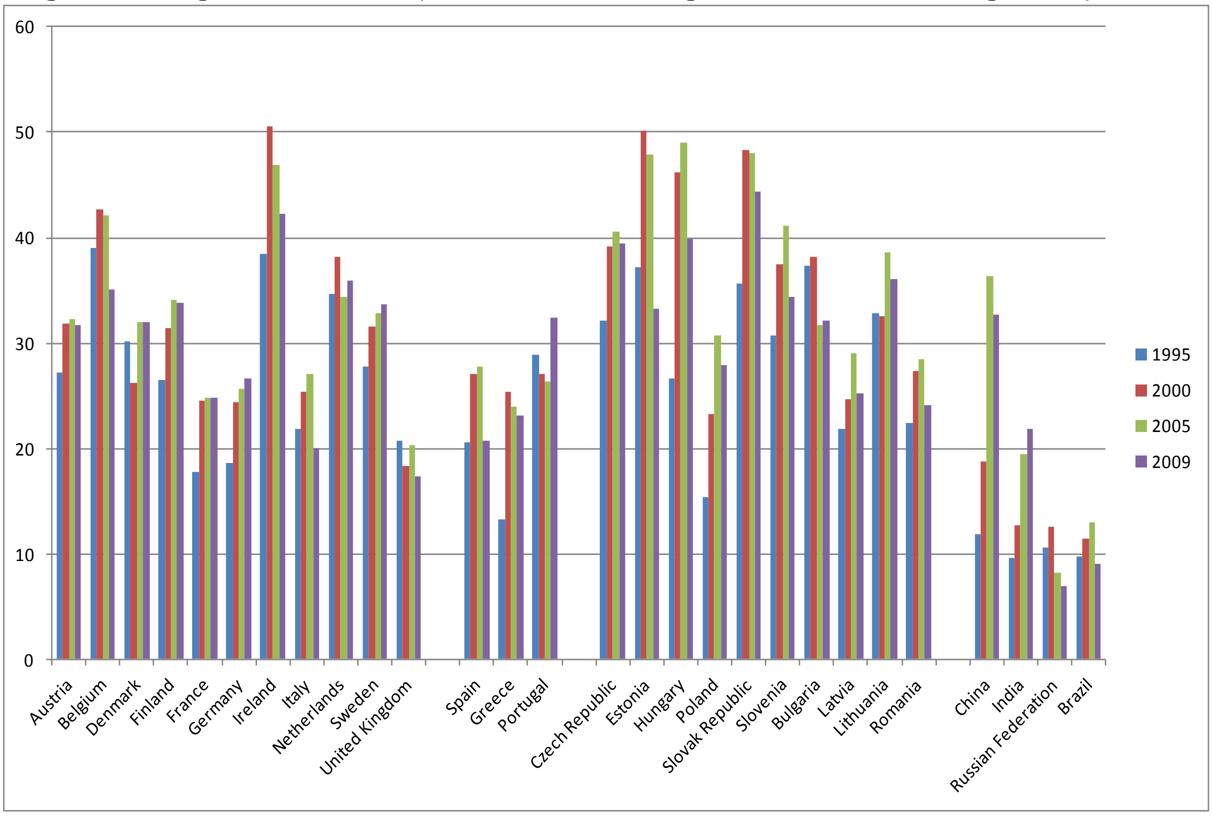
According to OECD (2007), increased activities along the global value chains resulted in intense intra-industry trade, i.e trade in the same industry, including trading of intermediate goods at different stages of production. This has been particularly observed in small countries where FDI inflows account for a large proportion of GDP. Yet not all manufacturing industries are opened internationally, and thus involved in trading chains to the same extent. Some industries such as textile, computers, radio and TV, electrical machinery and transport equipment are more open internationally than others, i.e. scientific equipment, aircraft and spacecraft, shipbuilding and chemicals (OECD, 2007). We can assume that the openness is proportionate to the complexity of technologies involved, intensity of knowledge required and standardisation processes. More technology and knowledge intensive industry, less open internationally the industry is.

Outsourcing of very technology and knowledge intensive goods can be domestic, i.e. large companies-SMEs, large companies-large companies or SMEs-SMEs located in the same region or country. Also, outsourcing can be international between firms located in different countries. This kind of outsourcing is also called offshoring and it “refers to purchases by firms of intermediate goods and services from foreign providers, or to the transfer of particular tasks within the firm to a foreign location” (OECD, 2007, 6).

Yet, companies outsource not only to decrease production costs, but also to purchase lacking technical knowledge or production capacities. This is particularly case of more technically advanced industries where very specific and costly technical knowledge and production processes cannot be completely supplied by one firm. Therefore, firms search for external suppliers that can address firm’s needs, and thus fill the gap in their production chain. This kind of outsourcing is often circular and based on stable collaborative relationship. Firms thus create linkages and collaborative networks to address their production needs.

Figure 4 depicts the share of foreign value in gross exports in selected OECD countries between 1995 and 2009. It provides a simple measure which shows how much value-added is generated abroad for a given unit of exports and, thus, the degree to which national economies are integrated in the global economy through production networks, i.e., through ‘vertical specialisation’. The higher the ratio the higher is the foreign content and the higher the importance of imports compared to exports.

Figure 4: Foreign Value Added Export Ratio - total foreign value added share of gross exports, %



Source: Calculated based on OECD-WTO Trade in Value Added (TiVA) - May 2013. Data extracted on 11 Feb 2015 18:18 UTC (GMT) from OECD.Stat

CEECs, which form the majority of the EU-13 group, have comparatively very high shares of foreign value added in their exports. These shares are partly influenced by their smaller size, but are quite high compared to other EU countries of similar sizes. They all show sharply increasing shares of industrial integration from 1995, reversed only by the effects of the 2008 global financial crisis. The biggest increases in terms of vertical specialisation occurred in Hungary, Poland, Slovak Republic and the Czech Republic. Among the EU-13, especially central European countries, FDI and GVCs play major roles. The best known is the German-Central European supply chain cluster (GCESC) (see IMF 2013a, 2013b) related largely to the automotive industry. The increase in foreign value added in four major countries in the GCESC (the Czech Republic, Slovak Republic, Poland and Hungary/CE4) appears to have led to an increases in domestic value added through productivity increases, and created a demand for ancillary products and services in host economies. It seems that participation in the supply chain cluster has led to considerable technology transfer to the CE4 countries although there is no clear consensus on its magnitude due to high heterogeneity among firms in the fostering of skills.

Leitner and Stehrer (2014) show that the EU-13 benefits the most from stronger trade integration. They specialize in the low-value added yielding assembly stage of the global production chain and do not gain from vertical specialisation. The EU-15 countries are located higher up the value chain and tend to gain more in output, employment and labour productivity growth (gross output based) from more intense vertical specialisation. The growth of exports is advantageous for the EU-13 in terms of gross output and labour productivity, but on the flip side higher degree of vertical specialisation does not necessarily translate into better industry performance. On balance, Leitner and Stehrer consider that the overall effect and losses in terms of value added growth or labour productivity are compensated for by gains in terms of higher average export growth.

Overall, this suggests that the effect of vertical integration of the EU-13 is mixed as long as countries remain located in the low value added assembly stages of the GVCs. This makes technology upgrading and innovation closely related to production capability in manufacturing and services, equally if not more important than a focus on upstream R&D activities and programmes designed to generate new products and employment through a kind of 'trickle down' process from investment in R&D excellence.

These two processes of integration – upstream R&D and downstream FDI and GVCs - are often unrelated. They have led to numerous positive effects in terms of productivity and the contribution of FDI and improved scientific excellence, but have left innovation systems in the EU-13 still structurally weak in terms of missing horizontal linkages between upstream and downstream R&D&I activities (see Figure 5).

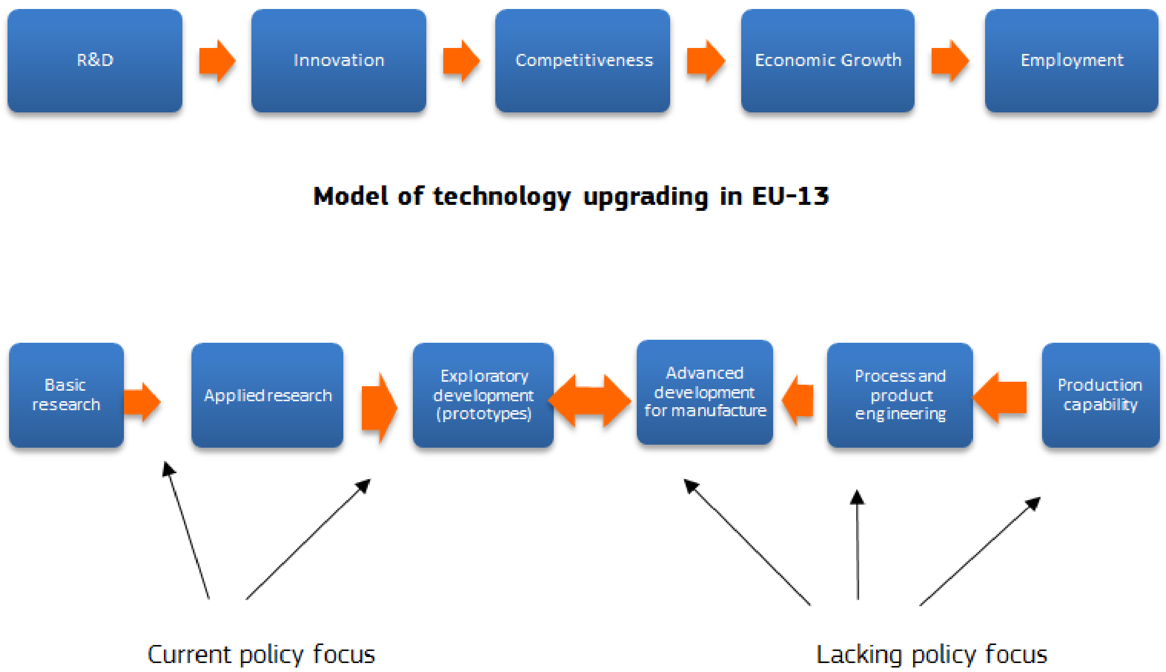
2.3 Patterns of technology upgrading in the EU-13

The lower part of Figure 5 shows patterns of technology upgrading in the EU-13 (for a further elaboration see Radosevic et al., 2015). This pattern does not follow the linear innovation model logic depicted in the upper part of Figure 5. This R&D based model of growth exists in enclaves in the EU-13, around a few clusters of new technology based firms. However, it is of much lesser economic relevance compared to alternative patterns of technology upgrading (right hand-side of Figure 4) around production capability, and upgrading from production to technology capability.

This differentiation between two patterns of technology upgrading in the EU-13 is quite important since the current policy focus is on Horizon 2020, which is largely about R&D based growth. The policy model for the EU-13 should include the pattern of technology upgrading typical of catching-up economies. This model assumes that there is process of upgrading that starts with production capability improvements (quality) and is followed by process and product engineering improvements (incremental innovations). Following this, firms focus on mastering advanced manufacturing and exploratory developments (prototypes). The next step of applied research has a significant threshold and requires different types of skills and a well-qualified (PhD) labour force.

The key focus of the Horizon 2020 programme is R&D based growth, which is concerned mostly with advancement from applied research to development, i.e., how science-industry links and the knowledge triangle are used to commercialize the results of R&D and make it relevant to the needs of the economy. On the other hand, innovation is *prima facie* a business activity and firms do not necessarily have to engage in R&D in order to innovate. More than half of the innovative firms in Europe do not perform in-house R&D, and there is no difference in performance, measured by changes in turnover growth, between innovative firms that do and do not perform R&D (Arundel and Kanerva, 2010, p. 27). In the EU-13, the share of non-R&D innovators is very high (Bulgaria 79%; Romania 65%; Latvia 59%; the Czech Republic and Slovakia 55%, Estonia 53%, Lithuania 48% and Hungary 46%). If we add firms that occasionally perform R&D or acquire extramural R&D from a parent firm or some other organization, then the share of only R&D innovators ranges between 5% and 30% (Arundel et al., 2008). Non-R&D innovators focus more on process innovation and are less likely to draw on the expertise of design engineers (Arundel and Kanerva, 2010). Thus, the key focus of the EU-13 in technology upgrading, at sector and firm levels, is about the shift from production to technology capability depicted in Figure 5.

Figure 5: Alternative models of technology upgrading R&D based growth



Source: Radosevic et al (2015)

Patterns of current technology upgrading in the EU-13 show that entirely R&D-led based growth is a potentially important source of growth, but that the main source of productivity is improved production capability (Kravtsova and Radosevic, 2011). Innovative firms in the EU-13 are largely concerned with users and demand side factors, which are the major factors differentiating more and less successful innovations (see Radosevic and Yoruk, 2011).

2.4 Smart specialisation in support of technology upgrading through internationalization

The left hand-side of Figure 5 is addressed to the design of the smart specialisation process. For example, the *Guidance for Expert Assessment of Regional Research and Innovation Strategies for Smart Specialisation* (Foray et al., 2012, p.113) explicitly considers the integration of both upstream and downstream actions. However, assessment of downstream actions is restricted to 'downstream actions (which) aim to diffuse R&I results from Horizon 2020 swiftly into the market' (ibid, p. 113*).* In Figure 5, the focus is mainly on the left hand-side, on technology upgrading at the expense of the right hand-side of enterprises as carriers of market led innovation and productivity improvements. We consider that this side of the smart specialisation design should be strengthened. It does recognize (at least implicitly) the importance of support for non-R&D activities for innovation and productivity. The Guide for RIS3 explicitly defines smart specialisation activities as needed to 'foster the internationalization of SMEs and (to) stimulate regional clusters/initiatives to make connections within international/GVCs' and the importance of 'strategic cooperation with other regions' (ibid, p.113).

Smart specialisation is a massive collective effort involving countries and regions in mapping and exploring local strengths and weaknesses in R&D&I capabilities and assessing them within the wider international context. This process involves a large number of local stakeholders that may include foreign operators, such as direct investors or foreign R&D organizations. However, on balance, the international dimension is the least developed dimension in the S3 strategies and their implementation. We need to understand why those EU-13 countries and regions where foreign direct investors employ a substantial share of the labour force and are responsible for a major share of exports, have not always involved FDI actors directly in the RIS3 process.

Smart specialisation has been perceived as an opportunity to strengthen local R&D&I capacities. There was a view that it was necessary first to strengthen local R&D&I actors to enable them to link with FDI actors such as branch plants, R&D centres, regional headquarters or contractors. Unfortunately, this overlooked the fact that FDI firms are the most productive among local firms, and some are important potential sources of knowledge exchange, subcontracting links and spillovers. However, most often this reflected the weak capacity of public bodies to engage in a dialogue and consultation process with FDI actors.

To summarize, in this section we have argued that:

- R&D in the EU-13 is collaborative in nature while growth at firm level is closely related to export, FDI and vertical specialisation;
- both the upstream and downstream parts of innovation process (both R&D and non-R&D) are strongly internationalized, but weakly linked;
- smart specialisation design emphasized internationalization as an important activity, but stressed upstream or R&D activities related to Horizon 2020 more than downstream activities related to GVCs. However, during the RIS3 implementation phase, attention will be paid to both synergies and integration/upgrading in GVCs;

- a particularity of the EU-13 economies is that much of their innovation activities are non-R&D, and at the core of their technology upgrading is the transition from production to technology capability;
- internationalization of upstream (R&D) activities in the EU-13 is more advanced than the internationalization of downstream and non-R&D activities.

Against this background, in the next section we focus on the issue of internationalization through GVCs and how they can be supported and made integral to smart specialisation. This discussion is at a lower empirical level of detail than is desirable for several reasons. First, there has been no systematic mapping of collaborative networks; the data are fragmented and/or not available for confidentiality reasons. Second, the literature on trans-regional cooperation in the context of smart specialisation and the role of regional governments/authorities in the EU-13 is limited. Work exists on the globalization of regions, but is confined largely to metropolises and metropolitan rankings.

3. Smart specialisation and technology upgrading via and in cooperation with global value chains

Internationalization and innovation are inextricably linked (Altomonte et al., 2013). There is a positive and strong correlation between the extent of involvement of firms in both international and innovation activities (ibid). This is quite important for regional R&D&I policy which overlooks this stylized fact of international economics. In addition, innovation systems are becoming internationalized although the institutions that support them have remained country-specific (Carlsson, 2006, Gosens et al., 2015). The interaction between national and foreign and, increasingly, global innovation systems, takes place within increasingly globalized networks of suppliers rather than single firms. As GVCs become more fragmented, MNEs can be considered ‘international coordinators’, whose main competence is to organize effectively the flows of value added activities distributed among individual subsidiaries (Rugman et al., 2011).

MNEs and GVCs have been and continue to be an important mechanism for EU-13 firms to learn and innovate. Participation in GVCs is a crucial means for obtaining information on the type and quality of products and technologies required by global markets, and of gaining access to those markets (Pietrobelli and Rabelolotti, 2011). However, this by itself is not sufficient for technology upgrading. Yoruk (2012), in the first in-depth study of technology upgrading through GVCs in the EU-13, shows the major importance of both knowledge and production networks for firm upgrading. Yoruk argues that by narrowing the learning opportunities for upgrading to interactions with global buyers within GVCs, as if they were the sole source of knowledge, is extremely misleading. She shows the major importance of local and national networks (not only GVCs) for firms’ technology upgrading. Also, opportunities offered by GVCs are of little use unless firms have the ability to internalize this external knowledge based on their human resources, and internal training and research.

Thus, GVCs and MNEs are no panacea, but, equally, it would be misleading to presume that reliance on only own forces would ensure technology upgrading. GVC suppliers and local MNE subsidiaries are at the intersection of two flows of knowledge - global and national or local - which can facilitate learning from MNEs and linking with external sources of expertise and know how, and use them to leverage local capabilities (Mathews, 2002). Since regional sources of knowledge are not enough, it is important to create the mechanisms to enable involvement in the international knowledge creation and diffusion process. The empirical evidence suggests that there is a variety of roles that MNE subsidiaries can play in relation to regional or national knowledge systems (Marin and Arza, 2009). They can be highly innovative, or evolve towards more sophisticated technological activities, or they can remain isolated and not innovative. The subsidiaries that have managed to move to intensive innovative activities are those that have drawn heavily on learning links with their parent companies, i.e. they are integrated or connected to international networks and are entrepreneurial. The more connected subsidiaries are to the global production network, the greater their involvement in innovation locally (Marin and Arza, 2009).

3.1 How smart specialisation can help technology upgrading through and in cooperation with GVCs

From a smart specialisation perspective there are three important aspects to consider in relation to GVCs. First, the *choice of GVC* that is suited to regional R&D&I and manufacturing or services capacities. Second, how firms can be assisted to 'climb the ladder' or move from process, to product, to functional or value chain upgrading. Third, discovery of 'new ladders' or new production and market uses for existing capabilities, not originally envisaged by either the foreign or local partners.[10]

a. Matching regions with value chains

Smart specialisation is an opportunity to target investors (by FDI promotion agencies) with the aim to leverage the effect of the smart specialisation strategy on regions. Also, regions' smart specialisation strategy should be used as the basis for better FDI promotion activities to strengthen regional development (Ecorys, 2013).

From a smart specialisation perspective, search activities are focused on identifying not only emerging/promising markets but also promising or appropriate value chain leaders. The idea is that a good match between the type of region and the type of GVC can have catalysing effects on the region in terms of technology spillovers. Table 2 presents the relationship between types of regions in the EU-13, and the modes of their integration into GVC/MNE networks. X indicates strength or suitability of a specific activity for a specific type of the region with XXX being the strongest and X the weakest.

[10] We use the word 'ladder' to emphasize that GVCs are potential levers of regional economic growth and technology upgrading.

Table 2: Types of regions in EU-13 and types of internationalized business activity

Type of business activities /Type of region	'Connecting Globally'	'Cluster building'	'Deepening pipelines'	'Peripheral regions'
	Capital regions building R&D strengths and international connections	Small grouping of potentially competitive business with limited local connectivity	Region dependent on limited number of global production networks/global value chains	Regions outside of access to global production network
Research	XXX			
Innovation	XXX	XX		
Production	X	XXX	XX	X
Marketing (sales)	XXX			
Distribution	XXX	XX		
Administrative support (regional headquarters)	XXX			

Source: authors. Taxonomy of regions is modified and adapted based on Benneworth and Dassen (2011).

'Globally connected' regions are usually metropolitan or capital regions with extensive participation in national and international competitive research programmes and international technology networks. 'Cluster building' regions are those that have a critical, or subcritical, but potentially critical, mass of firms in the respective technology areas. Many of these are manufacturing regions with relatively high knowledge absorptive capacity.

'Deepening pipelines' regions partly overlap with the cluster building regions in terms of links to GVCs, but they do not have a critical mass of the local clustering firms, and have local infrastructure deficiencies which significantly weaken their absorptive capacity. 'Peripheral regions' are marginalized regions, which may be rural areas in less developed EU-13 countries or old industrial centres that have not been restructured, but which effectively are excluded from the internationalization process in relation to FDI and GVCs. The activities described in Table 2 are necessarily generic or indicative, and need to be specified in terms of technology and sector or area of application. However, they indicate the match or mismatch between what is possible and what is desirable in terms of regional infrastructure and capacities, and type of activities that could be attracted via the GVCs. Attracting non-production activities, such as research, marketing and distribution, for a region that does not have the required infrastructure and skills for upstream GVC activities, may not be beneficial in relation to the region's potential comparative advantage regardless of the available funds and vision for the future. Equally, specializing in activities in which the region already has strengths is merely pandering to existing comparative advantage, which may not persist and may not lead to further diversification.

From the perspective of GVCs, globalized regions have strong advantages in the non-production stages of the innovation chain. They assume a gateway role for MNEs by housing their regional or their national headquarters (Fratesi, 2012). Regions with few local clusters are the best placed to become integrated into global production networks and the stages of production such as innovation and distribution. They lack connectivity and knowledge intensive business services firms (Capello and Perucca, 2013). They may be located close to the country or regional capital that engages in these non-production functions. 'Deepening pipelines' regions and especially 'peripheral regions' are well placed to attract branch plants. The objective may be functional upgrading, but largely within the production mandate.

The key to internationalization via smart specialisation is to fit the type of region to the respective activity and, thus, the type of GVC. This taxonomy represents an *ad hoc* framing of a problem that requires in-depth analysis of each region from a GVC perspective in order to make it applicable. As part of smart specialisation activities, it is important to embark on an analytical process to identify *which type of GVC will best fit regional capacities*. Local firms will be required to satisfy the product quality, delivery time, process efficiency, environmental, labour and social standards requirements of these chains. However, these requirements are neither generic nor easily recognizable, and differ across industries and technologies. Sectoral specificities matter and influence the mode and extent of upgrading in clusters integrated in GVC (Giuliani et al., 2005). In 'buyer led' GVCs, which are usually hierarchical, product and process upgrading are enhanced, but functional upgrading is almost always inhibited[11] [12] (Giuliani et al., 2005). If confined to individual firms these upgrading strategies are rarely supportable. Hence, it is important to try to create a critical mass of local suppliers that will generate demand for supporting services. Within that context, a smart specialisation process might 'discover' areas where a critical mass of local demand for such 'upgrading services' could be created. For example, this applies to industry specific programmes of quality improvement services, or to programmes to meet international industry standards or to supply technology specific training. It would be preferable if these were designed and implemented in collaboration with the users of these services, including GVC leaders.

The more developed the local support, the more numerous will be the opportunities to get involved in higher value added activities. So, strategic analysis for the EU-13 should identify the needs in the system of organizations that provide technology diffusion and extension services, such as Metrology, Standards, Testing and Quality (MSTQ), and technical and organizational consultancies (or knowledge intensive business services) and, later, R&D&I support (Pietrobelli and Rabellotti, 2011). However, these aspects cannot be unrelated to potential GVCs, which may be likely candidates for location or expansion in the region. In this case, stakeholder involvement in the process of smart specialisation can avoid irrelevant or overly generic R&D&I infrastructure services, and identify those for which there is effective demand from local firms.

b. Smart specialisation - a process for 'discovering' new GVC-related opportunities or 'climbing the ladder'

Choosing the right GVC and creating the appropriate 'milieu' to embed it into the regional economy are the first, although static dimensions of the selection process. There is also a dynamic dimension, consisting of discovering new opportunities for further *technology upgrading within the GVC*. The types of capabilities and external support required for each type of upgrading differ for different types of global value chains or MNE subsidiaries. These are presented in Table 3 as ranging from arm's length market relationships to major types of value chain relationships and two

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[11] Buyer led value chains are usually organized by large distributors or global retailers.

[12] Process upgrading comprises more efficient transformation of inputs into outputs through a reorganization of the production system or introduction of superior technology. Product upgrading involves moving into more sophisticated product lines in terms of increased unit value. Functional upgrading involves the acquisition of new, superior functions in the chain, such as design or marketing, or abandoning existing lower-value-added functions to focus on higher-value-added activities. Inter-chain upgrading refers to applying the competence acquired in a particular function to move into a new chain.

forms of vertical integration via MNEs. The major types of global value chains are described below (based on Gereffi and Fernandez Stark, 2011, pp. 9-10).

- **Market**: Market relationships with the GVC are relatively simple since they are based on product specifications that are easily transmitted, and suppliers can produce their goods with minimal input from buyers. These arms-length exchanges require little or no formal cooperation among the actors, and the cost of switching to new partners is low for both producers and buyers.

- **Modular**: In modular relationships, suppliers make products to customers' specifications and take full responsibility for process technology, using generic machinery that spreads their investment across a wide customer base. Linkages (or relationships) are more substantial than in simple markets because of the amount of information flowing across the inter-firm links.

- **Captive**: In captive chains, small suppliers are dependent on one or a few buyers which often wield huge power. The core competence of the lead firms tends to be in areas outside of production, helping suppliers to upgrade their production capabilities that do not encroach on this core competency and benefit the lead firm by increasing the efficiency of its supply chain.

- **Relational**: Relational global value chains require frequent interactions and knowledge sharing between the parties. Lead firms specify what is needed and, thus, have the ability to exert some level of control over suppliers.

MNE subsidiaries are heterogeneous in terms of their internal capabilities and their role within the MNE and the regional economy. Highly integrated subsidiaries are those that are embedded in both the MNE innovation process and the regional knowledge network. Research shows that this type of subsidiary is a real conduit of knowledge transfer and the source of technology spillovers for the regional economy (Marin and Sasidharan, 2010; Cantwell and Mudambi, 2005, Marin and Guliani, 2011). In contrast, from a regional economy perspective, isolated subsidiaries do not operate as a source of technology spillovers. They are not embedded in MNEs' innovation processes and are isolated from local knowledge networks although they may have superior equipment and technology. In isolated subsidiaries, joint projects with local suppliers do not go beyond commodity supply. They can be entirely dependent on or isolated from flows of knowledge from the MNE, but in either case, they are not engaged in knowledge exchange within the region (Marin and Giuliani, 2011).

Table 3: Types of GVCs and the internationalization of the smart specialisation

Type of value chain/MNE subsidiary	Strategic aim of internationalization of smart specialisation	Role of GVC leader/ MNE	Role of regional public support
Arm's length relationships	Building competencies for entry into GVC	n/a	Technical support services for meeting GVCs standards
Modular chains	Learn how to meet GVC standards	Passive	Technical support services for meeting GVCs standards
Captive chains	Support upgrading of local suppliers up to a level of competent supplier	Active	Support to process and product upgrading
Relational chains	Strengthen production and linkages capabilities	Cooperative	Support to product upgrading
Highly integrated subsidiaries	Assist subsidiaries to operate as conduit between local and MNE innovation system	Active	Support to product and functional upgrading
Isolated subsidiaries	Assist subsidiary to become highly integrated subsidiary	Passive	Support to improve linkage capabilities

Source: adapted based on Gerrefi and Fernandez Stark (2011), Pietrobelli and Rabellotti (2011), OECD (2013).

Arm's length relationships in GVCs, modular chains and captive chains are either solely or largely about process upgrading. In each case, the aims of smart specialisation strategies are quite different depending on the type of GVC based on differences in the required capabilities. Product upgrading is possible within captive and relational chains, although lead firms retain tight control. Value chain relationships are usually confined to production or services and do not involve the full range of the firm's non-production activities such as R&D, design or marketing. Thus, functional upgrading is limited to the production process.

The role of external support for firms' upgrading varies with the nature of the required capabilities. In the case of process upgrading this is related mostly to quality and compliance with specific industry and technology standards. The role of the GGVC leader or MNE varies across different types of relationships from passive, to cooperative, to active. Similarly, the role of regional public support varies depending on the required capabilities and firms' technology upgrading strategies.

Functional diversification can be considered a type of technology upgrading since it involves the uptake of relatively more sophisticated, knowledge-intensive and higher value adding assignments that complement the production-related tasks (Szalavetz, 2012, p. 316). Functional upgrading to non-production services requires knowledge-intensive services and business services, which in the EU-13 (with exception of a few capital regions) are not competitive, which limits the potential for service innovation to support economic restructuring. However, these activities are important to increase the value added generated by the manufacturing sector (Komninos et al., 2014).

The major structural shift among EU-13 firms consisted of the transition from only production or only assembly activities to Original Design Manufacturer (ODM) and then Own Brand Manufacturer (OBM). GVCs are an effective mechanism for upgrading at least up to ODM level and there is evidence that they do not hinder functional upgrading (Yoruk, 2012). Advancement beyond these levels is not easy, but may be enabled by licensing, franchising or alliances, or collaboration for marketing with a (foreign) consulting firm.

The more autonomous the firm, the more it will be able to engage in functional upgrading or development of a larger number of functions. However, such upgrading implies increased fixed costs to establish additional functions (strategy, R&D, marketing, etc.) not necessarily accompanied by increased production volumes or increased profitability. As a result of this trade off, Rozeik (2011) shows that the pattern of company upgrading in the Central European automotive industry is more scale based (i.e. involves a large increase in production volume) as opposed to scope based or functional upgrading.

In the case of local subsidiaries of MNEs, product and functional upgrading requires changes to the subsidiary's mandate. Although there are examples of success in the EU-13, such as Siemens which diversified into higher value added activities, the share of upgraded subsidiaries in this group is small. Szalavetz and Sass (2011) point to the unfounded assumption that much depends on the subsidiary's efforts, and especially its entrepreneurship. Research on FDI subsidiaries in four CEE countries shows that subsidiaries have relatively strong autonomy in business functions, but within a predominantly production-oriented mandate (Majcen et al., 2009). In production-oriented mandates quality seems to be paramount, and high productivity growth is ensured if the subsidiary is left alone. Subsidiaries control 'how' things will be done, but have significantly less control over strategic issues such as which line of businesses should be pursued. However, if policy is aimed at increasing the scale of functional upgrading, leaving the subsidiary to its own devices would seem to make this unlikely.

From a smart specialisation perspective, how to motivate MNE headquarters or GVC leaders to refine the mandates of entrepreneurial subsidiaries is a key issue. The importance of this is obvious in the case of isolated subsidiaries compared to subsidiaries that are well integrated into both MNE networks and regional knowledge networks. Assessment of new opportunities is cognitively biased not only by the intra-MNE perspective of the headquarters but also by lack of knowledge about local opportunities. The benefit to be derived from MNEs' extending subsidiary mandates beyond the original market or resource seeking investment, is not obvious unless there are significant infrastructural improvements in the regional technical and knowledge infrastructures. Such improvements must be coordinated to ensure that they are technology or firm specific. So how can smart specialisation contribute to resolving this vicious circle of how to initiate a technology upgrading process within the GVC?

c. Smart specialisation - the process of 'discovering a new ladder'

In addition to functional upgrading, MNE subsidiaries can discover opportunities being offered 'on the side', in the value chain stage in which the firm is currently engaged (Pietrobelli and Rabellotti, 2011). This process is not necessarily confined to the GVC lead firm and a local supplier, and usually is shaped by the infrastructural support for R&D&I on which the firm can rely. Areas of new opportunities emerge or are 'discovered' through close interaction among domestic firms, GVC lead firms and local universities or public research organizations. This is closest to the original idea of smart specialisation, but is confined here to a 'discovery process' involving the GVC coordinator, local suppliers and the local R&D infrastructure.

The more sophisticated the technology requirements of GVCs and MNEs, the greater the requirement for regional support systems to support the building of capabilities for technology upgrading within GVC and MNE networks. In terms of smart specialisation activities this does not require a separate system of support, but rather a reorientation of the existing networks towards the needs of these firms. However, a major change is required in the way that regional authorities and supporting organizations cooperate with GVC leaders, in understanding the key capabilities deficits among local firms, and the infrastructural requirements for the next stage of their technology upgrading.

The overall aim of internationalized smart specialisation is to extend participation in supply chains from commoditized and shallow, to deep and integral participation. This is important since not all GVC activities involve technology upgrading which may not necessarily ensure sustainable competitive advantage and growth (Steinfeld, 2004). Not even functional upgrading necessarily leads to greater value capture (Szalavetz, 2012). However, the scope for technology upgrading through and in cooperation with GVC leaders is an inevitable step on the path to technology upgrading among the EU-13. This includes intra-chain upgrading as well as inclusion in new GVCs.

Internationalized smart specialisation is about discovering new ways of partnering which go beyond passive acceptance of the rules governing connectivity upstream and downstream. They are also about discovering new opportunities for more integral processes, opportunities that must be coordinated and co-designed with upstream and downstream partners in the network. If the gaps are not too large, the smart specialisation discovery process might allow local firms to organize collective action towards full functional upgrading, by moving to non-production parts of the value chain, e.g. by building a regional or national brand. Finally, if smart specialisation is about specific activities or technologies that can be used in multiple supply chains, e.g. producing a standalone component that can be plugged into a variety of downstream products, this could lead to entirely new innovation strategies that go well beyond GVC dependence.

3.2 Identifying internationalization opportunities through smart specialisation: at which level?

The level at which smart specialisation priorities are identified and supported lies between micro-project and sector-level policies. If the level of granularity is too fine the outcome will be micro-projects, if too coarse the result will be sectoral policy. From an internationalization perspective, it would seem logical to focus on the quality or value added of different business functions (manufacturing, development, engineering, logistics, etc.). However, this overlooks the possibility that subsidiaries or GVC suppliers might be involved in high value added activities in one part of the business function while at the same time being simple implementers in another part of the same business function (Szalavetz, 2012, Rugman et al., 2011). This would suggest that policy should not identify a subsidiary or GVC supplier that has one dominant function and a presumed value added level. A specific dominant function in reality might consist of a mix of diverse value adding activities, whose expected level of value added might be marginal or non-existent. This would suggest that policy should be targeted towards activities rather than whole functions, whose description should be sufficiently specific to reveal their technology, knowledge or value added content. In other words, the function should be an activity whose description is sufficiently specific to identify its technology and knowledge complexity level. The challenge for smart specialisation analysis is how to survey demand and supply of technology activities at this level to reveal potential areas for technology upgrading activities.

4. Strengthening internationalization of smart specialisation in the EU-13: institutional preconditions and policy environment

The inter-regional and transnational dimensions must be an integral part of any smart specialisation programme. Thus, we do not envisage adding more steps to those stipulated in Annex I of the Guide for RIS3, which include:

Step 1 - Analysis of the regional context and potential for innovation;

Step 2 - Governance: Ensuring participation and ownership;

Step 3 - Elaboration of an overall vision for the future of the region;

Step 4 - Identification of priorities;

Step 5 - Definition of coherent policy mix, roadmaps and action plan;

Step 6 - Integration of monitoring and evaluation mechanisms.

However, we need to pay particular attention to steps 1, 2, 4 and 5. As part of step 1 we need to review the existing degree of internationalization in the region, i.e. scale, scope and types of integration into GVC and MNE networks through local subsidiaries and subsidiaries' links with local suppliers and public infrastructure organizations.

The process of discovering new internationalization opportunities is similar to the smart specialisation process of entrepreneurial discovery (steps 1-4), but with three possible directions. First, it is necessary to choose and attract new GVCs or MNEs or matching regions as discussed in Section 3.1.a. Second, it necessary to identify technology upgrading opportunities among existing local suppliers and local subsidiaries. This is the process of 'discovering' new GVC-related opportunities or 'climbing the ladder' (3.1.b). Third, there is the process of discovering new opportunities alongside existing GVCs or discovering new GVC related opportunities, i.e. 'a new ladder' (3.1.c).

The choice among these options depends on the level and competencies of local suppliers and the regional supporting technical infrastructure. However, unlike the process of 'inward' oriented smart specialisation or specialisation where local public and private actors act autonomously based on their knowledge of the external environment, in this process, the actors are not fully autonomous. Local subsidiaries of MNEs have very different degrees of strategic autonomy and find themselves with quite different degrees of freedom in relation to the strategies they can pursue. GVC leaders' views about the role of local suppliers may be different to the views of these local suppliers. This makes the process of 'entrepreneurial discovery' more complex since stakeholders' opinions about the situation and the regional strengths and opportunities will differ from those held by international actors. These cognitive biases are to be expected and they should be reconciled through a process of 'entrepreneurial discovery'.

However, given the higher barriers to the process of 'entrepreneurial discovery' that involves foreign actors, two factors involved in this process deserve special attention. These are the institutional preconditions for smart specialisation (step 2) and policy environment (step 5). The institutional capacity for smart specialisation is implicitly considered to be unproblematic although, in reality, it is a major area of concern. Experience shows that it is a major stumbling block to effective implementation of smart specialisation, especially in the EU-13. The internationalization of smart specialisation adds further complexity since the EU-13 regions usually do not have developed mechanisms for interaction with foreign investors after completion of a capital expenditure project. 'Investor aftercare' (with the exception of CzechInvest)[13] remains rare. It involves activities to support expansion, reinvestment and the development of R&D activities; searching for suppliers in the region; providing support for training and recruitment; promoting cooperation with vocational colleges and universities, etc. Another precondition is a developed policy environment oriented to linking and leveraging domestic and foreign investors and suppliers both upstream (R&D, technical services) and downstream (manufacturing and services). Smart specialisation on its own will not be enough to overcome the barriers to actors' engagement in 'discovery processes'. Strong incentives and appropriate policy instruments will be needed to shift expectations in the direction of long-term R&D&I oriented activities.

4.1 Collaboration in smart specialisation areas

EU-13 countries have identified their smart specialisation areas through entrepreneurial process of discovery (step 4). However, knowledge of only its own priorities is not enough to establish cooperation in smart specialisation. Thus, policy-makers, practitioners and experts need to gather information on smart specialisation priorities in other EU countries to understand better opportunities for trans-regional and transnational cooperation. Knowledge of smart specialisations areas as they have been identified and selected by EU countries and regions is crucial for designing cooperation policies at local level, and thus achieving R&I goals at European level. Eye@RIS3 is an open source tool providing information on smart specialisations in 25 EU countries, 177 EU regions, 6 non-EU countries and 19 non-EU regions.[14] The tool has been developed by Smart Specialisation Platform (S3 Platform) to provide for full and accurate information on smart specialisations and thus offer a picture of R&I activities in Europe.

As of today, Eye@RIS3 contains more than 1,300 smart specialisation entries. An average number of priorities is six while 17 is the largest number of priorities encoded so far. The most common RIS3 priority areas in the EU are energy, health, information and communication technologies, food, advanced materials, services, tourism, sustainable innovation, advanced manufacturing systems, and the cultural and creative industries (Sorvik and Kleibrink, 2015). Users can search information by country or region, NUTS 2, national/ regional research and innovation capabilities, business areas and target markets and/or EU priorities. NACE taxonomy was used for the search by national/ regional research and innovation capabilities, business areas and target markets while EU priorities are linked to Europe 2020 priorities including KETs, Digital Agenda, Blue growth, service innovation, social innovation, etc. Users can also search by "description of priority" typing a (key) word in a field box.

While search taxonomy of capabilities and business markets is based on NACE, categorization of smart specialisation areas is hardly possible. The reasons are manifold. Firstly, smart specialisations are defined as areas, cross-sectoral activities, crossing two or more fields of research and business. Secondly, there are differences in the definition of areas: they can be defined more broadly or narrowly depending on each country/region understanding. Also, smart specialisations can be described in "creative" way, i.e. "cradle to cradle, waste management" or

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[13] CzechInvest is the Czech Investment and Business Development Agency. See http://www.czechinvest.org/en.

[14] As of 20 April 2015

"made in …". Description of specialisation areas thus varies among the regions and countries and this makes systematic categorisation difficult.

Moreover, smart specialisation is by definition an on-going, evolutionary process based on continuous exploration and exploitation of research and business potential and opportunities. In consequence, smart specialisation areas cannot be conceived as fixed, unchangeable sets of R&I areas, rather as flexible living domains that adapt quickly to new and changing conditions. What does this flexibility mean for trans-regional and transnational cooperation in smart specialisation? In the first place, policy-makers and public authority representatives are called to gather constantly information on research, business and market opportunities at local as well European levels. This means continuous entrepreneurial process of discovery and exploration of activities, capacities and needs of regional actors as well as opportunities. Are regional actors searching for new partners to perform R&D of some niche technologies? Do they need to acquire some specific technologies to complement their products? Are they searching for designers, developers, manufactures or customers? At what level can stakeholders' needs be satisfied best – local, national or international? Who are competitors and possible partners or consumers? These questions need to be addressed constantly though it requires resources and time. However, continuous entrepreneurial process of discovery and analysis are a precondition for finding partners in other countries and regions.

4.1.1 Smart specialisation areas in EU-13

From EU-13 countries, 12 countries have RIS3 strategies at national level and one country, Poland, has both national and 16 regional RIS3 strategies. According to Eye@RIS3, EU-13 countries and 14 Polish regions have identified altogether 197 priorities.[15] On average, countries and regions have 7 priorities. Interestingly enough, some medium size countries have identified between 4 and 6 priorities while Poland identified 19 priorities at national level and between 4 and 15 priorities at regional level.

In order to identify the most frequent smart specialisation priorities, we have grouped priorities into 14 larger thematic areas. The most listed priorities are bio-economy & agriculture, ICT, energy, health & wellbeing and engineering & electronics (table 4).

[15] It is important to note that 2 Polish regions do not have their smart specialisation priorities encoded in the Eye@RIS3 database.

Table 4. Smart specialisation priorities in EU-13 countries.

Smart specialisation priority – thematic area	Number of priorities	% of all priorities
Bio-economy & agriculture	26	13.2
ICT	24	12
Energy	23	11.7
Health and wellbeing	21	10.7
Engineering & electronics	19	9.6
Business & services	17	8.6
Transportation	15	7.6
Chemistry, pharmaceutics, cosmetics	14	7.1
Creative industries	10	5
Green growth & clean technologies	9	4.6
Tourism	7	3.5
Construction	5	2.5
Iron & metal	5	2.5
Manufacturing	2	1

Source: authors. Based on Eye@RIS3 database

Nine out of 13-EU countries and 10 out of 14 Polish regions selected "bio-economy and agriculture". They will specifically focus on agricultural innovations and technologies as well as healthy and safe food. Similarly, "ICT" priority has been selected in 9 countries and 7 Polish regions. For example, the region of Slaskie identified six cross-sectoral ICT priorities where ICT is applied to other areas including biotechnology, electronics, energy and health. "Energy" has been identified in eight countries and seven Polish regions. Countries and regions will focus on resource/energy efficiency, renewable sources and energy technologies. Priority "health and wellbeing" is largely represented across EU-13 countries (9) and Polish regions (8). The focus is mainly on technologies in medicine and healthcare, biomedicine, health products, active and healthy aging. "Engineering and electronics" is a priority area in five countries and six Polish regions while "business and services" in four countries and seven Polish regions. Finally, "transportation" including automotive, aviation, transport and mobility, transport means, maritime activities and logistics is a priority in eight countries and five Polish regions.

4.1.2 Exploring and mapping opportunities for trans-regional and transnational cooperation in smart specialisation areas

Eye@RIS3 database is a useful source of information on smart specialisations identified in EU countries and regions. However, it does not provide for a complex picture of specific projects or activities that take places in countries/regions. In order to get better understanding of complex smart specialisation activities and opportunities for collaboration across the borders, it is essential to complement data from Eye@RIS3 with additional information. What methodology can be used to gather and analyse information? What evidence is needed to get a better understanding of trans-regional cooperation opportunities in smart specialisation?

In the first place, it is essential to understand current and past trans-regional activities of regional stakeholders in smart specialisation areas. In other words, exploration of collaborative networks among regional/local actors and those located in other regions can be the first step in the process. A number of questions can be thus answered: are there already linkages among actors in smart specialisation areas? What is the nature of trans-regional and transnational collaboration e.g. participation in R&I initiatives such as EU Framework Programmes (EU FP), Joint Technology Initiatives (JTIs), Joint Programming Initiatives (JPIs), Knowledge Innovation Communities (KICs), INTERREG, etc. or other multiregional and multinational initiatives such as Visegrad Group? What outputs including patents, publications, knowledge transfer through exchange of experts, etc. have been produced jointly with institutions, organisations, individuals, etc. located in other regions in Europe?

Relevant data and information can be gathered through dedicated databases, maps and websites. Majority of databases and sources of information are open and free:

- Database of EU-funded research projects and project results under EU Framework Programme 7.[16] The database provides for information on funded projects and their results searchable by subject, participation institution, output and country.

- Five Joint Technology Initiatives (JTIs) are currently operating:[17]

    - Innovative Medicine Initiative (IMI)
    - Aeronautics and air transport (Clean Sky)
    - Fuel Cells and Hydrogen (FCH)
    - Embedded Computing Systems (ARTEMIS)
    - Nanoelectronics technologies 2020 (ENIAC)

- Up to day five Knowledge Innovation Communities (KICs) have been established. They focus on:[18]

    - Climate change mitigation and adaptation
    - Healthy living and active ageing
    - Future Communication and Information Technologies
    - Sustainable exploration, extraction, processing, recycling and substitution
    - Sustainable energy

  In 2016 European Institute of Innovation and Technology (EIT) will publish two calls to complement current five KICs with two additional KICs:

    - Food4Future – sustainable supply chain from resources to customers
    - Added-value manufacturing

- Information and data on projects and partners of Territorial Cooperation Programmes – EU programmes dedicated to cross-border, trans-regional and interregional cooperation in Europe have been made available by KEEP.[19] The database provides aggregated data on the INTERREG programmes as well as the IPA (Instrument for Pre-Accession) and the ENPI

[16] http://cordis.europa.eu/projects/home_en.html (as of April 2015)
[17] http://ec.europa.eu/research/jti/index_en.cfm?pg=individual#imi (as of April 2015)
[18] http://eit.europa.eu/eit-community/map#zoom=4&lat=54.29088&lon=13.18359&layers=TB (as of April 2015)
[19] http://www.keep.eu/keep/ (as of April 2015)

(European Neighbouring and Partnership Instrument). Users can access statistics and build their own datasets based on aggregated data, as well as access maps and heat maps per countries. Keep is thus a very useful tool for policy-makers, officers and practitioners who are exploring and designing trans-regional and transnational cooperation programmes in smart specialisation areas.

Regarding R&I outputs, a number of databases can be consulted:

- OECD patent databases provide data on patents by regions and technology fields (REGPAT) or on international cooperation in patents. In REGPAT database data is linked to applicants and inventors at regional level according to their addresses. Data is also linked to other regional growth indicators including GDP, etc. and more specific information on patents (citations, abstracts) and patent holders (institution type, private/public organisation, etc.). Thus, policy-makers, officers and practitioners can have an in-depth insight into trans-regional S&T activities of regional actors (through co-patenting).

- Data on publications (bibliometric) can be gathered through some commercial databases, e.g. Elsevier that use SCOPUS, etc. data.

- Also data and information on enterprises, SMEs and other business actors are accessible via commercial databases including ORBIS and AMADEUS.

4.2 Institutional pre-conditions for internationalizing smart specialisation

The institutional preconditions for smart specialisation, such as the administrative requirements and policy capacity, are new for the EU-13 (see Karo and Kattel, 2015). Internationalization of smart specialisation inevitably exacerbates these weaknesses since the EU-13 regions have no mechanisms in place enabling continuous interaction with foreign owned firms. In relation to this very important dimension of the smart specialisation process we highlight a few priority areas and issues:

- public-private coordination mechanisms, including meso-level coordination mechanisms (activities, sectors and GVCs), need to be developed further;

- the vertical-horizontal nature of smart specialisation policies and accompanying administrative and policy preconditions needs further investigation;

- sector and technology specific expertise is required to evaluate smart specialisation alternatives;

- tailor-made policies and greater policy capacity are needed;

- the ‘entrepreneurial discovery process’ requires further investigation including consultation with public sector stakeholders;

- the institutional conditions and requirements for experimentation within an annual multi-year programming framework need to be defined.

However, the above requirements must be based on an organization with the ability to assume responsibility for FDI/GVCs and innovation. FDI is usually managed by an FDI promotion agency, and R&D&I are usually overseen by the Ministry for Science and Technology. However, these arrangements vary across the EU-13. For example, in the Czech Republic the entity responsible for the modernization and integration of the food sector into the EU industrial networks is the industry association. CzechInvest has managed successfully to integrate management of the EU Structural Funds with FDI and innovation programmes. It seems that what matters is not the specific organizational form, which can vary from country to country, but the success or failure of the organization. This calls for a better understanding of specificities of each country, and of the organizational and policy factors in the EU-13 that lead to organizational success in public policy.

The EU-13 has seen a proliferation of agents detached from ministries and with different levels of policy autonomy. It is hoped that this will ensure the quality of public policy implementation including interaction with foreign firms. This process of 'agencification' has taken place as part of the EU accession process. In the pre-accession period, candidate countries saw policy transfer as necessary to secure EU membership rather than considering it a tool for improving the quality of policy design and implementation at the domestic level (Nakrosis, 2015, p. 135). As a result, the EU-13 countries all have FDI agencies. These actors are potentially important players in the implementation of smart specialisation and its integration and embedding in local economies and innovation systems. However, the reality is diverse roles of investment promotion agencies. Cass (2007) distinguishes among their 'symbolic', 'practical', 'comprehensive' and 'strategic' roles. Symbolic agencies are legal organizations with varying facilities, which exist, but do not act. 'Practical' actors are those that provide a substantial range of information and services to new and existing investors. 'Comprehensive' agencies try to promote the relevant country to potential investors, and provide certain services, with varying degrees of success. Most agencies belong to this category. 'Strategic' investment promotion agencies are clear about the areas where FDI is needed, and have the influence and capabilities to be successful. According to Cass (2007, p. 103) 'among transition countries CzechInvest is perhaps the only one that comes into this category'.

Thus, strategic investment promotion agencies are a vital missing precondition for the promotion of technology upgrading via FDI and GVCs. Their absence is due to the high rates of politicization of agencies in the EU-13, the frequent changes of governments which hinder organizational learning, a strong legalistic approach to the design of public sector organizations which focuses on formal and structural features at the expense of operational characteristics and relationships within the environment (Randma-Liiv et al., 2011, p. 162).

However, as already mentioned, the precise form of agency or body responsible for implementing the internationalization of smart specialisation is secondary to whether this organization is a case of organizational success or organizational failure. There are several features that explain CzechInvest's success as a strategic investment promotion agency including (Benáček, 2009, 2010):

- adoption of high standards for management, and managerial techniques based on teamwork, managerial initiative and regular monitoring of performance;
- political consensus at the national level that the agency should be independent and protected from 'political bickering';
- freedom to act like a private consultant whose services are free of charge;
- provision of support programmes to upgrade and enhance domestic activities;

- autonomy in the operative aspects of policy implementation allowing delegation of responsibilities to divisions and teams;
- government policies that continuously adjust to the changing external and internal situation;
- face to face interaction between agency employees and investors, complemented by personal accountability and the implementation of safeguards against corruption;
- assessment of the outcomes of policy-making to reduce risk and allow adjustments to its implementation.

However, public-private coordination mechanisms, including meso-level coordination mechanisms (activities, sectors and global value chains), and organizationally successful strategic investment promotion agencies, are not sufficient for successful smart specialisation unless the policy environment is conducive to internationalization, and linking between domestic with foreign investors and GVC leaders.

4.3 Policy environment

Smart specialisation may generate new insights and new programmes, but for these to be effective will require the overall policy environment to be geared towards the generation of both foreign and domestic knowledge. Below, we outline the major policy areas that influence the internationalization of systems of innovation in the EU-13, and which are the policy preconditions for the internationalization of smart specialisation.

4.3.1 Fostering demand driven FDI in R&D&I

The major focus of R&D policies in the EU-13 is on R&D excellence, and smart specialisation provides the opportunity to work towards fostering demand-driven R&D and facilitating the upward evolution of existing manufacturing and services. The EU-13 countries are unlikely to attract significant supply-driven R&D in the business sector; there are few locations in the EU with the relevant science and technology infrastructure (Narula and Guimon, 2009). Thus, it would be more effective to focus on fostering demand-driven R&D, i.e. R&D that is related to the implementation of improved products and processes which are produced or assembled in the EU-13. However, this requires critical mass and international leverage, which, in turn, require FDI oriented investment complemented by local investments in technology and firm specific infrastructures. Therefore, the issue for the EU-13 countries is how to attract technology oriented FDI and exploit it to leverage local investment in R&D, especially in downstream areas.

4.3.2 Focusing on the ‘quality’ of FDI and GVCs

This requires a shift from prioritizing and attracting FDI towards a focus on the quality of subsidiary developments. CzechInvest recognized the need for a shift from focusing on FDI investments in manufacturing and blue-collar jobs towards new sectors (Software & ICT Services, Business Support Services, Aerospace, Advanced Automotive, Industrial Machinery, Equipment and Tools, Life Sciences. Electrical Engineering/Electronics, Advanced Renewable Energy/Cleantech, and Nanotechnology). It identified this as a ‘shift from quantity to quality’ (see also Filippov and Guimon, 2009; Alfaro and Charlton, 2007). This requires closer links between FDI, and industry and innovation policies. The tendency in the EU-13 has been to focus on FDI inflows and to ignore the

R&D&I content of FDI, explained by the primary aim of generating employment rather than technological upgrading of the economy. However, this provides only a temporary easing of the problem since it addresses only cost competitiveness and does not resolve the issue of technology competiveness. The example of the successful Czech case (see Box 1) is useful.

Box 1: Merging FDI and innovation policy

The Czech Republic's location seems to be no more advantageous than that of neighbouring countries such as Slovakia and Hungary. However, the Czech Republic can be distinguished for its high volumes and improved quality of FDI. Beginning in 2007, it has paid great attention to innovation and services FDI via the establishment of technology centres and business services centres.

It could be argued that this shift has been driven by successful FDI and establishment of a business development agency. This latter is the only investment promotion agency in the CEEC that has involvement in shaping investment priorities and influencing their implementation. It is also responsible for tasks such as development of small and medium sized enterprises, and administration of EU Structural Funds; it has become de facto a 'development agency'.

However, the Czech Republic experience shows that such developments are not straightforward, and there is still a need for deeper linkages between innovation and industry policy. This process takes time and involves huge learning, and may be uneven across industries.

For example, the Czech Republic has been successful in building new comparative advantage in motor vehicle and motor components production, but its supplier-oriented upgrading strategy failed. There are no Czech-owned companies among the first tier suppliers despite an active policy aimed at 'embedding' MNEs. However, restructuring of second tier suppliers, led partly by foreign first tier suppliers, has been very successful. Similarly, Czech investment initiatives to stimulate the creation of linkages between MNEs and Czech suppliers in the food and electronics and electrotechnics industries have been successful (Chobanova, 2009, p. 130). It has raised the overall standard of domestic suppliers and helped selected companies to become suppliers to MNEs. Although the 1999 supplier development programme focused mainly on electronics and electrotechnics, this did not prevent the food industry association from assuming the *de facto* role of investment agency, and facilitating the preparation of domestic firms for EU accession. The Agro-food Industry Association acted as the major intermediary and facilitated contacts between Czech and foreign food companies and their suppliers. The Association provides specialized technology counselling in the area of agriculture production processing. It was assisted by the Ministry of Agriculture of the Czech Republic, which invested 24 million Euro in providing business incentives, which generated 3 billion Euro of investment (Chobanova, 2009, p. 131). This was enabled by an adjustment programme aimed at the food industry which resulted in compliance with EU requirements in the pre-accession period or firm exit.

Box 1 suggests that Czech FDI policy has been relatively successful in attracting large amounts of FDI, which has either generated or preserved jobs, and is now engaged in a shift towards 'quality', i.e. technology value added or knowledge content. Czech success is due largely (although not exclusively as the case of food industry shows) to its successful FDI agency which has evolved into a development agency. The post-2008 environment has not changed Czech FDI policy priority of high quality FDI. The global financial crisis and vulnerability of growth in CEECs has worked only to re-confirm the need for this policy orientation, which was underway in the Czech Republic - earlier than in other EU-13 countries.

4.3.3 Integrating FDI and innovation policy

Organizational and policy separation of the promotion of innovation and FDI in the EU-13 is a major obstacle to the internationalization of smart specialisation. This organizational and policy deficiency reduces the effects of even the most successful 'entrepreneurial discovery processes' since there are no follow up incentives in place nor institutional structures on which to build. The internationalization of local companies consists mainly of participation in foreign exhibitions and international R&D support through EU funds. Also, EU-13 Embassies and delegation to foreign countries carry out promotion and economic activities in support of domestic companies to help them enter foreign markets and establish business relations. These activities are arranged in a form of business breakfast or cafe, meetings at Embassies or visits. Yet, measures to stimulate strategic subcontracting or participation of the EU-13 firms in GVCs are still weak, although the drivers of growth in the EU-13 are closely linked to export and internationalization.

Support for technologically demanding investment projects with high added value should become a priority. For example, the Czech government has been funding the establishment of technology centres[20] through the Framework Programme for the Support of Technology Centres and Centres of Business Support Services.[21] These Centres are located in important industrial centres with high innovation potential and are a good example to follow.

It seems that the EU-13 have reached limits in terms of the number of MNEs investing in R&D. Further development of such investments is limited mainly by the lack of qualified labour force, low quality of R&D management, low level of cooperation between research institutes and MNEs, and low support for R&D activities in large MNEs. Policy objectives should include strengthening the interaction between FDI and domestic R&D&I policy.

Within this process of integrating FDI and innovation policy the ultimate step is assisting the internationalization of local firms. Again, we would highlight the example of CzechAccelerator 2011-2014, a successful CzechInvest project which has helped develop Czech technology SMEs in foreign markets.[22]

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[20] Technology centres are defined as centres engaged in R&D&I in high-tech products and technologies. There is an expectation that the output of these centres will be transferred to and used in production. Support for technology centres has focused on the following sectors: aerospace, office and computer equipment, electronics and microelectronics, telecommunications and pharmaceuticals, scientific instrument and professional equipment, motor vehicles, industrial electrical machinery, production of chemical products, road transport equipment, engines, turbines and agricultural machinery.

[21] Business support service centres are defined as centres engaged in selected activities with close ties to information technology and with a distinct international focus. ICT developments and implementation centres, high-tech repair centres, shared services centres and data centres are supported via the ICT and Business Support Services Programme. The support is provided in the form of subsidies for business activities, and subsidies for training and retraining.

[22] The aim of the project is the development of managerial experience and activities to commercialize own products, implement business plans and strengthen marketing and managerial skills. Advice is given on how to obtain business angels or venture capital finance. The programme covers the costs of office space, training, seminars, mentoring, participation in specialist events and consultancy services, and provides co-financing for transport and accommodation. The project extends over several cycles and builds on a previous successful pilot phase in the period April 2010 to March 2011 in Silicon Valley in the United States. The project was implemented under the Operational Programme Enterprise and Innovation, 2007-2013 (OPEI), Priority Axis 6 'Business Development Services' programme. As part of this programme, CzechInvest established its Expara business accelerator in Singapore which specializes mainly in ICT,

4.3.4 Developing a strategic approach to the internationalization of R&D

Smart specialisation strategies are often inward oriented in their implementation despite a design related to external opportunities and constraints. This is often because regions/countries do not have the capacities required to develop a strategic approach to internationalization. This is particularly clear in relation to participation in the EU Horizon 2020 activities where there is not a strategic approach to international funding including funding from the EU. In many EU-13 countries there are incentives for individuals to apply to the EU Horizon 2020 projects. However, this has not led always to optimal outcomes since much foreign-funded research is not relevant or involves only limited links with the wider research community. There is a need for a more strategic approach to the internationalization of R&D.

The EU-13 should try to maximize the impact on their domestic and FDI driven innovation systems, of EU and international funding instruments. The level of subsidiarity achieved through national and Horizon 2020 projects appears limited because they are considered two separate channels for raising finance. Also, bilateral co-operation with non-EU countries frequently lacks an underlying or clear strategy for bilateral cooperation. Rather than increasing the funding for international co-operation, these activities should be more firmly rooted in the strategic interests of national innovation systems. This will require a paradigm shift away from providing incentives for high levels of participation in international programmes, towards a more integrated appraisal of the usefulness of international collaboration for the country's overall development. This strategic approach to international cooperation, exploiting opportunities for joint programming and cross-border co-operation, and exploiting the leveraging effects of EU instruments has yet to be developed.

4.3.5 Strengthening and improving horizontal links in the innovation system

Our focus so far has been on either upstream (R&D) or downstream (manufacturing and services) vertical integration. However, Figure 1 shows that smart specialisation activities should be aimed at strengthening vertical links and also enhancing horizontal linkages, or links between upstream R&D and downstream non-R&D activities.

This is not a trivial task since foreign companies' R&D activity is often part of a global strategy and, hence, does not require close cooperation with domestic universities. For example, the international comparison of science industry links undertaken by Technopolis (2011) reveals relatively low intensity of interactions between the science and business sectors. The Czech Republic level is equal to or lower than interaction levels in other CEECs. The Technopolis (2011) study concludes that science-industry links would play a key role in the process of upgrading towards more knowledge intensive activities in the Czech production system. Measures are needed to embed multinationals in local R&D systems. These should include attracting MNEs via the bundling of competencies in research centres, strategic partnerships with universities, tax incentives for traineeships or integration in the organization of industry-oriented PhD programmes. We would expect that as the quality and depth of vertical linkages improves, there will be increased opportunities for stronger horizontal linkages in innovation system. However, the outcomes are not

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biotechnology and life sciences. Since the start of the programme, 26 companies have been involved in the pilot programme in the United States at a cost of 5 million CZK (203,000 Euro). In addition to Singapore, Czech companies are looking to expand to the Zurich Technopark in Switzerland and the Misgav Venture Accelerator in Haifa, Israel.

automatic, and activities such as smart specialisation will be instrumental in identifying potential niches for both vertical and horizontal cooperation.

5. Conclusions

An important assumption related to this Paper is that technology upgrading is highly dependent on whether countries and regions use GVCs and international R&D networks as levers, linkages and mechanisms of learning. The key challenge for smart specialisation is how the local production stage of GVCs may become a building block of regional innovation strategy (Foray, 2014).

This Paper is aimed at contributing to a better understanding of inter-regional and trans-regional cooperation in the EU-13 in the context of smart specialisation. It is obvious from the discussion that internationalization should be the sixth principle of smart specialisation strategies in addition to: (1) the level ('granularity') at which priorities are identified and supported; (2) the entrepreneurial discovery process; (3) the temporary nature of actions; (4) inclusiveness; and (5) the need for continuous evaluation (Foray, 2013). The key feature of this sixth principle is that learning and technology upgrading should follow from intensive international leveraging and linking involving all the relevant actors**.**

Our discussion of policy issues is underpinned by the following 'stylized facts' related to the EU-13 countries' R&D&I activities:

- R&D in the EU-13 is collaborative in nature while growth at firm level is closely related to export, FDI and vertical specialisation;
- both the upstream and downstream parts of the innovation process (both R&D and non-R&D) are deeply internationalized, but also weakly linked;
- a specificity of the EU-13 economies is that much of their innovation activities is non-R&D, and the core of their technology upgrading is about the transition from production to technology capability;
- we have argued that the internationalization of upstream (R&D) activities in EU-13 is much more advanced than the internationalization of downstream and non-R&D activities;
- smart specialisation design emphasizes that internationalization is an important activity; however, within this the emphasis is more on upstream or R&D activities related to Horizon 2020 than downstream activities related to GVCs.

GVCs and MNEs on their own cannot resolve all the issues, but this is not to ignore their linking and leverage potential to improve the R&D&I capacity of the EU-13. Their importance stems from the acknowledgement in international economics that internationalization and innovation are inextricably linked (Altomonte et al., 2013). Finally, GVCs and FDI have been important drivers of productivity growth in the EU-13 and it is difficult to believe that the post-2008 shift in their growth model is based entirely on endogenous resources, knowledge and skills. It is important for small open economies, such as the EU-13, to explore new ways that MNEs and GVCs could be exploited as mechanisms for learning and innovation in EU-13 firms.

Smart specialisation as an ex-ante conditionality for using R&D&I funds represents a historic opportunity to leverage substantial EU Structural Funds enabled by foreign sources of R&D&I, both upstream and downstream in the value chains. Since the EU-13 countries are now fully integrated in EU R&D&I networks, which we have argued, are largely upstream oriented, this Policy Paper focuses especially on downstream linkages and how smart specialisation activities could enable technology upgrading in the EU-13 via GVCs and FDI.

We highlighted three key issues: first, the choice of GVC best suited to regional R&D&I and manufacturing or services capacities. We presented this issue through a taxonomy that combines types of GVC activity with types of regions. We proposed this as a heuristic to frame a problem that requires in-depth and region specific analysis. We argued also that the level at which smart specialisation should be prioritized is not individual business functions, but rather activities or descriptions of technological activities within specific business functions.

Second, we investigated how firms can be assisted to 'climb the ladder' or move from process, to product, and to functional or value chain upgrading. The types of capabilities and external support required for each type of upgrading within the GVCs differ in different types of global value chain or different types of MNE subsidiaries. This issue is illustrated in Table 3, which combines types of upgrading with types of relationships ranging from arm's length to types of value chain relationships and forms of vertical integration via MNEs.

Third, smart specialisation is about discovering new 'ladders' or new production and market uses of existing capabilities, not originally envisaged by either the foreign or local partner. This process involves interaction between GVC lead firm and local supplier, but also is shaped by infrastructural support for R&D&I on which firms can rely.

We considered the inter-regional and transnational dimensions of smart specialisation as integral, and we do not envisage additional steps to those already stipulated in the smart specialisation Guide for RIS3. However, we foresee several additional obstacles to smart specialisation related to choice of GVCs or attracting MNEs, in terms of technology upgrading through GVCs and in discovering new opportunities alongside existing GVCs. These barriers emerge because domestic actors need to interact with the local MNE subsidiaries or GVC subcontractors, which have limited autonomy. Also, their notions of areas providing mutual opportunities may diverge greatly from those of the MNE headquarters and other local actors. A major challenge and source of complexity related to the internationalization of smart specialisation is how to overcome cognitive biases without established institutional systems for interaction and continuous communication with foreign actors, and in the absence of a rich policy environment to provide incentives to foreign actors to consider new options. We investigated these issues in some detail drawing on the example of CzechInvest as a successful strategic investment promotion agency that combines FDI and innovation policy tasks. However, rather than plumping for one particular organizational form that combines FDI and innovation policy issues, we consider it essential to explore the factors that can lead to organizational success in the public promotion of FDI and innovation.

We have considered several major policy areas which are an indispensable part of the policy mix for 'internationalized' smart specialisation. In particular, we highlighted the need to foster demand (as opposed to supply) driven FDI in R&D&I; to focus on the 'quality' of FDI and GVCs; to integrate FDI and innovation policy; to develop a strategic approach to the internationalization of R&D; and to strengthen and improve horizontal links in the innovation system.

In view of the complexity and novelty of this topic we consider this Paper to be primarily an agenda defining rather than resolving the problems. Nevertheless, we hope that our discussion and proposals will advance thinking about the ‘internationalization of smart specialisation’ and lead to further discussion and policy advances.

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