17. What policies, initiatives or programmes can support attracting, embedding and reshaping Global Value Chains in regions?[1]

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Introduction

This paper outlines the regional industrial policies most conducive to Global Value Chain (GVC) reshaping and emergence, on the basis of an analysis of concrete experiences in regions in the OECD countries and outside. It starts by examining the current changes in the competitive context of industries, namely the new phase of globalisation together with the Fourth Industrial Revolution, to outline the implied structural changes most likely in GVCs, and some already occurring. This is useful to define the most appropriate industrial policies at regional level that are confronted with some successful concrete experiences in regions.

Overall, what emerges is that policies should aim at developing productive capabilities as already stressed in the literature, but also networking different specialisations in order to exploit complementarities, both within and outside regions. The governance of the policy process is also important, and has to be participative, and policy coherence is another feature that we stress as essential in times of deep and complex structural changes not only in the economy, but also in the society and culture.

This paper does not identify the policy for building, embedding and reshaping global value chains, in the sense of a set of instruments that can be successfully implemented in any context or more specifically, region. Regions are heterogeneous, and each require a specific set of instruments to

[1] Abridged form OECD and European Commission Project*: Broadening innovation policy: new insights for regions and cities Building, embedding and reshaping global value chains.* The full paper includes case of Italy Emilia-Romagna; Finland, the Lahti region; Norway; Spain, Basque Country; Austria, Styria region; Ireland, software industry. First draft: August 27, 2018.

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Studi organizzativi - Special Issue 2020 - Issn 0391-8769, Issn-e 1972-4969

DOI: 10.3280/SO2020-001-S1019

develop the capabilities necessary for the reshaping of existing GVCs and the emergence of new ones.

We define industrial policy as a policy aimed at favouring structural changes, implementing various sets of instruments (Bianchi and Labory, 2011a, b). Instruments comprise support to investment, access to finance, promotion of export and of innovation, but also instruments aimed at providing the conditions for structural change and industrial development to take place, including the provision of public goods (infrastructure) but also human capital, without which firms do not find the skills they require. It is not about "picking the winner(s)" but about providing the conditions for industrial development (Bianchi and Labory, 2011, 2018a, b).

Various authors have highlighted the importance of industrial policy, particularly in time of deep changes in the competitive context. In times of globalisation and industrial revolution, industrial policy is necessary because it is not only products and processes that are renewed and changed, but also the society, culture and institutions. For this purpose, industrial policy is not about specific subsidies but about a comprehensive set of instruments and actions that a government designs to position a territory in the new global geography of production.

Our interpretation of the changes in the competitive context is what we have called *digital globalisation* (Bianchi and Labory, 2018a), namely a timeless globalisation where flows of data become prominent with respect to flows of goods and tangible capital. The capacity for data collection and analysis becomes key assets for firms and regions, as information and knowledge can be accessed from any place in the world in real time, and networks of individuals and organisations sharing and collectively creating knowledge can operate on a global basis, maintaining rapid communication and constant interaction.Technological changes are however multiple, in different scientific fields and areas, that are often converging, creating opportunities to develop new products and new processes in many different sectors. Any sector can benefit from the new technologies, and any firm in any place, if it has access to knowledge together with absorptive capacity. The latter are in great part determined by the local conditions: the presence of rapid and cheap communication infrastructure, as well as human capital with appropriate skills.

An important characteristic that has to be taken into account for effectiveness is that regional industrial policy should constitute a process, where policy-making aims at promoting specific development paths, providing the conditions (tangible and intangible assets) for the regional ecosystem to evolve in this orientation. The identification of the proper

trajectory for the future is difficult, but it is a political choice. This implies that different possible trajectories have to be contemplated, making choices and preparing for learning and adjustments in case of failure. This process should involve regional stakeholders so as to realise a diagnosis of the regional ecosystem, outlining its strengths and weaknesses, and to choose a development path thanks to a shared vision of future developments.

Policy should indeed try to anticipate changes rather than wait for their realisation and react to them. The main reason is that structural changes take time to be realised, since they arise in the long-term, while once shocks or changes have occurred one has to react quickly. Perfect anticipation is difficult, but a policy process defining a vision and regularly adjusting or revising it according to new knowledge learnt in a dialogue with regional and external stakeholders can help provide the conditions for regional GVCs to upgrade or emerge.

Policy evaluation is important in such a dynamic context, so as to monitor results and learn and adjust instruments accordingly.

The cases analysed in this paper show that such an involvement and dialogue with stakeholders contributes to the success of industrial policy.

The key difficulty in this context is that policy jurisdiction (the region, the territory) is much smaller than the area of action and perspective of the businesses to which the policy is aimed. Hence the importance of policy coherence, particularly between levels of government intervention (local, regional, national and supranational).

This paper is structured as follows. Section 1 examines the changes in the competitive context, namely digital globalisation and its effects on GVCs. Section derives implications for industrial policy and points to the key importance of the regional level. Section 3 outlines four main policy elements for successful regional industrial policy. Section 4 analyses different concrete cases, especially in the Emilia-Romagna (ER) region. The last section concludes.

1. Industrial revolution and transformation of GVCs

Summary: Digital globalisation is the consequence of the ongoing Fourth Industrial Revolution, with new technological system and new production system. Globalisation continues but it is characterised by large growth of data flows, not so much of product flows as in the past decades. As a consequence, GVCs are reshaping and emerging, in ways that have to be further researched, but with a number of clear tendencies: smart

manufacturing makes the strategy of searching for low labour-cost territories less important, while territories with dense knowledge and competencies, supported by appropriate infrastructure and institutions, provide the conditions for GVC reshaping and emergence.

We argue that globalisation has entered a new phase that can be called digital globalisation, mainly as a result of the structural changes induced by the ongoing Fourth Industrial Revolution.

1.1 New technological system

GVCs are deeply transforming in all industries and cannot be analysed without consideration of these structural changes (Bianchi and Labory, 2017, 2018a).

Industrial revolutions are primarily characterised by technological innovations, in many different fields. For instance, the first industrial revolution had water-powered mechanisation processes, Cort's process for the use of iron, while the second industrial revolution had the Bessemer process for making steel, Goodyear's vulcanisation process, the discovery of aniline purple, the first synthetic plastic, etc. All these technological innovations enabled the upgrading of existing products (for instance, the affordable car produced by Ford in the mass production system at the beginning of the second industrial revolution) and the emergence of new industrial sectors (such as electricity generation and distribution, as well as railways, in the second industrial revolution).

Today technological developments are happening in various fields, such as biotechnologies, genomics, new materials, robotics, nanotechnologies, renewable energy, and so on. Often these new technologies converge to produce new products and processes. Examples include the sequencing of human genome, which has opened new opportunities not only in the health sector; the mechanisms with which genes, proteins and enzymes function is better understood and therefore more targeted treatments of diseases are made possible.

Another example regards nanotechnology, which is used in various fields of science such as organic chemistry, molecular biology, energy, environment science, semiconductor physics, food safety, etc. It allows the creation of new materials and devices with a vast range of applications, such as in nanomedicine, nanoelectronics, biomaterials energy production, and consumer products. Industrial applications are numerous, ranging from

the development of new materials to nanostructured solar cells for energy generation.

A key technological development concerns the new and upgraded Icts, allowing everything and person to be connected. They determine the essential infrastructure for economic and social activities today, namely Networks, Connectivity and Digitalisation, as well as Big Data (NCD&BD), since they have both direct and indirect impact on industry, the economy, the society and culture. Their direct impact is the development of new products, from computers to smartphone, smart glasses and so on. Their indirect impact on industry is through smart manufacturing, since they are allowing new production systems, with high automation, as well as new market places, with platforms. Society and culture are also affected since individuals change not only their consuming habits but also their culture with their constant use of smartphones and connected devices.

Artificial intelligence is making rapid and impressive advances thanks to big data analytics in super computers, able to collect and treat enormous amounts of data. "Big data" refers to the spectacular growth of the digital universe, as the society, organisations, and people are increasingly interconnected and "always on".

Data science is another example of technological and scientific convergence. The converging scientific fields making data science are database technology and data mining, machine learning and artificial intelligence, complex system theory and network science, statistics and statistical physics, information retrieval and text mining, natural language processing and applied mathematics.

Applications are numerous, both in the private and in the public sector: goods and services can be better personalised, advertising better targeted; in the public sector, big data can be used to improve the policy process, increase citizens' participation in decisions, empowering citizens more generally.

The field of robotics is also generating many innovations using big data to develop artificial intelligence. As a result, robots' learning and perception improve and these machines are increasingly used in many sectors, including health (assistance to the elderly and the disabled), services (robots assisting in house cleaning, restaurant services, etc.) as well as in production (as most simple tasks in manufacturing are increasingly being performed by robots). Artificial intelligence also derives from converging scientific fields and technologies, namely IT, Mathematics, cognitive sciences, neurobiology and philosophy.

Applications of AI techniques include autonomous vehicles (such as drones and self-driving cars), medical diagnosis, search engines (such as Google search), online assistants (such as Siri), image recognition in photographs, spam filtering, and targeting online advertisements.

1.2 New production system

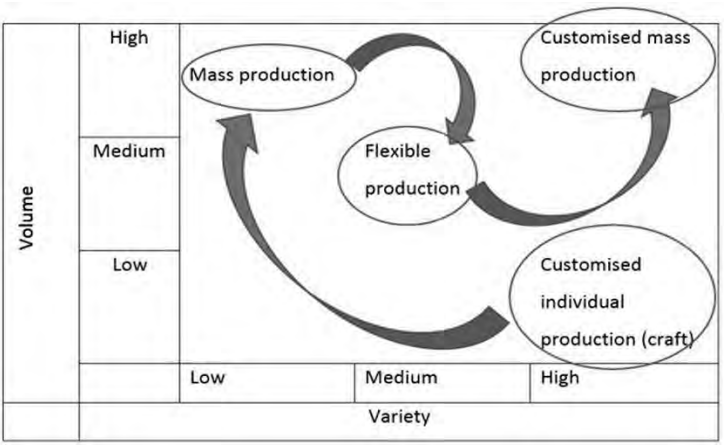
The technological and scientific developments that are in many ways converging are making new production processes possible. Economies of scale are maximised in the factory, thanks to the use of autonomous robots, integrated computational materials engineering (computer models of products and production processes, which can be tested even before their physical creation), digital manufacturing, digital internet and flexible automation. Economies of scope are maximised too, since consumers are also directly connected to the factory, and can send their specific requests on products, which the digital factory processes and produces by sending precise instructions to the connected robots and machines.

A new prevailing production system, or manufacturing regime, thus emerges (Bianchi and Labory, 2017a), characterised by high economies of scale and economies of scope, or mass customisation. In addition, 3D printing is likely to have a deep impact on market competition, since firms will be able to send product specifications anywhere in the world, even in remote places. Smaller firms realising niche products will find it easier to manufacture their products, even in small batches, in any global market, if they can print them even in remote places. The technology may develop as much as making it possible for consumers to print their own products, inducing industrial goods companies to revise their business models.

Each industrial revolution is associated with a particular manufacturing regime. The first industrial revolution was the shift from craft production to the factory system, the second industrial revolution was associated with the mass production system, which had high economies of scale but low economies of scope (low variety of products). The flexible production system, still exploiting high economies of scale but with increasing product variety (hence economies of scope), can be argued to the production system of the third industrial revolution. In the Fourth Industrial Revolution, mass customisation, simultaneously exploiting high economies of scale and of scope, volume combined with variety, prevails (Figure 1).

In the mass customisation system, time to market substantially reduces not only thanks to the flexibility of adjustment described above, but also thanks to more effective and rapid development of prototypes.

Figure 1 – Manufacturing Regimes and Industrial Revolutions



1.3 Consequences for GVCs: GVC reshaping and emergence

In the last decades, offshoring production to low-cost countries appeared as a good strategy to both reduce production costs and access to emerging markets, especially in Asia.

However, offshoring also created costs and disadvantages: quality problems often appeared, and the advantages of having R&D and manufacturing produced in a single place, hence with strong communication, creating externalities and 'industrial commons' in the territory was lost (Bailey and de Propris, 2014). Some managers have argued that offshoring can also lead the whole business to be offshored (Jeff Immelt, see Bianchi and Labory, 2018a, p. 63).

Following digital globalisation, many production chains (or networks) will remain global. However, with smart manufacturing they will take a different form. In principle production can be done in any location, since the digital factory can be replicated anywhere. However, it is also costly to set up, requiring large investments in robots and machines, and appropriate conditions in the territory where it locates: particularly communication

infrastructure, as well as transport and energy infrastructure, but also skills. The digital factory can take order from consumers located anywhere in the world, provided they are connected. It can rapidly produce large amounts of very differentiated goods. How much the digital factory will be replicated in different markets in the world will depend on demand and production capacity of single factories, and transport costs.

It is likely that simple assembly tasks will be integrated in the digital factory, making the strategy of locating assembly in low-labour cost countries less convenient. However, production may require peculiar parts and components, that are better produced by specialised firms. Insertion in GVCs will still be an important strategy for the latter type of firms.

The key assets for firms become its knowledge base, its technologies, experiences, together with its capacity to identify market trends, consumers' tastes, and its capacity to innovate, to renew products and services. The necessary knowledge base becomes enormous, made of data on the different markets, the different tastes and needs of consumers in different parts of the world, as well as the new technologies, the behaviour of rivals and firms in other markets: being able to gather and analyse these data is a key asset for firms to be able to provide the right products to the right consumers, and in real time.

The digitalisation of the different phases of production processes favours the organisation of production on a global scale, by distributing production phases in different countries, exploiting each country's comparative advantages, together with a strong unity in data sharing, codification, management lines and long-term strategies.

Industrial organisation is likely to become more varied, according to sectors' characteristics (product, demand, technology etc.). As robots and machines connected via the Internet diffuse, many firms will stop looking for low cost labour in developing countries, so that reshoring might be observed, especially when distance decreases dynamic efficiency.

Unless developing countries develop capacity for pre and post manufacturing phases. China is a country where many multinationals have set up manufacturing divisions in order to exploit low labour costs. Not only are these costs progressively increasing, as the Chinese economy develops, but also the country is realising massive investments in new technologies, infrastructure and innovation capacity. Territories only relying on low labour costs are likely to have very limited development prospects. In fact, some authors have stressed that many firms investing in China have obtained greater benefits than low-cost labour. For instance, Nahm and Steinfeld (2014) argue that US and European innovators of wind

and solar energy technologies have found in China the manufacturing capabilities that they miss in their home country. More precisely, Chinese engineers were able to develop manufacturing processes for the ideas in a both rapid and efficient manner. This innovative manufacturing capability therefore appears to be a distinctive competence and competitive advantage, also exploited by Japanese producers in the motorcycle industry (Ge and Fijumoto, 2004). It is also a key competence in this stage of the Fourth Industrial Revolution, in order to transform scientific discoveries into new products and technologies.

Production organisation is already experiencing important changes. In particular, companies focus on high phases of the production process, namely and pre and post manufacturing. Manufacturing is increasingly performed by robots in smart factories, that can be located anywhere, provided there is access to energy, high capacity Internet and materials (McKinsey, 2015). Territories able to pool and develop key resources for pre and post-manufacturing phases will attract firms, which will be willing to locate their most value-creating activities in these areas if they have access to infrastructure, especially for high and rapid communication, as well as low energy costs, and also innovative capacity, with highly qualified human capital and appropriate research facilities, namely hubs of knowledge creation, consisting in dense networks of universities, research centres, and other. In this manner, ensuring the availability of R&D capabilities is very important.

Investment in skills is also important because the most value-creating phases of production processes are those most intensive in skills. Firms are likely to localise therefore in territories with dense knowledge bases (manufacturing experience and R&D capabilities) and high skills, at medium to high levels. This means that governments have an important role to play in attracting and developing skills, ensuring a good living environment (territories paying attention to the environment and with social services) for attraction of talents, and institutional density: good education institutions networked with other institutions, as well as with businesses and other stakeholders, to provide an appropriate *milieu* or fertile ground for learning, innovations and industrial applications to emerge.

Market interactions also change in the new production system. As already mentioned, consumers can directly interact with the factory system to ask for products with specific characteristics. There are also interactions between consumers, on online platforms, to share experience with products. In this context, the service content of products becomes more valuable. For example, consumers buy cars for the service a car provides, allowing to

move across places, to transport heavy objects, and so on. Ownership of the car itself tends to be less important, as shown by the booming of car sharing services. The same is true for books, which many consumers buy and read online or on their electronic device, so that the tangible value of the book reduces relative to the intangible one.

To some extent, leading companies offer integrated solutions rather than specific products[2].

For this purpose, production processes are no longer linear processes where phases are sequentially performed but instant processes, whereby the smart manufacturing system captures the requests of consumers and provide answers in real time. The interaction between the producer and the consumer is no longer only based on the market transaction and is much more frequent, since firms can create and maintain communities of consumers who are kept loyal thanks to the proposal of updates, different versions, and targeted advertisement made possible by big data analytics.

Big data are the strategic assets of companies: in the online community they collect data on consumers, on their preferences, past choices and purchases, which become even richer if these data can be matched with data on other choices made by these consumers, in their travels, leisure activities, purchase of other products. The companies that collect such rich sets of big data, such as Google or Amazon, namely pure platform businesses, have large market power, and have become key market intermediaries, selling an ever-increasing range of products on their online platform[3].

The role of territories in the Fourth Industrial Revolution also lies there: a territory providing the appropriate infrastructure for the building of smart factories will attract businesses and will grow. This means having broad band, fast and high-capacity communication infrastructure; strong research and scientific capacity, in public and private research centres and universities, with which business can integrate to build the capacity to answer consumers' needs in real time; human capital, namely data scientists, engineers in various fields, as well as technicians, that can set up and work in the smart factories. As argued by Bianchi and Labory (2018a), a characteristic of the Fourth Industrial Revolution is the integration between science and technology: these two fields were separate during the first industrial revolution, since technological developments arose without a

[2] The management literature calls this "servitization" (Kowalkowski *et al.*, 2017).

[3] The power of algorithm is discussed in Bianchi P., Labory S. (2018). Chapter 4.

scientific base; from the second industrial revolution science and technology increasingly interact.

Digital globalisation may offer new opportunities for peripheral regions, provided they invest in infrastructure, particularly communication (Bianchi and Labory, 2017b). The latter regions may attract leaders and insert in GVCs if they develop specific capabilities in industrial activities; or they may specialise in specific intermediary or final products and services, on the basis of specific competencies, which might be linked to the territory (e.g. environment favouring the production of particular agrofood products, or cultural heritage favouring tourism) or to human capital (specific knowledge and competencies accumulated through time, helped by the education system, e.g. in fashion industry like in Tuscany in Italy, or software industry in Dublin). These firms can interact with consumers located anywhere in the world, provided they have knowledge and competencies required to develop their own platform or to use existing platforms. Whatever their size however, firms have to develop capabilities to interact with numerous actors, not only consumers but also other firms (suppliers, producers with which they can develop complementarities in product research and development) and institutions (research and education in particular). Firms' main assets are no longer their realised products and physical capital (the work done in the words of Smith, 1776), but their capability to collect and treat information, interact and create knowledge, so as to be able to adapt to the market (the *work to be done* according to Smith, 1776).

The policy implication is that regional industrial policy should focus on the work to be done. Using extreme stylisation we can claim that old industrial policies acted on the conditions for static competition in order to attract work done (with single actions such as subsidies, specific regulation), namely single production plants. In contrast, the new industrial policies act on the conditions for dynamic competition in order to favour the work to be done, namely the management and creative functions which govern the whole production process and the most strategic phases, pre and post manufacturing. For this purpose, it is necessary to create a smart and competent context, where knowledge is not only individually generated and acquired, but also collectively shared and transferred. This requires institutional-building, namely the construction of an educative and research infrastructure that could generate positive externalities for the growth of each part of the community, be they persons, firms and institutions, and that could generate and consolidate the systemic capacities that favour

innovation and development. The case of the Emilia-Romagna region below illustrates this type of policy.

However, more research is needed on how digital globalisation is likely to impact on GVCs and industrial organisation more generally, analysing different firms in various sectors.

2. Policies for the new GVCs: policies for industrial development (in a broad sense)

Summary: Given the attractiveness of territories that are hubs of knowledge and competencies, regional industrial policy becomes paramount to favour the reshaping and emergence of GVCs. This policy consists in sets of actions aimed at favouring structural changes, by overcoming a number of barriers to the emergence and reshaping of GVCs: skill deficit, lack of investment, lack of innovation and networking capacity.

2.1 Industrial development and territories in the era of digital globalisation

Digital globalisation, or globalisation together with the Fourth Industrial Revolution, have important consequences for industrial development in territories.

First, *manufacturing is again a key activity* for countries' – and territories' – growth and development, mainly because manufacturing integrates with services: the service of part of products increases, as outlined in the previous section. In addition, the Fourth Industrial Revolution is also characterised by a growing integration between science and production, and firms' relationships with research centres and universities become more numerous and dense, in open knowledge innovation models, which also rely on services to function.

The growth of services has been driven by the Fourth Industrial Revolution, with its first phase of rapid and impressive development of Icts, allowing the boom of new sectors and the changes of existing sectors, which could transform organisation and products thanks to the use of these new technologies.

Second, *territories have to become hubs of knowledge and competencies*, able to transform these knowledge and competencies into

productive capacity, in order to attract firms and to be part of global networks of R&D and production and attract high-value phases of production. The institutional density of territories or institutional thickness in the words of Amin and Thrift (1994) is again crucial for industrial development.

What policy instruments are necessary for this? Instruments must act on all the dimensions of the territorial ecosystem: firms' assets and capabilities (knowledge, R&D capacity, human capital, access to finance), infrastructure (transport, public goods, and communication infrastructure which is crucial in the Fourth Industrial Revolution), but also society and territory: territorial planning to ensure good living conditions and smooth realisation of industrial activities, thanks to well-functioning institutions and infrastructure, and good living environment, possibly sustainable, so as to attract and keep human capital; social policy is also necessary, to ensure participation of the labour force, decent jobs and decent income, access to education and training. As already stressed, strengthening territorial identity through various actions including territorial marketing might be useful. This can be based on the valorisation of specific knowledge and competencies present in the region, such as industrial capabilities (mechanical engineering in the Emilia Romagna region, valorised through the creation of museums of some important firms like Ferrari and Ducati, as well as specific technical schools linked with firms). The valorisation of the quality of land and nature, or historical heritage can be useful when products are associated with them (agriculture and food, craftsmanship, tourism).

When knowledge access and exchange are key for economic development local societies and communities must have networking capabilities, because a society with strong interaction and absorptive capacity favours knowledge exchange and creation. In other words, the higher the social capital, the better.

Policy has to be pro-active: policy-makers have to try an anticipate changes, rather than wait for changes to take place and adapt. Adaptation to shock and structural changes is necessary but policy has to try and anticipate changes in order to prepare the territory for structural changes in desirable directions.

Third, *regional industrial policy* is the most important policy to implement, coherently in the multi-level governance framework.

When the whole economic system is changing, Industrial policy is not only justified by market failures. The latter have to be corrected with appropriate instruments. However, these corrections should be integrated in

a vision, a strategy of industrial development so that all instruments used, namely those correcting market failures and those promoting structural changes, combine to embark the socio-economic system on specific development paths. Otherwise policy is fragmented, acting in different parts of the socio-economic system in often inconsistent ways, with a strong separation of policies, such as trade, innovation, competition, education and social policies, making it difficult to orientate industrial and economic development.

Structural changes arise in the long-term, through trial and error processes, characterised by high uncertainty and unpredictability, so that industrial policy has to be a process, characterised by learning and adjustment: sets of instruments are implemented, assessed after a while and adjusted in accordance with the realised effects. For this purpose, participative governance as mentioned above makes is more likely to contribute to the effectiveness of policy.

The organisation of industry as global networks of local industrial systems implies that industrial development primarily starts at local level. We will argue here that policy has a role in spurring industrial development at local level, and that the relevant local level is the regional one.

The "local" level, or the territory, indeed has to be defined: does it mean the level of a city, an urban area or a region? The industrial system is embedded in a territory, which width and frontiers vary. The industrial system embeds in a territory where there is a strong sense of identity. In the territory, the effects of history and institutions are fundamental.

We have argued above about the important role of attraction that territories have to play in the globalised industrial system, namely when firms organise production on a global scale. Institutional thickness (Amin and Thrift, 1994) favours the development of the territory as an actor in the globalisation process of the economy. This institutional thickness has tended to be taken for granted at local level, as for instance in the literature on industrial districts where it was argued that the social capital resulting from the cohesive local community was simply there for the firms in the district to take advantage of. However, institutions are also influenced by policy action, and regarding districts the national laws favouring SMEs and entrepreneurship as well as the strong focus on social policies in a region such as Emilia-Romagna certainly contributed to develop this institutional thickness.

Nowadays the challenge is that products are more knowledge-intensive and the creation of the necessary knowledge base for product creation and development requires an intense exchange in complex networks of the firm

and other firms, other institutions such as universities, in the region and in the rest of the country, and abroad. Globalisation also involves large migration flows and many territories have experienced massive arrivals of immigrants who have to be integrated to the local community. In the Emilia-Romagna region in Italy, the action of the government in this direction starts with the schools, where specific programmes for the integration of immigrants' children have been implemented.

The territory is then not so much a specific area where resources have to be optimally allocated, but rather an area where agents interact through the institutions and in so doing generate the necessary resources for development.

The next section defines the regional industrial policy for GVC reshaping and emergence in more details, particularly the barriers that this policy should address.

2.1.1 Policies favouring the reshaping and emergence of GVCs

The previous section highlighted that regional industrial policy should aim at making regions hubs of knowledge and competencies, making capabilities, favouring the combinations, the complementarities on which firms can base their distinctive competencies and the attractiveness of their products and services.

There are *market barriers to the reshaping and emergence of GVCs*. Some of these barriers are well-known and have been addressed in innovation policies in the past: skill deficit, lack of investment and lack of innovation capacity. The latter aspects have been widely stressed in the literature (Economics of innovation, economic geography etc.) and considered in innovation policy-making.

We stress another important barrier, the lack of networking capacity, which is key in order to search for and exploit complementarities between regional firms, between regional firms and other institutions, such as universities, both within the territory and outside. Networking has been stressed in the field of evolutionary theory, in the concept of innovation systems, which have been analysed first at national level but also later (and since Phil Cooke in the 1990s) at regional level.

GVC reshaping means the production of new products and/or processes, of higher quality or different variety. The production of the past might be transformed so that there is branching into a new activity. This requires the creation or the adoption of new knowledge, sometimes the adoption also of

new technologies. Production processes are likely to be altered so that organisational changes occur. New logistics might be involved, as well as new markets. GVC reshaping therefore generally require new transport and communication infrastructure, or investment to upgrade the existing one. Investment in tangible and intangible capital is necessary to support this reshaping. The new activities require new, different skills, that can be provided by re-training or attraction of new talents.

Similarly, GVC emergence requires new knowledge, innovation, as well as appropriate infrastructure and skills. It might arise through spinoffs of existing industrial or research activities in the region, or it might be imported through FDI in the region. R&D capacity is needed, appropriate skills and infrastructure.

If these investments are not made, GVC reshaping or emergence will not occur. The lack of investment might be due to a difficulty for firms to access to finance, which can be overcome by appropriate policy instruments, such as support to the development of capital markets, venture capital, or specific guarantees to banks providing loans to enterprises.

Hence there might be barriers to GVC reshaping and emergence, mainly:

1. skill deficit;
2. lack of investment;
3. lack of innovation capacity;
4. networking capacity.

The importance of relationships has been widely stressed in the literature, at both theoretical and empirical level, but mainly regarding innovation, and particularly the links between the firm and universities and research centres (see the vast literature on U-I links, e.g. the review by Perkmann *et al*., 2013). The importance of adopting open innovation models for firms has also been widely discussed since the work by Chesbrough (2003).

Regional governments can have a role on favouring the setting up of relationships of the regional firms within the region and outside, as shown by the ER region case below. For this purpose, instruments or actions supporting networking have to be implemented. The regional government can help in the prospection of potential links, by strategically choosing and establishing partnerships with external regions, taking part in international programmes such as Interreg in the European Union. In addition, the organisation of events such as international trade or research fairs, inviting enterprises with complementary activities to those of the regional firms, can

be undertaken or supported by the regional government, or by an agency or organisation specifically created to take the responsibility for this prospection (the role of Aster in the ER region).

3. Key policy elements that emerge from the cases

Summary: The regional industrial policy cases analysed for this paper, together with the analysis of the changing competitive context characterised by digital globalisation leads us to outline four main policy elements for GVC reshaping and emergence. First, developing capabilities for industrial development, namely appropriate skills, infrastructure, knowledge base; second, enhancing networking in order to exploit complementarities, within and outside the regional industrial system; third, policy governance should be participative; and fourth, policy coherence, between government levels but also between policy fields should be ensured.

Both the cases and the arguments in the first sections highlight four main elements of regional industrial policy for GVC reshaping and emergence: capabilities to develop regional knowledge and competencies, networking for complementarities, governance and policy coherence. These elements are examined below.

3.1 Capabilities

Capabilities, namely knowledge and competencies, human capital and research capacity, as well as appropriate infrastructure and institutions, are essential for GVC reshaping and emergence, insertion in GVCs without vulnerability, or leading GVCs.

Beyond basic education generally provided at national level in national education systems, GVC reshaping and emergence require new skills that can only be provided by specific training and education programmes set up at regional level. Thus, for instance, the ER region has created new technical and high-technical institutes to provide specific skills needed by the regional industry; in Styria too, the regional government dialogued with businesses and education institutions to favour the adaptation of the regional human capital to the new industrial activities. Similarly, tertiary education was developed in Shenzhen to allow the upgrading of indigenous

industry, and in Ireland the availability of appropriate skills was essential for the software industry to develop.

3.2 Networking for building complementarities

Policy actions aimed at favouring networking within and outside the region appear to be essential. Within the region, they allow to exchange knowledge and competencies for higher knowledge creation and transformation of innovation into industrial applications and commercial success.

The literature on innovation systems has long stressed the importance of both intra- and inter-regional networks for innovation and the development of new specialisations in. Most innovative – learning – regions are generally those with most external collaborations: Baden-Württemberg has an open and international network focused on Northern Europe and the US; outside Europe California is a leading hub in the global network, also collaborating with regions in emerging countries such as India and China.

Bathelt *et al*. (2004) also showed that intra-regional cooperation without interregional links can bring lower innovative performance (in the context of clusters). In fact, both an appropriate local network (innovative *milieu*, and external links are essential to knowledge exchange and creation by providing access to new knowledge and technologies. However, there is also evidence that external links may hinder regional innovation especially when the local industrial structure mainly consists in SMEs.

Boschma (2014) and Boschma and Iammarino (2009) stress that connecting both within and outside the region might be a key asset for regional innovation and development, only however if the external knowledge is related to the regional sectors. Absorptive capacity is also important for extra-regional links to generate positive effects (Cohen and Levinthal, 1990). The industrial policy implemented in the Basque region paid attention to this aspect in order to favour GVC reshaping.

This networking arises at all levels: between businesses, administrations, universities and research centres, and across different types of institutions. It enables the identification of competencies and potential cross-fertilisations, across sectors and across institutions, such as for instance between research institutions and businesses.

Facilitators, such as Aster in the ER region or ACStyria in Austria, can have a very positive role in favouring the emergence and in exploiting the complementarities between the economic activities of the region.

Facilitators favour networking and can also have a role in the identification of complementarities not only between regional stakeholders but also between regional stakeholders and external organisations (businesses, universities or research centres outside the region or abroad).

External links can be particularly important when the regional industry lacks a critical mass to become a hub of knowledge and competencies sufficient to attract GVCs or to be a basis local firms to set up their own GVCs. More generally, some firms in any type of region may incur high R&D costs, especially in times of industrial revolution where technological changes are outstanding. Especially developing prototypes at the industrial application phase of research might be extremely costly. Hence finding partners in other regions might be profitable in order to share these high sunk costs. This is the rationale for the collaborative projects in the Vanguard Initiative. Collaboration is built at the level of individuals, who have diverse jobs, diverse organisational cultures, according to whether they work in public or private organisations for instance; they have varied knowledge and competencies, which require a learning process in order to be able to communicate. Calamel *et al*. (2011) showed the importance of policy attention to the construction of collaboration. For this purpose, attention to the building and strengthening of social capital, as in the ER region appears to be essential.

Without this networking regional industrial policy is likely to fail. For exemple, a regional policy to develop the logistic sector in Bremen in Germany, namely the "Innovision 2010" programme, failed because not enough attention was put on the creation of relationships and interactions between firms.

The search for complementarities can be implemented through the definition of platforms, defined around specific technologies (general-purpose technologies or knowledge-enabling technologies).

Examples of complementarities exploited through platforms abound. A platform policy implemented in Linköping in Sweden, where the Saab military technology was transformed into biomedical technology in the Berzelius science park. Asheim *et al*. (2006) showed the case of Preseli in Wales, where a platform based on tourism was defined, allowing the development of quality tourism linked to the Neolithic heritage existing in the region, but also to quality food and artistic and cultural production that led to the development of textile sustainable agriculture and biofuel productions in the region.

The ways in which external links matter for GVC reshaping and emergence is summarised in Table 1.

Table 1 – Importance of external links

POLICY ACTIONS	EXAMPLES
ATTRACTING EXTERNAL FIRMS TO THE REGION	
Relocating firms within the country	• Swedish regions show that the relocation of Swedish Ict firms to the lagging region of Blekinge (old industrial region) has led to the development of a dynamic Ict cluster there in the ’90s. • Southern Italy after WWII: State-owned firms where induced to create divisions in this region, but they tended to create cathedral in the desert, due to a lack of development of general capabilities, as well as institutional failure
Attraction of foreign firms (FDI)	• Software industry in Ireland. • Agder region in Norway to develop the oil sector. • Styria, Emilia-Romagna. • Shenzhen. • Condition for success is development of autonomous capabilities. • Otherwise regions might become locked-in external networks and external firms do not embed or anchor in the region.
Attracting human capital, individual actors	• The arrival of members of the creative class such as scientists, artists, designers etc., namely talented people can help the development of the region, if it is open, diverse and tolerant. • The development of Ict industries in Asia has often been triggered by returnees that had studied and initiated activity in other countries. • There is a positive impact of transnational entrepreneurship on the institutional environment of less developed regions.

Table 1 – From previous page

POLICY ACTIONS	EXAMPLES
BUILDING EXTERNAL INKAGES	
	• There are different knowledge sourcing mechanisms depending on the degree of formalisation (market links, research collaborations or informal links) and interactive learning that takes place. • Boschma and Iammarino (2009) show that trade linkages may favour the exploitation of related variety, with a positive impact on regional growth. • Linkages among actors based on social or cognitive proximity may also play a role, such as for instance the relationships between former colleagues, exchange of knowledge in conferences and trade fair. • The following results are noticed on role of external links according to type of RIS: - organizationally thick and diversified RIS: low need for external knowledge, high attraction of external knowledge; - organizationally thick and specialised RIS: high need, low attractiveness; - thin RIS: high need, low attractiveness.

3.3 Governance

As already stressed, policy-makers must have a capacity to understand the evolution of the regional ecosystem and identify the possible evolutionary trajectories. This is not easy, but a dialogue with stakeholders of all sides (firms, workers, education institutions, research institutions, etc.) appears to be useful to obtain information and make appropriate choices: this kind of participative governance process was adopted in regions such as Emilia Romagna and Styria. In addition, being directly involved, stakeholders are more likely to mobilise towards the aim of the policy, so that they make decisions accordingly, and policy effectiveness can be higher.

Such participative governance processes have been outlined as essential for the success of policies in the case of resilience to shocks like disasters or economic crisis (Bristow and Healy, 2014a, b, on regional resilience; Alexander, 2010; Özerdem and Jacoby, 2006, on resilience to disasters). Adapting to an industrial revolution certainly requires regional economies to be resilient, and industrial policy implemented to favour such adaptation is in fact a policy for resilience. The complexity of changes involved in these deep structural changes make dialogue with stakeholders and shared vision more likely to favour an effective adaptation of the regional industry and of the whole socioeconomic system. The examples provided in Section 4 also confirm this point.

Good governance has been stressed as a key factor for the effectiveness of policies in general (OECD, 2006, 2012).

In addition, regions are inserted in multi-level governance systems, with other policy levels both above (national and supranational) and below (local systems, cities). The coherence of policy between the different policy levels is important. For instance, the actions adopted at local level should be coherent with the regional industrial policy, favouring the development of capabilities at local level. In addition, the actions at higher levels should be coherent too, in order to strengthen the industrial paths initiated at regional level. Thus, national education and research systems should be designed and adapted to the emerging competitive context and business needs. Actions at national level should also favour the identification and exploitation of complementarities between the knowledge and competencies of the different regions.

Especially in times of industrial revolution, the regulatory framework generally has to be changed: new jobs emerge, new technologies and industrial sectors, that might require new regulation. For instance nowadays the issues of privacy and preservation of personnel data on online platform has been subject to new regulation (European Directive entered into force in May 2018), and antitrust authorities are controlling the competitive behaviour of online platforms (cases of Google, Facebook in the EU).

Policy coherence is also important between the different areas of policy: human capital, social and labour policies, trade and innovation policies, fiscal and monetary policies, etc., as stressed in the next section.

3.4 Policy coherence

The different cases analysed above also show that policy coherence is important for GVCs to reshape and emerge. Thus, the ER region has undertaken a joint definition and coherent implementation of labour, social, innovation, environment and trade policies. All policy actions have to work in the same direction, namely the aim of strengthening a development path or embarking on a new path. For instance, social policy favours both the participation of all the regional community in the development process and the enhancement of social capital, which is the basis for networking; human capital policy develop the skills while territorial and environment policies favour functioning infrastructure and institutions, and sustainable living and working environment for the attraction of talents and industrial activities.

Overall, the main instruments for the promotion of GVC reshaping and emergence can be summarised in the following table (Table 2).

Table 2 – Instruments for the Promotion of Emergence and Reshaping of GVCs

OBJECTIVES	INSTRUMENTS
CAPABILITIES	
Investment in R&D	• Support to private R&D • Public R&D • Support to patenting • Support to internationalisation and participation in international research projects for universities • Creation of R&D labs, R&D facilities
Infrastructure	• Communication, adapting to the needs created by the transition of manufacturing regimes (4G and 5G connections, big data etc.) • Energy: development of renewable energy sources, actions to minimise energy costs compatibly with sustainability • Transport: renew transport infrastructure in sustainable manner • Environment: develop protection and preservation, preparation to disasters linked to climate change
Improvement in the capacity of regional firms inserted as suppliers in GVCs	• Support to SMEs • Brokering and platforms between suppliers and buyers • Technological standards

Table 2 – From previous page

OBJECTIVES	INSTRUMENTS
CAPABILITIES	
Human capital: skills	• Specialised training on-the-job and in universities. • Partnership between groups of firms and education institutions. • Training opportunities for talents coming from outside the region.
Support to high value-added production phases (R&D and commercialisation)	• Access to GPTs and KETs - Financing of joint research projects between firms and universities and research centres. - Other instruments for technological transfer: spinoffs, mobility of university students and researchers in firms and so on. - Events (conferences, seminars) on the new technologies and their potential applications. - Diffusion of information at regional level on the knowledge and competencies present in the region (and outside). - Expert groups with knowledge of the strengths and weaknesses of regional industries aimed at identifying potential complementarities. - Development/attraction of strategic sectors: strategic in the value chains (e.g. key input) or strategic due to cross-fertilisation with many sectors (e.g. creative and cultural industries). - SME policy (favour growth, groups; specific instruments to favour their access to finance and tangible/intangible resources).
Commercialisation	• Development of demo cases as in Vanguard. • Support to the financing of prototypes resulting from collaborative R&D projects • Technological transfer programmes. • IPR law.
Access to financial resources	• Consulting on financial operations. • Public guarantee. • Attraction of venture capital.

Table 2 – From previous page

OBJECTIVES	INSTRUMENTS
NETWORKING	
Search for complementarities	• Maps of industrial and service activities, competencies and knowledge. • Maps of competencies and knowledge base of universities and research/technical centres. • Use of coordinators (expert groups) to identify potential complementarities. • Collaborative projects between firms, between firms and universities. • Promote clusters and sectoral/inter-sectoral platforms.
Networking	• Facilitators: private or public agency, consortium between regional main stakeholders, that prospect potential complementarities and facilitate their exploitation, by organising conferences, seminars or forums, specific collaborative projects, information exchange and training programmes to raise absorptive capacity. • Financial incentives to the creation of relationships. • Financing of collaborative projects.
External linkages	• Attraction of external firms. • Assistance to investors arriving in the region. • Information on the global market. • Partner search. • Support to relationships in the value chain. • Export promotion. • Participation in Interreg projects (EU). • Macro-regions as forums for knowledge exchange with a view to identify and exploit complementarities. • Specific initiatives of associations of regions like Vanguard.
GOVERNANCE	
	• Involvement of regional stakeholders in definition and implementation of policy. • Learning and adaptation in the policy process. • Monitoring and evaluation.
POLICY COHERENCE	
	• Mobilise all policies: act on all parts of the socio-economic system. • Joint definition of actions in the different policy areas to ensure coherence

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