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Local innovation and global value chains in developing countries

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Local Innovation and Global Value Chains in Developing Countries

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Abstract

The GVC approach has stressed that inter-firm linkages within GVCs can play a crucial role in transferring technological knowledge and promoting innovation. However, the exact nature of these GVC inter-firms relationships, and their impact on the learning and innovative processes of firms involved in such GVCs in developing countries is still controversial and rather understudied. In this paper we argue that to investigate whether and how firms involved in GVCs (as well as industrial clusters, regions and countries) innovate, scholars should not focus entirely on GVC characteristics and the role of lead firms, but they also should take into account domestic technological capabilities at the firm, industrial cluster/regional and local innovation system-levels. In this study we undertake a systematic review of the literature on GVCs in developing countries to investigate if and how innovation has been undertaken at the local level. With cluster analysis, we have identified three types of GVCs, defined as (a) *GVC-led Innovators*, consisting of innovative local firms, which intensively use knowledge sources from within the GVC; (b) *Independent Innovators* also consisting of innovative firms, but whose learning sources mainly come from outside the GVC; c) *Weak Innovators*, including a large group of scarcely innovative firms, drawing selectively on some of the knowledge sources available within the GVC but poorly using other forms of learning.

Key words: Local Innovation, Upgrading, Global Value Chains, Developing Countries.

JEL Codes: O14, O19, O33, O38

1. Introduction

Innovation is crucial for economic growth and sustainable economic development. An open question for developing countries is how to innovate and improve their competitive position in an increasingly globalized world – provided that many developing countries are still characterized by shortage of human skills, capitals, technological capabilities, and proper institutional and business environments. Given their weak indigenous technological resources and capabilities, the importance of learning from advanced countries has been widely emphasized for a long time (Hobday, 1995; Lall, 1996). Scholars have shown that firms can learn through many channels: through technology licensing, reverse engineering, labor mobility, and through information and knowledge exchanges with suppliers and buyers, learning by exporting and foreign direct investment (FDI) spillover (Barba Navaretti and Venables, 2004).

More recently, development scholars have put emphasis on the capacity of developing countries to learn through their firms' insertion in Global Value Chains (GVC),¹ in which intermediate goods and services are traded in fragmented and internationally dispersed production processes. The organization of production in the form of GVCs has become diffused as firms in advanced countries have tried to become more flexible and reduce their production costs, and have therefore started to coordinate cross-border networks of affiliates, contractual partners and arm's-length suppliers. This phenomenon is growing and UNCTAD (2013) estimates that GVCs coordinated by large multinational firms account for some 80 per cent of global trade.

The GVC approach has stressed that inter-firm linkages within GVCs can play a crucial role also in transferring technological knowledge and promoting innovation (Gereffi, 1999; Giuliani et al, 2005; Pietrobelli and Rabellotti, 2011). However, the exact nature of these GVC inter-firms relationships, and their impact on the learning and innovative processes of developing countries' firms involved in such GVCs is still controversial and rather understudied.

In the GVC literature there is a general positive expectation that firms coordinating the GVC (i.e. the lead firms) produce a positive impact on suppliers by transferring them valuable knowledge to compete in global end-markets (Gereffi, 1999; Gereffi et al, 2005; Sturgeon et al, 2008). Indeed, it is expected that for small firms in developing countries, the participation in GVCs is probably one of the few opportunities they have to both obtain information about the type and quality of products demanded by consumers in global markets, and to actually gain access to those markets. What role the GVC lead firms do play in fostering and supporting this process, however, depends on the

¹ GVCs are defined as the full range of activities that are required to bring a product from its conception, through its design, its sourced raw materials and intermediate inputs, its marketing, its distribution and its support to the final consumer (<http://www.globalvaluechains.org> provides a synthetic and clear presentation of the concept).

governance patterns and power relations characterizing the GVC. The main focus of the GVC literature is exploring this question (Gereffi et al, 2005; Giuliani *et al.*, 2005).

However, other strands of research suggests that, to investigate whether and how firms involved in GVCs (as well as industrial clusters, regions and countries) innovate, scholars should not focus entirely on GVC characteristics and the role of lead firms, but they *also* should take into account domestic technological capabilities at the firm- (Morrison et al., 2008), industrial cluster/regional- (Pietrobelli and Rabellotti, 2007) and local innovation system-levels (Pietrobelli and Rabellotti, 2011).

In this study we undertake a systematic review of the literature on GVCs in developing countries to investigate if and how innovation has been undertaken at the local level. In our review of the selected articles, we have searched for empirical evidence on: a) innovation taking place at the local level in developing countries (who innovates, what forms of innovation etc.) and b) the most significant learning mechanisms – which include GVC learning sources (e.g. technology transfer from lead firms), as well as learning sources internal to the firms and coming from non-GVC actors (e.g. local universities). We have codified this information into a quantitative dataset and we have then performed a cluster analysis to identify GVC typologies using as clustering variables their innovative and learning behaviors (points a and b above). Based on this statistical analysis, we identified three types of GVCs, which we have defined as (a) *GVC-led Innovators*, consisting of innovative local firms, which intensively use knowledge sources from within the GVC; b) *Independent Innovators* also consisting of innovative firms, but whose learning sources mainly come from outside the GVC; c) *Weak Innovators*, including a large group of scarcely innovative firms, drawing selectively on some of the knowledge sources available within the GVC but poorly using other forms of learning. We have then investigated the existence of a relationship between the three GVC types and their patterns of governance (e.g. market, modular, relational, captive and hierarchy as defined in Gereffi et al, 2005). Finally, we have explored the way in which local firms, industries, clusters or regions involved in the different GVC typologies introduced above engage in upgrading processes, broadly defined, including all activities that offer developing countries' firms a "better deal" (Ponte and Ewert, 2009).

The paper is structured as follows. In the next section we present the methodology of the literature survey and provide details about what information has been searched and codified in the different GVC cases taken into account in the analysis. Section 3 discusses the different governance patterns found in the investigated GVCs. Section 4 gives an overview about the various forms of local innovation encountered in the cases under analysis. Section 5 describes the main learning

mechanisms at the basis of the local innovation processes, introducing the distinction between within and outside the GVC mechanisms. Section 6 presents the results of the cluster analysis introducing the GVC typology. Section 7 discusses upgrading and Section 8 concludes providing policy implications.

2. Methodology

The paper is based on secondary information collected through a survey on the existing literature about GVC in developing countries. Our search strategy has consisted in looking for relevant studies in both the scientific literature and in non-academic (grey) literature sources. As far as the scientific literature is concerned, we have chosen to limit our sources to peer-reviewed journals, which are likely to have higher impact and quality, using the Scopus database.² Moreover, we have complemented the electronic databases search method with hand searching, by identifying additional relevant papers, cited in the articles selected in Scopus. Additionally, we have selected relevant books and reports by some of the international organizations mostly involved in GVC studies, namely the World Bank, WTO, UNIDO, UNCTAD, OECD, UN-CEPAL, IADB (Werner et al, 2014).

We have used different criteria to identify the relevant literature. The first criterion regards the time span of the analysis. We have considered contributions published since 2005, the year when the literature on GVC has first gained the critical mass of 50 publications per year (Figure 1). In this year, it has also been published Gereffi's et al. (2005) article, with the highest number of citations in the field.³ The second criterion regards the content of the contributions. We have focused the electronic search on words resembling the Global Value Chain approach in developing countries.⁴ The keywords searched in the title, abstract or keywords are listed in Table 1.⁵ With this search we have identified 171 articles (in English) in the following subject areas of analysis: Social Sciences; Business, Management and Accounting; Economics, Econometrics and Finance; Decision Sciences; Arts and Humanities or Multidisciplinary. By reading the abstract (and the papers when the abstract was not providing enough information), we have cleaned the initial sample eliminating the papers not focusing on developing countries (18) and those without an empirical content (48). We have further cleaned the 114 remaining papers to select those providing some information about innovation, including processes of catching up, upgrading, technological spillover, new product

² Scopus is the largest abstract and citation database of peer-reviewed literature, including more than 20,000 peer-reviews journals.

³ 954 citations in Scopus (accessed 20 November 2014).

⁴ As defined by the World Bank list of developing countries available at <http://data.worldbank.org/about/country-and-lending-groups>

⁵ Search algorithms use basic Boolean operators.

development and the like. Indeed, considering that innovation is not uniquely defined in the literature or may not be explicitly mentioned, we have manually screened the abstracts and the papers, rather than relying on keywords. This selection process has led to the identification of 55 articles in the Scopus dataset, which represent the bulk of our analysis, together with 4 reports in the grey literature and 12 articles identified through the hand search process. Considering that many of the papers retained through the search strategy in the scientific literature contain just partial information on the issues at stake (innovation and GVC characteristics) we have included in the systematic analysis 50 GVC cases, listed in Table A-1, relying on the remaining ones as complementary sources of evidence.⁶

In the identified GVCs, the available empirical evidence has been carefully analyzed along the following dimensions: a) the main characteristics (e.g. size, origin; specialization) of the GVC leading companies and the GVC governance patterns; b) the type and degree of innovation introduced at the local level; c) the learning mechanisms operating at the local level; c) the local innovation system and its main actors (e.g. universities, business associations, etc.); d) the different forms of upgrading registered in the GVCs. Each dimension has been assessed on quali-quantitative grounds – i.e. based on a very detailed analysis of the text, we have measured each dimension quantitatively (typically using Likert scales or other categorical classifications). In reviewing the documents about the GVC cases, we have taken into consideration the context presented and the specific wording, trying to minimize the occurrence of biases and misinterpretations complementing and cross-referencing information in all possible ways. To reduce subjective interpretation and biases, two different persons have read the case studies and have independently assessed each case on a quantitative ground. Discordant cases have then been further analyzed until a decision has been made for each case. Moreover, it is worth adding that we could not retrieve all the information in all the considered GVCs; therefore our reading of the literature is necessarily based on the limited information available. We are fully aware that the evidence on certain dimensions could be either over-emphasized or under-emphasized by the authors of each study, based on their own research interest and focus. All that said, as with any study of this kind there may be potential problems related to the accuracy of the results, which therefore calls for cautious interpretations.

⁶ There are a few GVC cases that are analyzed in more than one paper (e.g., Automotive in China, Software in India, Electronics in Indonesia and China). We have considered them as different GVCs because the papers are focused on different segments of the chain. For example, in the case of automotive, the paper by Hatani (2009) focuses on the sub-chain of Chinese firms involved in the Japanese GVC while Altenburg et al (2008) is more generally investigating the Chinese auto industry; similarly, in the electronics case the paper by Sturgeon and Kawakami (2012) studies the Taiwanese GVC and Altenburg et al (2008) maintain a more general approach. These differences justify the different cluster classification in some of these cases.

In the Appendix we present some tables providing information about the geographical (Table A-2) and sectorial covering (Table A-1) of the GVCs taken into account in the analysis. There is an over representation of Asian cases and within it of China (60% and 22% of the total respectively), which is due to the very strong focus of the GVC literature on this area. With regard to the industries of specialization, the main geographical focus of the investigated papers explain the bias towards the specialization on ICTs and electronics (12 cases corresponding to 24% of the total) and on the automobile industry (6 GVCs, 12%) classified as Complex Products, adapting a classification used in Giuliani et al (2005) based on Pavitt (1984). In traditional manufacturing industries, such as clothing, footwear and furniture, there are 16GVCs (32% of the total). The remaining GVCs are specialized in sectors related with natural resources (8 GVCs in e.g. coffee, wine, floriculture) and 3GVCs are on services (software and the movie industry).

Table A-3 (in the Appendix) provides some information about the focus of the different papers included in the desk review, which is very diverse because there are a few studies investigating the role played by firms in GVCs but the large majority is focused on how clusters, regions or countries are involved in GVC.

3. GVCs and governance patterns

Following Porter (1985), the idea of value chain builds on the series of activities needed to turn raw materials into finished products and sell them, and on the value added at each link (Gereffi, 1999). It is increasingly rare that individual companies alone undertake the full range of activities, which are required to bring a product from the conception to the market. Nowadays, it is very common for enterprises to outsource activities that previously were handled internally, and to keep in house those in which they have core competences.

The design, production and marketing of products involve a chain of actions divided between different enterprises often located in different places, sometimes in different countries. In the context of globalization, the activities that constitute a value chain are generally carried out in inter-firm networks spread on a global scale; these value chains are named GVCs and they are commonly dislocated across various developed and developing countries (Gereffi and Fernandez-Stark, 2011).

GVCs involve different types of firms: multinational enterprises (MNEs) as well as independent suppliers, including small and medium-sized firms (SMEs). In our review we find that the vast majority of GVCs are led by large MNEs from advanced countries (only 5 out of the 47 GVCs cases reviewed here are led also by SMEs; and 92% of the cases are GVCs led by advanced countries firms), in line with extant research (Sturgeon and Kawakami, 2011). However, evidence

of lead firms from developing countries (i.e. the South) has also become more frequent, and in some cases we have observed the coexistence of lead firms from both the South and the North, either in the form of the same local suppliers serving both North and South lead firms, or in the case of different firms belonging to the same cluster, region or nation and being connected to several lead firms.

Among the GVC cases considered here, there are interesting cases of leading firms from developing countries taking the place of advanced countries firms. Kaplinsky et al (2011) study the Thai's cassava and the Gabon's timber value chains and show that the leading firms have shifted from being EU based to being Chinese MNEs. In other cases, MNEs from the South have been the very first international contact for local companies, as described in the paper by Haakansson (2009), who analyzes the pharmaceutical industry in Uganda, and shows how Ugandan pharmaceutical companies are tied to Indian companies through whom they access technology and intermediate components for production. In all these cases, the emergence of lead firms from the South and the increasing importance of South-South and regional value chains disclose the growing importance of developing and emerging country markets (Cattaneo et al, 2010).

Manufacturers, more often than buyers, drive the GVCs investigated in this study (67% vs. 32%), following a differentiation based on industry specialization. Buyer-driven value chains are more common in traditional manufacturing industries (in 70% of the GVCs specialized in these industries for which the information is available), including sectors such as clothing, footwear, sport goods and furniture, as well as in natural resource based industries (57%). Being large retailers (such as Wal-Mart and Tesco), or branded merchandisers (e.g., Nike, Reebok, IKEA), such lead firms are mainly focus on marketing and sales. Chains specialized in the complex-product and in services are producer-driven chains. Their lead firms are manufacturers controlling the design and the assembly of the products and having core competencies in technology and R&D. They are more vertically integrated along all segments of the supply chain and leverage the technological or scale advantages of integrated suppliers (Gereffi and Fernandez-Stark, 2011).

The focus of the GVC literature is on the nature of the relationships among the various actors involved in the chain, and on their implications for development (Gereffi, 1999; Humphrey and Schmitz, 2002). To study these relationships, the concept of *governance* is central to the analysis. At any point in the chain, some degree of governance or coordination is required in order to take decisions not only on *what* should be done, or *how* something should be produced, but sometimes also on *when*, *how much*, and at *what price*. Coordination may occur through market, hierarchy and network relationships. Gereffi et al (2005) have introduced a typology of GVC governance patterns

based on three factors: i) the complexity of the information involved in the transactions; ii) the possibility to codify that information; and iii) the competence of the suppliers along the value chain. In the chains investigated, we have found the presence of all the different archetypical governance patterns: a) market; b) modular; c) relational; d) captive and e) hierarchy.

At the two extremes of the typology there are market and hierarchy. *Arm's length relationships* involve transactions that are relatively simple and information on product specifications is easily transmitted. These chains are dominant for standard products that can be easily specified and can be manufactured with minimal input from buyers. In these linkages the key element linking the lead firms with suppliers is price. As reported in Table 2, we have found market relationships in 13 chains (34% of the GVCs for which is available the information), being as different as wine in South Africa (Ponte and Ewert, 2009), surgical instruments in the Sialkot cluster in Pakistan (Nadvi and Halder, 2005) and software in Bangalore (Chaminade and Vang, 2008). Moreover, market relationships are a common pattern in the context of natural resource industries, where they have been reported in 5 cases out of 9.

At the other extreme, in *hierarchical value chains* suppliers are vertically integrated with the lead firms, being owned by them.⁷ According to the literature, this type of governance is generally considered to be more common when product specifications are very hard to codify, products are complex and competent providers are in short supply. Therefore, lead firms are forced to manufacture their products in-house and choose to undertake foreign direct investments. Indeed, this governance structure is recurrent especially in the context of electronics and other complex product industries in general (72% of the GVCs specialized in these industries). In a survey on the ICT industry in Suzhou Municipality, China, Dennis Wei et al. (2011) report that 65% of the firms interviewed are wholly foreign-owned. Yang and Liao (2010) describe the development of the PC manufacturing in the Pearl River Delta in the South of China as the transplantation of the Taiwanese industry. This is confirmed by Sturgeon and Kawakami (2011), who also describes the revitalization of the Guadalajara electronics cluster in Mexico as the result of greenfield investments undertaken by US-based global contract manufacturers. Similarly, Kadarusman and Nadvi (2013) stress the key role played by Japanese and South Korean MNEs, via joint ventures and FDIs on the development of the Indonesian consumer electronic industry. Joint ventures are also predominant among MNEs auto manufacturers entering the Indian market (Kumaraswamy et al., 2012).

In between these two extreme governance patterns there are three network forms: modular,

⁷ We have not included in our survey studies on Foreign Direct Investments' impacts on host developing countries.

relational and captive. According to Gereffi et al. (2005), within *modular GVCs*, suppliers make products to customers' specifications, taking full responsibility for building up the required competencies. This is possible when the design of products is modular, that is, when the different components (or modules) are designed independently and have standard interfaces that allow these modules to communicate and function as an integrated whole (Baldwin and Clark, 1997). This kind of product architecture allows the different components to be outsourced, as suppliers can produce their own independent modules by complying with well-codified standard requirements (at the level of interfaces). We have found this governance pattern in chains such as mobile telecom and electronics (Brandt and Thun, 2011; Sturgeon and Kawami, 2011), automotive (Hatani, 2009) and wind turbine manufacturing (Lema et al, 2013).⁸

In *relational value chains* transactions are complex and not easily codified. Relationships tend to be idiosyncratic and thus difficult and time-consuming to re-establish with new value chains partners (e.g. switching costs are high). The power of suppliers and buyers in relational GVCs is considered to be relatively equal and their mutual dependence is regulated through reputation, social and spatial proximity, long-term commitment and, in some cases, it can be based on family and ethnic ties. In Yang and Liao's (2008) study on Taiwanese investments in the PC industry in the Pearl River Delta in China we have found a confirmation about the role played by ethnic ties in facilitating relational linkages in GVC. In fact, Taiwanese MNEs interviewed by the authors have admitted that their transaction practices are greatly influenced by the trust existing among Taiwanese firms, based on their common ethnic ties.

Interestingly, relational governance does not seem to be tied to any specific industry pattern and it is present in 11 GVCs. In this regard, an interesting example is described in Meléndez and Uribe (2012) in the context of the food industry in Colombia, where the governance structure between the international lead firm and the local suppliers has modified over time, evolving from the continuous need of technical assistance to the technological and market independence of the local producers. The existence of local competences is key to enable a relational governance pattern, and it can be a 'side-product' of a long-term connection with lead firms started under different governance patterns (e.g. captive evolving into relational governance as in the Colombian case discussed above) or a prerequisite for the decision of the lead firm to get involved with the local companies, as suggested for example by Yang (2014) in the context of the Chinese liquid crystal display industry.

Within *captive relationships*, small suppliers are described as highly reliant on large buyers and are under strong control from lead firms, because they generally lack competences and therefore need

⁸ In the GVCs the occurrence of this governance typology is limited to 5 cases but according to the literature it is a common pattern in the electronics and automotive industries (Giuliani et al, 2005).

to be actively supervised. The power asymmetry in captive chains is clear and suppliers are tied up to the lead firms under the conditions set by, and often specific to, that particular lead company. Therefore, switching costs for the suppliers tend to be very high. Captive governance is common in the sample cases considered (45% of the cases) and recurrent in traditional manufacturing industries, such as surgical instruments and sports goods in Pakistan (Nadvi and Halder, 2005; Nadvi, 2011) and garments in Indonesia (Kadariusman and Nadvi, 2013). There are also examples in complex products such as electronics and automotive (Kadariusman and Nadvi, 2013; Kumar and Subrahmanya, 2010) and in services (Barnard and Tuomi, 2008). Such cases clearly describe the dependency of the local firms on the product and process specifications set by the lead companies. As supported by a quantitative analysis by Kumar and Subrahmanya (2010) on the Indian automotive industry, lead firms are very often providing assistance and specifications as far as the products are concerned, including specific indications for input purchases, but *'there is no significant assistance especially in the area of production process, marketing, human resource and finance'* (565).

From the empirical evidence included in the GVC cases considered, two important additional considerations emerge. First, in GVCs the forms of governance are not given forever, but they can evolve if some conditions change. For instance, an increase in the competences of local suppliers may push the GVC architecture away from being hierarchical and captive towards being more relational and modular (Pietrobelli and Rabellotti, 2011), as described above in the Colombian case (Meléndez and Uribe, 2012). Among the GVC considered here, there are 12 GVCs in which such variations over time have been reported and in the majority of them there was a move from a market towards a relational governance pattern (e.g., Athukoraia, 2014; Nadvi, 2011; Cafaggi et al., 2014), but there are also examples of evolution towards hierarchy, as reported in the context of the electronic industry in China (Wad, 2008; Yang, 2014)

Second, within the same GVC different governance patterns can coexist depending on the specific characteristics of the suppliers as well as the end-market (40% of the GVCs, see Table 2). Multi-governance patterns can be both at the level of regions or clusters – i.e., different firms in the same cluster or region are involved in chains with different governance structures – and at the level of single firms, which operate in different GVCs simultaneously being exposed to different types of chain governance (Navas-Aleman, 2011). Kadariusman and Nadvi (2013) is an example of the first case, reporting that in the Indonesian garment industry among the firms selling to advanced markets there are some embedded in captive ties and others in relational ties and among those targeting the domestic and the regional Asian markets, there are firms involved in market and in modular ties. The Brazilian furniture and footwear clusters described by Navas-Aleman (2011) provide examples

of multi-governance within the same firms, where suppliers learned and employed various competences through working with several value chains: design and autonomous product development in the domestic and regional market, and production skills working for US buyers. By comparing the clothing industry in Kenya and Madagascar, Kaplinsky and Wamae (2010) explicitly indicate such ability to serve multiple markets and learn from different buyers as a major reason explaining the better performance of Madagascar as compared to Kenya in terms of resiliency, innovation and upgrading outcomes.

4. Innovation in GVC

As mentioned in the introduction, learning and innovation are considered to be key determinants of competitiveness and growth for countries, regions, clusters and firms. In developing countries, innovation is decisive for industrialization and catch up. Several developing countries have recently made considerable steps ahead in their capacity to innovate, although it is still a general contention that advanced countries retain most of the groundbreaking innovative capacity. However, evidence of innovation occurring in developing countries is widely available (see studies on Ghana, Fu et al, 2014; or China, Dennis Wei et al., 2011; Sun et al.,2013).

While we acknowledge that there are different ways to look at and, indeed, measure innovation in developing countries (see Bell and Pavitt, 1993), for the sake of simplifying the analysis of a literature which is not very sophisticated on innovation matters, in this paper we have adopted the very simplistic but widely accepted definition of innovation contained in the Oslo Manual, as creation or adoption of new product or process and new organizational and marketing practices, where “new” means new to the world, to the country or to the firm.⁹ For the purpose of the analysis we have selected GVC cases in which some forms of innovation (as defined above) could have been identified. To this end we have distinguished four types of innovation: product, process, organizational and market. Table 3 reports the frequencies for each category of local innovation in the GVCs analyzed.

We have found evidence of product innovation in 41 GVCs, corresponding to 82% of the total. Process innovation follows, being described in 31 cases: the improvement of quality and efficiency is reported respectively in 55% and 52% of these cases, sometimes achieved through the adoption of international standards linked with certifications (verified in 7 cases, corresponding to 23% of the

⁹ We are aware that this classification is naive and does not account for the level of sophistication introduced in each type of innovative activity, as it treats all kind of changes (from new to the world, to new to the firm) as being equal. In the codification of the information (see in the Appendix) we have nevertheless considered as more innovative, the cases in which firms have introduced new to the world products.

process innovators). Satisfying standards and improving working/environmental conditions is always taking place together with the improvement of quality. Organizational innovations are reported in 21 cases (42%) and regard mostly the introduction of lean manufacturing practices and the modification of organizational practices, often according to the standards required by international certification schemes. Interestingly, there are also cases of market-related innovations (30%), often overlapping with product innovation, which in the majority of cases regards the introduction of own brands and product lines (e.g., Chaminade and Vang, 2008; Sturgeon and Kawakami, 2011; Goto, 2012) and in a few cases distribution (e.g, Barnard and Tuomi, 2008) and packaging (Ponte and Ewert 2009; Matthee et al., 2006; Padmanand and Kurian, 2011).

While this evidence supports the idea that innovation occurs in developing countries as well, it leaves open a discussion about the level of innovativeness that they entail. Analyzing four selected industries in China and India, Altenburg and colleagues (2008) writes: “...*both countries lag far behind that of leading OECD countries. None of the successful industries has brought about major cutting-edge innovations*” (337). However, recognizing the strong innovation effort of the two countries, they add: “*although China’s and India’s technological efforts have rarely materialized in cutting-edge innovations at this stage, they have created conditions to attract the key elements of first-class innovation systems*” (341), therefore supporting the idea that, if certain conditions are respected, the two countries could in the future become highly innovative. In the context of the wind power industry in China, Lema et al. (2013) put forward a similar argument. The increasing indigenous innovation capabilities, measured by the presence of R&D facilities and international cooperation on R&D and by the number of registered patents, is also confirmed in the case of ICT in India by Khrisna et al.(2012).

Indeed, in a number of GVC considered (37% of the GVC in which product innovation is reported) there is evidence of at least one new-to-the-world innovation. In 9 cases, mostly concentrated in the context of electronics in China, these are innovations that have been granted a patent. For example, Sun et al. (2013) report that 18% of the domestic firms in their survey have on average been granted 2.33 domestic patents each. Similarly, Dennis Wei et al (2011) report that 21% of the firms interviewed have filed patents and more than half of them do have an internal R&D facility.

There are examples of breakthrough innovations also in traditional industries, such as the production of footballs described by Nadvi (2011). In this industry, in the mid-1990s a Taiwanese-owned company based in Dongguan, China, has patented a technology allowing to machine-stitching high quality footballs boosting Chinese productivity and pushing Pakistani hand-stitching traditional firms out of the market, therefore causing a radical change in the organization of global

production with a shift of export leadership from Pakistan to China.

Even if they may not be the initiators of breakthrough technologies, developing country firms could play a key role in the implementation of innovative ideas. Nadvi (2011) also reports that in later years, a Chinese firm co-developed with the leading firm in the GVC the so-called *14 panel thermo-molded football*, which entails a completely different technology than the one previously adopted and has resulted in significant increase in performance. Quoting the words of the author: “*the development of the non-stitched high performance thermo-molded ball with fewer panels, emerged, for example, from the research and development efforts of Adidas. However, the development of the process technologies to mass produce the thermo-molded product required close interaction between Adidas and its first-tier suppliers, initially Molten in Thailand and subsequently Long Way in Shenzhen, China*” (Nadvi, 2011: 15).

Another example of innovation introduced thanks to collaboration between local producers and lead firms is in the coffee industry in Brazil, described by Cafaggi et al. (2012). In this case, new varieties of coffee have been developed following the result of genetic research conducted jointly by local companies and the lead firm, Illycaffé, an Italian company.

An interesting type of new-to-the-world innovations, which seems to be peculiar to developing countries entailing a diffuse potential for increasing economic performance, regards the adaptation of international technologies to the needs of the local market. A clear example of this type is depicted in Brandt and Thun (2011) in the context of the mobile handset value chain in China. While in the past foreign firms ruled the industry (being 90% of the total firms in the industry in 1999) the share of Chinese firms has grown more recently, thanks to the introduction of product-related innovation aimed at targeting the local lower-hand handset segments. Such innovations have regarded the customization of products responding to specific needs of the Chinese market as explained in the following quotation: “*both the modular approach of the domestic firms and their primary focus on the Chinese market allows them to exploit market niches more effectively than a global firm. These niche handsets (e.g., an Olympic-themed handset in 2008, a phone with a compass pointing to Mecca for the Muslim market, etc.) would not be attractive to a volume-oriented foreign firm with high overhead costs, but can provide strong, albeit short-term, growth for a domestic OEM. This consumer-driven approach to product development can be highly effective for a product that is often more of a fashion accessory than a high-technology product. Tianyu has used this approach to become one of China’s leading handset producers, and by the first quarter of 2010 had a domestic market share of 7.5%*” (22).

This case is also informative about the fact that different innovations are taking place at the same

time: just 24% of the chains analyzed have reported that only one out of the four types of innovations have being introduced (being usually product innovation), whereas in 6chains all of them are reported. Indeed, Brandt and Thun (2011) suggest that the success of the Chinese-based OEM products depends also on the introduction of market and organizational innovations: the introduction of a new distribution systems (reaching customers in the rural areas through the establishment of commercial subsidiaries) and the development of a flat organizational structure allowing very quick response to changes in the domestic demand and a deep knowledge on local customers needs.

On the electronics value chain in Indonesia, another interesting example of innovation comes from Kadarusman (2012), who reports that Indonesian domestic firms “*create not only original design, but also original product functionality. For instance, a domestic- owned firm (Harapan Elektrindo) makes audiovisual products that generate a specific powerful sound demanded by Indonesian customers. For this reason, the firm developed and patented a speaker technology which is able to generate the powerful sound. As another example, the firm also developed an antenna system for its televisions which can receive an electromagnetic signal from every direction to adapt to conditions of weak transmitters in Indonesia.*”(p.87).

5. Learning mechanisms within and outside the GVC

The GVC framework clearly focuses on the nature of the relationships among the various actors involved in the chain and stresses the role that the global lead firms play in supporting suppliers in developing countries to learn and innovate. Moreover, it often implicitly assumes that *any* form of firms’ insertion into GVCs is potentially beneficial to *local* firms, without duly considering the capacity of local firms to absorb and effectively use GVC knowledge. In fact, local firms have heterogeneous technological capabilities, and have very idiosyncratic and firm-specific learning strategies(see among others, Nelson and Winter, 1982; Bell and Pavitt, 1993; Lall, 1992 and 2001; Giuliani and Bell, 2005), which prevent them from taking advantage of GVC knowledge in the same way.

As noted in Morrison et al (2008) and Nadvi (2011), the GVC literature is relatively weak in its conceptualization of how the endogenous process of technological capability development takes place, on the specific firm-level learning efforts and on the contextual factors enhancing and/or hindering the innovation process at the local level. Nevertheless, as it will clearly appear in the rest of this section, the literature on GVC provides rich empirical evidence about how firms, clusters and regions learn and innovate because of their involvement in GVCs. In a previous work

(Pietrobelli and Rabellotti, 2011), we have identified different mechanisms of learning, which are likely to dominate in different types of chains. The literature review has suggested the importance to consider also some additional learning mechanisms, working at the level of the individual firms involved in the GVC, at the collective level of clusters or groups of firms or through other external channels. Therefore, in this paper we introduce a distinction between learning instruments within and outside GVCs. Table 4 presents the frequency of the different learning mechanisms identified in the desk survey and in what follows we provide examples from the GVC cases investigated.

Learning mechanisms within the GVC

As said, the following learning mechanisms are derived by Pietrobelli and Rabellotti (2011):

a) *Mutual learning from face-to-face interactions* is common when there are complex and not easily codified transactions in GVCs; in these cases, firms own highly complementary competences. In developing countries suppliers must be able to maintain and strengthen their production and linkage capabilities to interact with the lead firms in the GVC. Learning efforts imply (sunk) costs and take time, which binds parties into continued interactions.

Our literature review suggests that there are examples of very tight relationships between the lead firms and their suppliers from very diverse GVCs, as the football production in China described in Nadvi (2011), the aeronautic sector and the coffee production in Brazil (Cafaggi et al, 2012) as well as the hot sauce industry in Colombia (Meléndez and Uribe, 2012). For instance, as suggested above, Nadvi (2011) stresses the role played by a very closed collaboration between Adidas and its first tier suppliers in China in the development of the process technologies to mass-produce the thermo-moulded footballs. In the case of the hot sauce GVC in Colombia, Meléndez and Uribe (2012) provide details about the technical assistance regularly supplied by Tabasco, the lead company, to the Colombian suppliers of chilli pepper paste in order to check on agronomic techniques and introduce technological innovations. Similarly, Cafaggi et al (2012) document the presence of a significant knowledge exchange undergoing between Embraer, the leading Brazilian aircraft manufacturer, and its first tier partners, which has helped many of them to evolve from being suppliers of single components to become subsystem integrators, also accessing other GVCs in this capacity. Very close relationships between the leading company and the suppliers are also behind the quality improvement of coffee in Brazil, as described in Cafaggi et al (2012). Illycaffé, the GVC leading company provides constant technical assistance in quality management and control as well as in packaging and transportation, ensuring the high quality of the coffee from the first to the final player in the chain. In order to stimulate the production of high-quality coffee and identify the best producers, Illycaffé has also promoted a coffee competition, offering a price

differential to reward quality. Another interesting initiative promoted by Illycaffé is the establishment of a club - i.e. a sort of loyalty programme for its best suppliers, giving benefits to its members, such as more intensive technical assistance aimed at establishing a closer relationship between Illycaffé and an elite group of suppliers.

b) A diffused learning mechanism is the *direct, formal or informal, training of local workforce undertaken by the lead companies*. This often happens when the lead firm takes direct ownership of some operations in the chain, establishing local subsidiaries as in the electronics industry in countries as diverse as Mexico (Sturgeon and Kawakami, 2011), Malaysia (Athukorala, 2014) and Indonesia (Kadarusman, 2012). In this last case, it is shown that the local workforce learns from the contact with the expatriates, who are placed in key management positions in foreign affiliates. The local staffs are also often sent to lead firms' training and production facilities in Japan particularly to learn about production activities.

Nadvi and Halder (2005) describe a similar mechanism in the case of the surgical instruments GVC, showing the existence of significant flows of technical knowledge, machinery, and blueprints from Tuttlingen in Germany to Sialkot in Pakistan. They find that workers go from Sialkot to Tuttlingen for training, while German technicians are sent to Pakistan to undertake quality inspections and advise on production practices.

A very interesting case is that of the diamond industry in Botswana (Mbayi, 2011) in which the Government has encouraged some cutting and polishing international companies to establish factories in the country for transferring their skills to locals. The Government has assured these foreign investors rough diamond allocations on the condition that they hire and train locals, so to enable the local establishment of higher value added activities in the chain, overcoming the traditional specialization only in the extraction phase. Skilled expatriates do the training of locals on-the-job.

In Brazil, Cafaggi et al (2012) report that in the aeronautic GVC, Embraer's engineers disseminate company knowledge by training SMEs' employees and management, monitoring the technical production, and promoting learning processes. Embraer basically trains SMEs to produce goods and services according to the quality standards that are technically required.

Moving to the coffee GVC, Cafaggi et al (2012) show that the lead Italian company, Illycaffé, transfer knowledge to the suppliers triggering a learning process toward high-quality production, through courses, seminars, and conferences. Illycaffé has also promoted the establishment of UniIlly, a public-private partnership in collaboration with the University of Sao Paolo, aimed at transferring to producers the know-how needed for the cultivation of high-quality coffee.

c) *Knowledge transfer from the GVC lead firms confined to a narrow range of tasks* is common when suppliers lack competences and therefore the lead companies provide them with support for avoiding the risk of non-compliance. Their support is usually confined to a narrow range of tasks – for example, simple assembly – with a risk for the local suppliers to be locked in the technologies and skills they acquire, and, therefore, of not being able to develop further other strategic capabilities. This is the case of the shoe industry in the Sinos Valley in Brazil (Navas-Aleman, 2011) where the US buyers have supported the domestic producers in improving the quality of their products and in increasing their efficiency, but they have discouraged them from engaging in design, marketing and sales because these are their core competences. Therefore, the Brazilian suppliers are confined in the manufacturing phase and have remained highly dependent on a small number of powerful customers keen to maintain the status quo in the GVC. Kadarusman and Nadvi (2013) describe a similar situation in the garment sector in Indonesia, where trade agents provide detailed garment patterns and construction manuals, and in some cases even the needed fabrics and accessories, assisting and monitoring suppliers in sample making, production and quality control procedures. In exchange of this technical assistance, the suppliers have to commit a large part of their production capacity to the global buyer.

In a different case such as the Indian automobile industry, Kumar and Subrahmanya (2010) describe the relationships of Indian SMEs with the global lead firms as confined only to a mere purchase–supply relationship where the GVC leaders provide only detailed specifications, feedbacks on product performance, advance information about future orders, preferential pricing and proper payment. Beyond this, there is no significant assistance especially in the areas of marketing, human resource and finance.

d) *GVC pressure to adopt international standards*. When GVC local suppliers are skilled and fully competent, or when their product is a commodity, lead firms can require them to adjust to specific technical and quality standards (e.g. ISO certifications), and to take full responsibility for process technology. In these cases, they do not become directly involved in the learning process. The involvement in the GVC and the need to adhere to standards is important for inducing learning and innovation at the local level and the role played by the lead firms is to impose pressure on their suppliers for innovating and keeping abreast of technological advancements. In other words, lead firms represent a crucial stimulus for inducing learning and innovation among suppliers, but they are simply spectators and final judges of the process.

As stressed in Pietrobelli and Rabellotti (2011), our literature review suggests that this learning form is very common in complex products, including electronics (Sturgeon and Kawakami, 2011;

Kadarusman, 2012), mobile phone (Brandt and Thun, 2011), wind turbine industry (Lema, 2013) and aeronautics (Cafaggi et al, 2011). In these chains, local firms need to undertake specific investments, build specialized production capabilities and constantly update in order to maintain their position in the GVC. Their learning efforts must be accomplished autonomously since they are not supported by direct involvement of the GVC leaders. In some cases, companies may rely on the support from external consultancies and accredited institutions.

The compliance to standards as a condition to be involved in GVC is also common in GVC specialized in agro-industry such as the production of vegetables in Guatemala (Padilla-Perez, 2014). Exporting firms have to fulfill requirements on health controls, rules of origin, and trade standards and buyers require certifications of good agricultural practices (GAPs) and good manufacturing practices (GMPs), as a guarantee that the product has the quality demanded by consumers. Also in this case, buyers are not directly involved in the process of quality upgrading, but the necessity to satisfy international standards create the right incentives for local suppliers to focus on quality.

Learning mechanisms outside the GVC

The literature review has allowed identifying some additional learning mechanisms, which do not involve directly the GVC, and in some cases complement while in others substitute for the GVC-related learning mechanisms. In particular, we have classified the available evidence in three different types of learning mechanisms outside the GVC: a) *firm-level learning efforts*; b) *collective learning efforts* within groups of firms and at the local cluster level; c) *other external learning efforts* unrelated to the GVC.

a) Firm-level learning efforts

There is a wide agreement in the literature that innovation is the result of constant and purposeful process of knowledge accumulation at the firm level (Dosi, 1988; Lall, 1992; Bell and Pavitt, 1993). We find here evidence that firm-level learning efforts are crucial for firms to take advantage of the learning opportunities offered by GVCs. In particular, we identify three distinct forms of firm-level learning efforts: internal R&D, hiring of skilled managers and workers and learning through acquisitions of other companies, joint-ventures or technology licensing.

In a study on China's ICT industry, Sun et al (2011) find, based on econometric analysis, that the impact of GVC on local technological innovation depends on local suppliers' absorptive capacity. According to these empirical findings, internal R&D efforts are the most important source of innovation for firms in China and being involved in GVC does not *per se* boost firms' innovation capacity: "*The process is mediated by the internal R&D efforts and absorptive capabilities and only*

in firms with strong internal R&D did subcontracting show positive impacts on firm innovation” (Sun et al, 2011: 1782) – a result that is widely coherent with other studies looking at the impact of FDI on host countries (see e.g. Giuliani and Macchi, 2014).

Based on case studies on the Indonesian electronics industry, Kadarusman and Nadvi (2013) show that, when local firms invest in building up their internal technological capabilities, they are able to compete successfully in both the domestic market, as well as export in the Middle East and in the ASEAN region. In contrast, other Indonesian companies in the same industry, which are involved in captive relationships with GVC leading companies and produce for developed countries, have not been able to increase their own technological capabilities. In contrast, the authors find that these firms were able to be more innovative, introducing new products adapted to the domestic and regional markets. With this case, the authors stress the importance of the end-markets and conclude that there is more space for innovation in the domestic or the regional market. Navas-Aleman (2011) confirms this empirical fact in the Sinos Valley shoe and furniture clusters in Brazil, where the most innovative firms in design and product development are those oriented to the domestic market.

Also the contribution of skilled workers is a relevant learning mechanism in the innovation process as empirically confirmed by Fu et al (2014) in their survey on Ghana. They have found that more than one third of process innovations have been produced by skilled workers, who were able – via trial and error - to make considerable improvements in the production processes. Obviously, the hiring of skilled workers spans different management areas, such as market and organizational functions, and involve both returnees and foreigners, as reported in Goto (2012): *“when [firm] B started producing in-house designed products in 2002, it recruited an Italian chief designer, who has been very valuable in establishing the current brand image”* (23) *“Because company C had failed in the past with its in-house designed businesses and was left with a large amount of inventory, the company recruited several foreign designers”*(23).

The recruitment of skilled personnel is also indicated as an important learning mechanism in the electronics industry in Malaysia (Athukorala, 2014) and Indonesia (Kadarusdam, 2012). In both cases, there is evidence of former employees of lead firms having established new local firms, as well as domestic-owned companies having acquired knowledge and expertise key in the innovation process through hiring professionals with previous experience in the GVC leading companies. Yang (2014) discusses the case of the LCD industry in Shenzhen (China) and concludes that the indigenous innovation capacity of domestic firms has benefitted from the recruitment of a group of senior managers previously employed by global leaders in flat-panel display working in the cluster.

In particular, Yang introduces the case of one Chinese company, which has successfully developed its own technology with independent intellectual property rights thanks to the expertise and the capabilities acquired hiring technical personnel from Taiwanese and Korean MNEs.

In India and China, the acquisition of skilled human capital has also involved return migrants from the US, essential learning source, particularly for the semiconductor industry. In China, this practice has been supported by the Government providing incentives for returnees with technological skills (Altenburg et al, 2008).

Finally, some firms have acquired knowledge by means of joint ventures or other equity-agreements. In the case of the Chinese mobile telecom sector, Brandt and Thun (2011) present examples of the establishment of joint ventures with foreign firms: both sides have benefited from the partnerships, the Chinese firms have gained access to the designs and technology they did not have and the foreign firms gained access to the Chinese market. Another example of joint ventures can be found in the case of the pharmaceutical industry specialized in anti-retroviral treatments for HIV in Uganda: Haakonsson (2009) provides evidence of JVs as a way for domestic companies to gain access to knowledge and technology and for Indian MNEs to enter into the Ugandan market, which has otherwise become difficult for the adoption of intellectual property TRIPS-compliant laws.

Finally there are examples of acquisition of foreign companies such as the well-known case of Lenovo, which acquiring the IBM PC Division has increased its brand reputation and accessed to a wide international R&D network (Altenburg et al, 2008; Sturgeon et al, 2011).

b) Collective learning at the local level

In some of the cases investigated the learning process takes place at the level of clusters or regions, involving groups of firms characterized by a common specialization and a geographic concentration. As shown in Giuliani et al. (2005) the degree of collective efficiency, given by the sum of external economies and joint actions, is positively related with upgrading and innovation in clusters.

A critical actor in cluster may be the local business association, which can provide local firms with technical know-how required to meet international standards. This has been illustrated in the case of the Sialkot (Pakistan) cluster specialized in surgical instruments investigated in Nadvi and Halder (2005), where the local business association has provided support and facilitated the cluster-wide adoption of ISO 9000 standards. De Castro Souza and Neto (2010) stress the key role of local associations supporting technical advancements in the production of fresh fruits in Brazil. This experience shows the importance of collective action among producers in order to guarantee a

common quality pattern. In the Petrolina-Jazueiro cluster, a cooperative of producers has played a key role in spreading the production techniques needed for satisfying international certifications, offering to its members training courses and on field technical assistance. Farmer cooperatives are the most common channel to transfer knowledge also in Guatemala; and they generally provide their members with services such as financing, technical assistance, training, project development, leadership training and business skill development (Padilla-Perez, 2014).

Firms can also rely on clusters and associations to gather information that is context and sector specific to the members needed for innovation. This is a finding of the survey undertaken by Fu et al (2014) in Ghana, who stress the role of clusters in fostering innovation and technological transfers, through knowledge spillovers and labor market pooling. In the Sinos Valley footwear cluster in Brazil, Navas-Aleman (2011) reports about the role played by the local business associations in supporting the development and the diffusion of knowledge in design and product development, which has been key in facilitating the success of local firms in domestic and regional markets.

c) Other external channels unrelated to the GVC

We have identified two other external mechanisms that occur outside the GVC context: i) learning from competitors; and ii) learning from non-GVC actors such as suppliers of machineries and knowledge providers such as universities.

One way in which suppliers learn from competitors is through the well known mechanism of 'reverse engineering' - a common practice reported in the case of automotive GVCs in China and India (Altenburg et al, 2008) and electronics GVC in Indonesia (Kadariusman, 2012). In the latter case, domestic firms use to purchase product samples to dismantle the product and innovate upon it (e.g. develop new design and functionality, adapting products to the specificity of their destination markets, etc.) As described by Kadariusman and Nadvi (2013) this is also a common practice in the Indonesian clothing industry. The local firms visit department stores abroad and purchase garment samples for adapting them to the domestic and emerging export markets. Firms also regularly send their designers and engineers to domestic and foreign exhibitions to obtain information about new product and process advances.

Other firms acquire knowledge and manufacturing know-how by purchasing equipment from global suppliers and by obtaining technical support from them. This is reported in the wind energy industry in China by Lema et al. (2013), who describe the role played by European suppliers having established subsidiaries in China, which provide specialized components and services in fields such

as electric control systems and hydraulics, as well as technical assistance to Chinese turbine manufacturers.

To improve product, quality and production efficiency, Indonesian electronics firms have obtained support also from consultancy agencies (Kadarusman, 2012). For instance most of the domestic firms have adopted standards applied in the global market by achieving international certifications (e.g. ISO 9000) with the support from consultancies and accredited certification institutions.

5. Patterns of Innovation and Learning in GVCs

In earlier sections we have discussed the main types of innovations and learning mechanisms observed in the reviewed literature on GVCs. Here we classify GVCs with a cluster analysis - a multivariate statistical technique that serves to identify different groups of similar GVCs¹⁰ on the basis of the two following dimensions:

- The *local firms' degree of innovativeness* taking into account the extent to which different types of innovations (product, process, market and organizational) have been undertaken at the level of the local firms that are part of the GVCs as well as the degree to which they have produced new-to-the-world innovations;
- The *learning mechanisms* adopted considering the extent to which local firms use the different learning mechanisms within and outside the GVC, presented in Section 5.

The Appendix provides details about how these dimensions are measured and how the cluster analysis is done. Following this exploratory statistical approach, based on the learning and innovation patterns of their local firms we have identified three main types of GVCs (the results of the cluster analysis are presented in Table A-5 in the Appendix):

GVC-led innovators (9 GVCs), which consists of local firms that are highly innovative and use intensively knowledge sources from within the GVC, as well as a selection of other sources outside the GVC;

- *Independent innovators* (14 GVCs), which consists of firms that are also highly innovative, but their learning sources come mainly from outside the GVC, while the latter plays only a marginal role in the transfer of knowledge;

¹⁰ Cluster analysis groups a set of objects in such a way that objects in the same group (called "cluster") are more similar (according to a set of pre-defined variables or dimensions) to each other than to those in other clusters.

- *Weak innovators* (27 GVCs), which consists of firms that show low to moderate innovation records, draw selectively on some of the knowledge sources available within the GVC, while they poorly use other sources of learning.

More than half of the cases analyzed falls into the group of the *Weak Innovators* (54%), while a third (28%) are *Independent Innovators* and only a fifth of the cases (18%) fall in the group of *GVC-led innovators*. Being the cluster analysis based on the empirical evidence collected in studies on GVCs with some attention to innovation (see Section 2 about how articles have been included in the desk review), these results are surprising in many ways: first, we would have expected a more leading role played by GVC in local innovation (i.e. GVC-led Innovators, in other words firms that manage to be innovative thanks to their connections within the GVC). Instead, we observe more cases of GVCs where local innovative firms draw their knowledge resources from sources outside the GVC, particularly from their internal capability building processes. This means that the GVC may, under certain circumstances, be the loci of innovation, but in fact the presence of alternative, extra-GVC learning processes at the local level seems to be a fundamental condition for local innovation to take place. Second, in the narratives and codification of cases we do find that, indeed, innovation is not to be taken for granted, as most of our cases score poorly in that respect. Hence, in spite of the fact that innovative processes do indeed occur also in developing countries' firms (see Section 4), about half of the observed firms do still underperform in that respect, even if they are part of a GVC.

This result may have also to do with the fact that such firms operate in weak *local innovation systems (LIS)*, which do not provide an adequate institutional support to firms' innovative processes (Pietrobelli and Rabellotti, 2011). Indeed, the quality of LIS is a dimension that some of the reviewed papers have narrated, and that we have codified in our literature review (see Section 2). We find that in more than half of the observed cases, where information on this item is available (the total number is 37), the LIS is described as being from very poor to poor, which means that the local knowledge organizations are deemed to be weak and there are very loosed or absent connections between innovative actors. Only in about a third of the cases, LIS are described as being more advanced – with stronger knowledge organizations and connections (Table A-6). With reference to the three GVC typologies, we do find that indeed LIS differ across groups, as we discuss in the following section.

GVC types and learning mechanisms

Learning mechanisms are widely different across GVC types (Table A-7). We find that *GVC-led Innovators* use all possible learning channels from within the GVC, and, particularly, they benefit

from face-to-face interactions and training of local personnel supported by the leading firms. In some cases, innovation is induced also by the need to comply with the strict production standards imposed by the lead firms, which are often achieved thanks to extra-GVC learning. Besides, GVC learning is not done in a vacuum, and in fact the majority of these innovators do also perform R&D activities at the firm level, and benefit from connections with other local non-GVC actors (such as suppliers, universities or business associations), as well as from the imitation of nearby actors. GVC-led Innovators are therefore local firms that benefit *both* from being part of a GVC, as well as are embedded in well-developed LIS. This also explains why connections to, and imitation of, other local actors is stressed by this kind of firms.

An illustrative case of this group is the coffee GVC in Brazil described by Cafaggi et al (2012) and characterized by a virtuous learning system in which the main lead firm, Illycaffé, has played a key role together with some local business associations, the universities as well as an intense innovative effort undertaken by the same local producers. Through the supply of concrete incentives (see Section 5) and direct technical assistance, Illycaffé has directly supported the introduction of process and product innovations needed for entering in the high quality coffee global market. The business associations (such as the Brazilian Specialty Coffee Association – GSCA and the Council of Coffee growers’ Associations of the Cerrado region – CACCER) have also sustained the local innovative effort, providing technical training and knowledge transfer, developing joint marketing initiatives and promoting scientific research programs in partnership with local research institutions. Supported by a favorable LIS and stimulated by their involvement in the GVC, local firms have invested in innovation as it is exemplified by the case of Daterra, a local company, which began as an exclusive supplier for Illycaffé and thanks to its many investments in the creation of its own laboratory of quality analysis and the development of a traceability system to map the quality it has more recently established its own chain in the global market, now selling only a small amount of its total production to the Italian company.

Differently from GVC-led Innovators, *Independent Innovators* use the GVC as a source of learning only to a limited extent, as merely about a third of them either receives knowledge from the lead firm (but this knowledge is mainly confined to a narrow range of tasks), or has some face-to-face interactions with the managers in the lead firm (or both). These innovative firms do not exploit other GVC learning channels, while they almost entirely use internal R&D to sustain their innovative efforts. About half of them, moreover, acquire knowledge from hiring skilled employees (in most cases being returnees or expats) and through other equity-agreements (acquisitions, JVs, licensing) that occur outside the GVC context. Interestingly, in many cases these

modalities have been highlighted as the most relevant, since they have enabled rapid and effective innovation.

The development of the China wind turbine industry described by Lema et al. (2013) exemplifies the Independent Innovators case, characterized by an important innovative effort undertaken at the firm level. Initially, the rise of the Chinese wind industry has been driven by the development of a domestic market and the technology was entirely imported from European producers, which established local subsidiaries of turbine manufacturers. The option of tapping into the established design and engineering capabilities of overseas firms buying licenses from European companies has been key to the Chinese success story. More recently, Chinese wind companies have started to invest in large R&D departments in China as well as in Denmark and Germany, the two technological leading countries in the industry. Besides, some Chinese leading companies have undertaken strategic acquisitions in Europe to strengthen their competitive and technological position. Lema et al. (2013) and Lema (2012) show that Chinese turbine manufacturers have adopted an innovation strategy that combine internal R&D effort with heavy reliance on external knowledge sourcing by means of the acquisition of licenses or the establishment of joint ventures (JV). It should be added that the Chinese innovative effort is also driven by the need to adapt technology to the requirements of the large size of the domestic market: Chinese companies produce large turbines and they are less motivated by the necessity to improve efficiency which is key for European turbine manufacturers, still leading technology in the sector.

Rather interestingly, Independent Innovators do not use local learning sources - such as imitation and interactions with other local actors - as much as GVC-led innovators. We explain this difference, by the fact that, in about half of the observed cases, Independent Innovators operate in LIS that are described as being poor. It is therefore possible that this lack of local learning is tied to the fact that the local context is too weak to provide firms with valuable knowledge assets.

Finally, *Weak Innovators* do not perform in-house R&D and barely use any local source of learning for their LIS are generally very weak. These firms moreover count on GVC knowledge only to a limited extent given that only about a third of them are involved in some forms of GVC learning mechanisms. Hence, these firms are poor innovators in spite of being part of GVCs that connect them to world markets and demanding consumers. Evidence of this kind is in line with the absorptive capacity interpretative framework, which suggests that firms characterized by weak technological capabilities are unlikely to establish knowledge-rich connections and remain somehow locked-out of the relevant innovative circles (Cohen and Levinthal, 1990; Giuliani and Bell, 2005; Giuliani, 2013).

Among the numerous cases characterized by weak innovation, there is the clothing industry in Kenya and Madagascar described by Kaplinski and Wamae (2010), who stress that local firms have received some technical assistance from buyers, but this has not ended up in much product and process innovation and that in particular Kenyan companies have remained locked into value chains serving the US market in the high volume commodity segment. An interesting conclusion of this study is that those companies from Madagascar involved in GVCs targeting the European or the South African markets, show greater evidence of process and product upgrading and this is explained by some different characteristics of the final market of destination, such as production of small batches requiring more flexibility and thus enhancing process innovation capabilities and greater design independence.

GVC types and governance patterns

In this section we explore whether the GVC types differ in terms of their governance patterns, in a bid to verify the existence of a relationship between innovation and type of governance within the GVC, which has been a major concern of the GVC literature focusing on upgrading. Insights from our literature review here are not clear-cut.¹¹ We noted the presence of multi-governance patterns in 40% of the GVCs analyzed (see Section 3), and we do find that multi-governance is more accentuated in GVC-led and Independent innovators (67 and 57 per cent of the cases respectively, see Table A-8 in the Appendix). However, some types of governance appear more frequent across the different groups, as we elaborate below.

Captive GVCs are more frequent among Weak Innovators (55% of them are part of a Captive GVC), and *all* but one of the GVCs that are exclusively captive (7 cases) fall within this group. This is to a certain extent coherent with the nature itself of this kind of governance, where local suppliers are totally under the control of the lead firm and simply comply with the requirements imposed on them, without having the freedom to experiment or invest themselves in the independent generation of innovations at the product, process, organizational and marketing level. Captive GVCs are also present in almost half of the GVC-led Innovators, but only in one case is this kind of governance *exclusively* captive, while in most cases captive governance *coexists* with other patterns, which may influence learning mechanisms and innovation. This is exactly the argument put forward by Navas-Aleman (2011) on the cases of furniture and footwear Brazilian clusters in which firms that couple export in US markets coordinated through captive ties with market governance in domestic markets have large learning potential. Indeed, such multi-chain, multi-market and multi-governance firms

¹¹ It should be noted that, while we count on evidence on 50 GVC cases (see Section 1), data on governance patterns are available only for 38 of them, which means that our analysis on this aspect needs to be taken with caution, which motivate our approach to cross-check it with the available qualitative evidence.

are more likely than purely exporters (in captive GVCs) or purely domestic (in market GVCs) firms to innovate in products and processes.

Weak Innovators are also part of GVCs that are exclusively *hierarchical* (in 5 out of 6 cases of exclusively hierarchical GVCs). Hierarchical GVCs are also quite frequent among Independent Innovators, although in this latter case they often coexist with other governance patterns. The predominance of hierarchical governance in these two widely different GVC typologies – Weak and Independent Innovators - can be explained in light of the very diverse coordination and governance modes that may exist *within* hierarchical GVCs – an aspect that GVC studies do generally overlook. As research in international business (IB) shows, the relationship between the lead firms (which in IB terms would be defined as headquarters) and the local firms (subsidiaries) may be very diverse (Ghoshal and Bartlett, 1990). At one end, subsidiaries may be totally dependent on the headquarters and have no autonomy to undertake even the smallest innovative initiative, or they may even draw very little knowledge resources from either the headquarters and other external sources, as well perform little innovation (Marin and Giuliani, 2011) – a condition that is coherent with a hierarchical governance pattern in Weak Innovators GVCs, in which innovation possibilities resemble those described in captive GVCs. At the other end, subsidiaries may be given ample mandate to undertake innovation activities independently on the headquarters, and to draw knowledge resources also from outside the corporation (Marin and Bell, 2006; Marin and Giuliani, 2011) – a condition that is aligned with the presence of Independent Innovators within hierarchical GVCs. In India, for instance, the independent innovation activities undertaken at the level of the subsidiaries are confirmed by the increasing presence of foreign R&D centers, mainly in software and ICT and in the pharmaceutical sector (Khrisna and Bhattacharya, 2012). Three different types of R&D facilities are identified: a) *support laboratories*, aimed at transferring locally knowledge developed elsewhere within the group, b) *locally-integrated laboratories* and c) *internationally independent laboratories*, where adaptive and basic research respectively is carried out autonomously at the local level, in some cases leading to patented technologies.

So the extent to which firms manage to learn and innovate within a hierarchical GVC does also depend on the nature of the relationships, in terms of autonomy and mandate existing between the headquarters and the subsidiaries. The Indonesian electronic firms described in Kadarusman (2013) provide a useful example of such a difference identifying foreign affiliates focusing solely on mass production as production centers and others which are “*authorized to carry out ... also design and product development ... particularly to adapt to the local market*” (86).

Relational GVCs are also a frequent governance pattern among Independent Innovators, but this pattern often *coexist* with other types of governance¹² - for instance, about a third of these relational GVCs do also coexist with market and modular GVCs. Indeed, within the same GVC, not all the firms have the capabilities needed to engage into a relational GVC. The case of the Brazilian aeronautics industry described in Cafaggi et al (2012) is a useful case in point. Indeed, they describe how the lead firm has ‘segmented’ local suppliers, so that some of them work as subcontractors under captive governance and just a smaller portion got *risk partners*, having higher responsibility (e.g., financial investments, certification of the subsystem, innovation development) and competences, for a large part developed previously thanks to transfer of know-how from the local firm Embraer. Indeed ‘*due to the amount of investment needed, the risk involved, the time delay for revenues, and the technological capabilities required to select risk partners, risk partner increase occurs only among enterprises with strong financial and technological capacities*’ (19). The fact that the relational governance is often the end point of a long process, started as a more subordinated partnership and that it involves just the more advanced portion of the local firms is supported in the analysis of the Penang (Malaysia) electronics industry (Athukoraia, 2014) but also in less technological intense industries such as sport goods (Nadvi, 2011 for the Chinese case).

However, it is clear that the opportunities for learning from different sources soar when a firm or a cluster hosts a variety of GVC governance patterns. Indeed, such a variety can be very valuable to enhance innovation and upgrading, because, as scholars on open innovation show, increasing the variety of knowledge sources does also contribute to creativity and radical innovations (Larsen and Salter, 2009). Not surprisingly, in fact, both innovating GVCs (GVC-led Innovators and Independent Innovators) are markedly multi-governance.¹³

Summary of the main characteristic of the GVC typology

We summarize some of the key traits of the GVC types identified (Table 5) and draw some additional remarks on the key findings of our cluster analysis. We have identified three different groups of GVCs on the basis of their local firms innovativeness and learning mechanisms. By innovativeness here we have referred to the extent to which these firms undertake any form of product, process, organizational and market innovation and we have also considered a plus when these firms generate product that are New-to-the-World – generally measured by the granting of a patent.

¹² There are only three cases of exclusively relational GVCs – one for each GVC typology.

¹³ Other types of governances (market and modular) are not significantly different across GVC typologies and therefore are not commented here.

One result is that local firms that appear more innovative are those that invest in in-house R&D – since both GVC-led and Independent Innovators do so, while Weak Innovators do not. While this result may seem obvious to innovation scholars (Dosi, 1988; Cohen and Levinthal, 1990), the GVC literature has tended to overlook this dimension by focusing mostly on issues of GVC governance (Morrison et al, 2008;Nadvi, 2011).

A second and related result is that innovative local firms use knowledge sources from within and from outside the GVC and extra-GVC in a very complementary way. Although they place different emphasis on one or the other – with GVC-led Innovators using more of the GVC knowledge sources than the extra-GVC ones and Independent Innovators doing the reverse – they both rely on a variety of knowledge sources and, having invested in R&D activities, have the internal capacity to exploit such a variety in line with Cohen and Levinthal (1990). In stark contrast to this, Weak Innovators do mainly rely on some knowledge sources coming from them being part of a GVC, but they poorly exploit all possible intra-GVC learning mechanisms, and they almost entirely lack of extra-GVC knowledge connections.

Finally, our analysis suggests that local firms that are subject to multi-chain governance and serve multiple-markets are better able to access a variety of knowledge sources and this is deemed to be associated positively to their innovation records. Multi-chain governance is in fact predominant within both GVC-led Innovators and Independent Innovators. While specific governance patterns are difficult to associate with specific GVC typologies – due to their coexistence – we find that GVCs characterized by exclusive captive or hierarchical governance patterns yield poor impacts on the innovative capacity of their local firms, by inhibiting their autonomy and freedom to experiment on different innovative and learning sources.

6. Upgrading across GVC typologies

The concept of *upgrading* is key to the GVC literature and it generally refers to the capacity of firms to make better products, make them more efficiently, or move into more skilled activities (Kaplinsky, 2000; Giuliani et al., 2005). According to Gereffi (1999), a process of upgrading denotes the ability of a firm or an economy to move to more profitable and/or technologically sophisticated capital- and skill-intensive economic niches. Therefore, the concept of upgrading may (e.g. developing more technologically sophisticated products) or may not (e.g. moving into more profitable economic niches) imply innovation in its narrow sense.

This distinction is very often overlooked in the literature, as both abilities – i.e. moving into more technologically sophisticated and profitable end-markets – are deemed to be interdependent, and the

GVC literature has therefore tended to analyze upgrading as going up on the “value ladder” in four ways (Humphrey and Schmitz, 2002): a) by upgrading products (i.e. moving toward more sophisticated products), b) processes (i.e. improving efficiency and effectiveness), c) by functional upgrading (i.e. acquiring new, higher value-adding functions) and, finally, d) by inter-chain upgrading (i.e. entering new sectors).¹⁴

In spite of the fact that this is the dominant way to look at upgrading, a second view exists where value creation is pursued not only via “value added-products”, but in ways that allow generating rents, which in some cases also implies downgrading the product or other aspects of business. Producing low-quality products, for instance, may temporarily be a “better deal” for developing country firms (Ponte and Ewert, 2009; p. 1648). This is coherent with Gereffi’s (1999) idea of upgrading as moving into more profitable market niches, although there are concerns about how long these niches – often characterized by low entry barriers – will remain profitable. An illustrative example of this broad idea of upgrading is offered by Ponte and Ewert (2009) in their analysis of the South African wine industry, which shows that producers focusing on bulk, low-quality wines, have had more chance of survival in the short run, because demand in that particular market segment was growing, and easier to satisfy – i.e. entry barriers were low due to the limited skills and technological capabilities that were requested in that market.

More recently, scholars have also given prominence to two other types of upgrading – social and environmental upgrading - given the pressures that global buyers face to engage in socially responsible business conducts (Giuliani and Macchi, 2014). Social upgrading is defined as the process of improvement in the rights and entitlements of workers as social actors, which enhances the quality of their employment (Barrientos et al., 2011), while environmental upgrading is defined as the process by which economic actors move towards a production system that avoids or reduces the environmental damage from their products, processes or managerial systems (De Marchi et al., 2013).

In this paper, we embrace a *broad* conception of upgrading, and consider all the different types of upgrading discussed above, including functional upgrading, inter-chain upgrading but also other activities that offer developing countries’ firms a “better deal” by entering more profitable niches (e.g., the entrance in new, more-profitable markets). In the literature review we have searched for evidence of any of upgrading occurred at the local level, and we do find that in almost 70% of the valid cases (evidence on upgrading is available for only 39 papers) local firms have achieved some kind of upgrading (data are available in Table A-9).

¹⁴In this paper we do not consider as upgrading both product and process upgrading, as these two overlap quite extensively with our definition of product and process innovation.

While most of the GVCs observed report some form of upgrading to have occurred, our evidence shows that indeed GVC typologies differ in terms of their capacity to upgrade. Specifically, all Independent Innovators GVCs and about 80% of GVC-led Innovators perform some kind of upgrading. As opposed to this evidence, upgrading occurs in less than half of the observed Weak Innovators GVCs (Table A-9).

An interesting case to describe the upgrading processes of *Independent Innovators* is the case of the pharmaceutical industry in Uganda, discussed earlier (Haakonsson, 2009). This case shows how domestic pharmaceutical companies undertook both processes of functional upgrading by shifting from being pure importers of medicines, to repackaging, assembly, as well as inter-chain upgrading as in some cases firms moved on to manufacture their own equipment. Such upgrading processes are tied, in this kind of companies, to their ability to search relevant knowledge from different sources (see also Section 5). As a managing director of one large Ugandan company put it: “*we keep a good and wide network and buy from many places, mainly in India, China, the EU and US, ...we have a key person in India who develops new ideas and technologies.*” (Haakonsson, 2009, p. 507) This case is moreover important for two kinds of messages that we deem to be valid in other cases. First, functional upgrading of the kind discussed here – i.e. incorporating more value-added activities at the local level – needs long-term commitment and cannot therefore be realized without a steady investment by the local firms that are part of the chain. Second, high value added stages of the value chain, particularly R&D, are hard to move to countries characterized by weak local (and national) innovation systems.

The case of the Brazilian coffee GVC led by Illycaffé, described by Cafaggi et al (2012), is a paradigmatic example of the upgrading processes by *GVC-led Innovators*. We have discussed extensively how Illycaffé has contributed to transfer knowledge and skills to local coffee producers, and how this effort has produced upgrading along different dimensions. One such dimension is the move of their offer from the production of standard coffee to high quality coffee, thanks to the product and process innovations introduced. Another dimension reflects on the capacity of Illycaffé local suppliers - Deterra is a case in point - to develop their own production process, technology, marketing and transactional competencies. As mentioned by Cafaggi et al (2012, p. 66) “*the company was able to take advantage of the directions and indications given by Illycaffé in order to develop its own quality concept and to establish its own consumption market in an independent way.*” Deterra has moreover been able to diversify its market positioning from Illycaffé, by focusing on organic and socially sustainable business practices – and has therefore demonstrated a capacity to pursue both social and environmental upgrading.

As opposed to this evidence, we have found that within the group of *Weak Innovators* GVCs upgrading is less likely to occur (see Table A-9 in appendix) – although there are eminent cases that point to the opposite. Local farmers in the non-traditional agriculture GVC in Guatemala, for instance, have undertaken significant social and environmental upgrading, to face the demands of the UK multinational chain Tesco (and US importers alike), which asked for the application and certification of the “Tesco Nurture” standard. As described by Padilla-Perez (2014), “*since 1992, Tesco has required its suppliers of fruit, vegetables and salad ingredients to apply the “Nature’s Choice” protocol, which includes standards on safety, quality and protection of the environment. The seven “Nature’s Choice” pillars are: rational use of plant protection products; rational use of fertilizers and manures; prevention of pollution; protection of human health; rational use of energy, water and other natural resources; recycling and reuse of materials, and conservation and improvement of flora, fauna and landscape.*”(274) In this case, local producers have introduced some changes in their production and organization practices without introducing major innovations at the level of the product, for which they fall within the group Weak Innovators GVC.

Another example is the inter-chain upgrading in Botswana with the move from diamond extraction to polishing and cutting (Mbayi, 2012), or the functional upgrading in the form of development of commercial functions, reported in the Brazilian fresh food industry by De Castro Souza and Neto (2010).

The evidence presented above suggests that to a certain degree *innovators do also upgrade*. In fact, in some of the cases analyzed, there appears to be a connection between the capacity of local firms to innovate and access a variety of knowledge sources – both intra- and extra-GVC – and the contribution to their ability to upgrade at the level of the whole GVC. In such cases, local firms in developing countries are not seen as *passive recipients* of knowledge and assets coming straight from the lead firms – as often subsumed by much of the GVC literature. They show instead to be crucial *innovative nodes of GVCs* in their own right, which is instrumental for them in such a rent seeking process. However, our evidence is not conclusive as we also note that sometimes *upgrading occurs without (much) innovation*. This is therefore an area that deserves further investigation, as discussed in the conclusive section.

7. Concluding remarks

Over the past two decades, analyses of GVCs and their repercussions on developing countries have grown considerably, attracting the attention of the economic development community. In 2013, as a matter of fact the UNCTAD World Investment Report has mainstreamed the GVC concept in the

international business community. In spite of this planetary success, it is still debatable to what extent, and under what conditions, small suppliers in developing countries that are part of GVCs benefit from it – either in terms of their capacity to innovate or to upgrade their activities.

Development scholars demonstrate a fairly positive expectation about the capacity of GVCs to produce different kinds of innovation at the level of firms in developing countries, but evidence on this is sobering. One current limitation, observed in our review, is that the GVC literature places particular emphasis on the governance mode and, therefore, on the power relationships existing within the chain, as if certain coordination forms would give local firms more chances to innovate and upgrade. While this dimension is definitely worth considering, GVC studies tend to overlook the wide heterogeneity existing at the local level, as local suppliers in developing countries are very different in terms of their capacity to absorb, master, and change knowledge and capabilities that lead firms in GVCs can potentially transfer to them. They are also heterogeneous in terms of their openness to sources of knowledge other than the GVC, and they are embedded in very diverse local innovations systems, some being more advanced and mature than others.

What is clear from our analysis of the existing literature, is that, in order to understand innovation and upgrading, it is important to integrate the development research on GVCs (Gereffi, 1999; Kaplinsky, 2000; Humphrey and Schmitz, 2002) with innovation studies and evolutionary economics views on firm level learning and innovation (Nelson and Winter, 1982; Dosi, 1988; Bell and Pavitt, 1993), as also suggested by Giuliani et al. (2005), Morrison et al. (2008), Rabellotti and Pietrobelli (2011).

This paper makes an effort to read GVC studies searching for the empirical evidence available on local firms' learning and innovative behaviors, as well as on the level of maturity of local innovation systems, in a bid to analyze the relevance of these dimensions to explain the impact of GVCs on developing country firms' innovation and upgrading processes. Our review sets the ground for a number of original considerations.

First, we observe that suppliers located in developing countries, in spite of being part of one or more GVCs, do not always use the GVC – i.e. their connections to different GVC members among which the lead firms – as a privileged source of knowledge and technologies. Quite on the contrary, only in a minority of our observed cases (roughly 20%) we do find such an exclusive relationship to exist and in such cases, as illustrated by the case of GVC-led Innovators, these firms do also invest in considerable capability building in their own rights (through e.g. in-house R&D) to be able to innovate and upgrade.

In most of the other observed cases, GVC-related knowledge is instead exploited only as a complementary source to other channels of knowledge (e.g. collective learning at the local level, imitation, learning from other non-GVC actors etc.), which received far more consideration. The case of Independent Innovators (roughly about a third of the observed evidence) is illustrative here, as these GVCs are characterized by innovators that draw their knowledge mainly from sources outside the GVC, which probably reflects the fact that GVC knowledge may be too narrow or specialized and that – as innovation scholars have pointed out in several occasions (Larsen and Salter, 2009) – a certain degree of knowledge variety is needed to be innovative.

Second, and probably most revealing, about half of our empirical observations are GVCs where innovation is hardly taking place, a condition that tend to coexist with local firms' relative closure to both GVC-related and other kinds of knowledge sources, as well as with local firms' poor skills and knowledge creation efforts. We have observed this behavior through what we have called Weak Innovators GVCs. This evidence, combined with observations of GVC-led and Independent Innovators, prompt us to speculate about the importance of local heterogeneity – both at the level of firms, as well as of the whole cluster, regional or even national system of innovation – in conditioning the extent to which suppliers in developing countries are able to take advantage of GVC-related knowledge.

Third and last, we have also delved into the relationship between innovation and upgrading, by analyzing the upgrading behavior of firms falling into the different GVC typologies mentioned earlier. We have discussed in this paper that innovation and upgrading are often overlapping and co-occurring concepts. However, in some cases upgrading may not imply the development of more technologically sophisticated products or processes, but simply moving into profitable market niches, even when this requires a downgrading of processes and products (i.e. the idea of a “better deal” for developing countries in Ponte and Ewert, 2009). While our analysis here is not conclusive, it points at two overall considerations. On the one hand, innovative suppliers and firms are generally able to engage in some kind of broadly conceived upgrading process – i.e. GVC-led and Independent Innovators are more likely than Weak Innovators to upgrade. On the other hand, a nontrivial number of Weak Innovators demonstrate some abilities to upgrade, that is, to create value without engaging in technologically more sophisticated market niches, or by simply downgrading their products to fit a growing but less demanding domestic market (see e.g. bottom of the pyramid domestic markets).

In terms of contributions to scholarship, this paper consolidates earlier studies calling for integration between GVC and innovation studies (e.g. Giuliani et al., 2005; Morrison et al. 2008;

Rabellotti and Pietrobelli, 2011). It therefore calls for more empirical research to include issues of inter-firm learning and innovation heterogeneity at level of firms, clusters, regions and countries that are at the Southern-end of the GVCs. Moreover, our empirical analysis has not paid due attention to the growing prominence of GVCs impacts in terms of social and environmental upgrading. We envisage research on such kinds of impacts will soar in the next few years, given the urge scholars and practitioners have to address the sustainable development ‘grand challenge’. Finally, most of the available empirical evidence focuses on GVCs that are led by large corporations (either buyers or manufacturers) from advanced countries (i.e. the North) sourcing from suppliers in developing countries (the South). Little research is on South-South GVCs, and South-North GVCs received far less consideration – while we know this is a growing phenomenon. We therefore encourage more research along these lines.

In terms of policy implications, it is clear that integration in GVCs should not be seen as a panacea for promoting innovation and upgrading in developing countries but as a window of opportunity that can have development effects. GVC interventions are widespread among international organizations and donors (Pietrobelli and Staritz, 2013) because they offer a practical way of working with the private sector. Humprey and Navas Aleman (2010) identify three main objectives of GVC initiatives: a) to strengthen the weakest links in the chain (e.g. by improving the capabilities of local small suppliers) b) to strengthen the linkages between firms (e.g. by improving knowledge flows between the local firms and the lead firms) and c) to create new links in the chain for connecting local firms with new lead firms and/or end markets. Our survey of the GVC literature shows that these three areas of interventions are all potentially relevant in terms of enhancing local innovation opportunities. Nonetheless, there is no systematic assessment of the impact in terms of innovation of the existing GVCs initiatives. More evaluation studies in that direction would be therefore a welcome effort to be undertaken by the numerous organizations and donors involved.

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Acronyms

ASEAN - Association of Southeast Asian Nations

EU - European Union

FDI - Foreign Direct Investments

GAP - Good Agricultural Practices

GMP - Good Manufacturing Practices

GVC - Global Value Chains

IADB - Inter-American Development Bank

IB - International Business

ICT - Information and Communication Technologies

JV - Joint Venture LCD - Liquid Cristal Display

LIS - Local Innovation System

MNEs - Multinational Enterprises

OECD - Organization for Economic Cooperation and Development

OEM - Original Equipment Manufacturer

R&D - Research and Development

SMEs - Small and medium-sized firms

TRIPS - Trade Related Aspects of Intellectual Property Rights

UN-CEPAL - United Nations Economic Commission for Latin America and the Caribbean

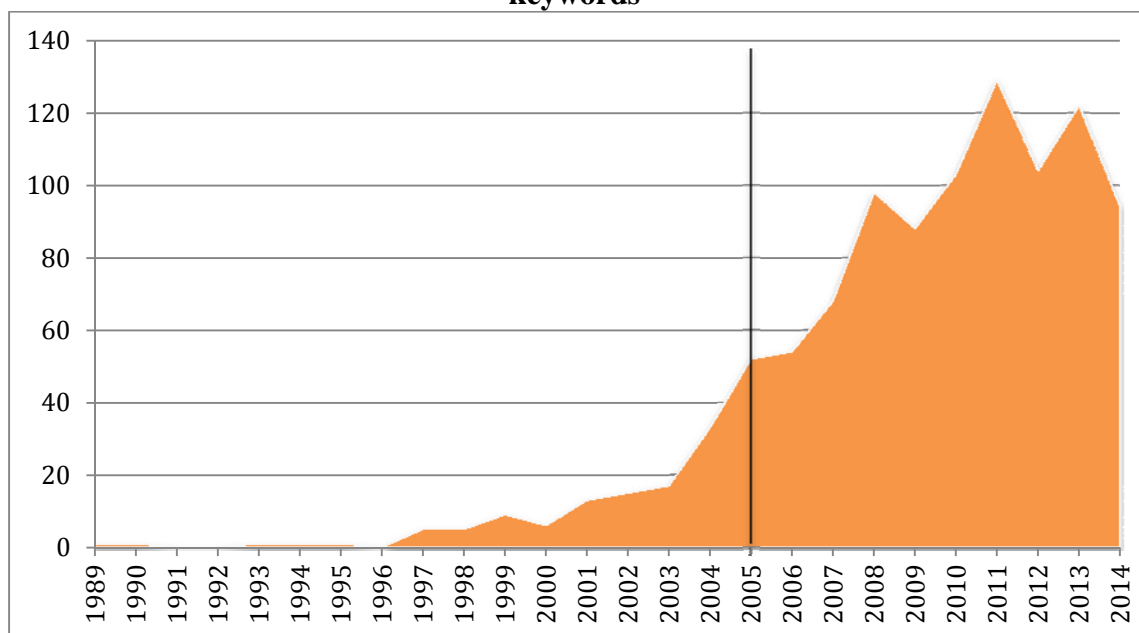
UNCTAD - United Nations Conference on Trade and Development

UNIDO - United Nations Industrial Development Organization

US - United States

WTO - World Trade Organization

Figure 1 – Publications with the words ‘Global Value Chain’ in the title, abstract or keywords*



* The scientific fields are i) business management and accounting, ii) economics, econometrics and finance, and iii) social sciences

Source: Scopus

Table 1: Keywords used to identify relevant contributions

	Synonyms and alternatives
Global Value Chains	“Global Value Chain*” OR “Global Production Network*” OR “Global supply chain*” OR “export processing zones”
Developing countries	“Developing countr*” OR “developing econom*” OR “developing market*” OR “emerging countr*” OR “emerging econom*” OR “emerging market*” OR “third world” OR BRICS OR “Global South” OR “transition countr*” OR “transition econom*” OR “transition market*” OR “rising power*” OR “Least developed countr*” OR “Least developed econom*” OR “Least developed market*”

Table 2: The governance structures of the GVCs

	#*	%
Market	13 (1)	34.2
Modular	5 (1)	13.2
Relational	11 (3)	28.9
Captive	17 (7)	44.7
Hierarchical	16 (6)	42.1
Mixed	20	52.6

*In parenthesis the number of GVCs where there was just one type of governance type.

Note: Percentages in the table refers to the number of cases for each governance type on the total number of cases where information on governance have been codified in the reviewed papers (38).

Table 3: Local Innovation in GVCs

	#	%
Product	41	82.0
Process	31	62.0
Organizational	21	42.0
Market	15	30.0

Table 4: Learning mechanisms in GVCs

		#	%
Within GVC	Mutual learning from face-to-face interactions	17	34.0
	Training by GVC lead companies	11	22.0
	Knowledge transfer from lead firms confined to a narrow range of tasks	18	36.0
	GVC pressure to adopt international standards	17	34.0
Outside GVC			
Firm	Internal R&D effort	24	48.0
	Hiring of skilled managers and workers	13	26.0
	Learning through acquisition/joint venture/licensing	10	20.0
Collective	Collective learning at the local level	12	24.0
Other	Learning from actors such as suppliers, universities	15	30.0
	Imitation from competitors	13	26.0

Table 5: A GVC Typology

	<i>GVC-led Innovators</i>	<i>Independent Innovators</i>	<i>Weak Innovators</i>
Innovation	Strong	Strong	Weak
Within GVC learning	Strong use of GVC: Face to face Training Transfer of knowledge on narrow tasks Standard pressure	Selected use of GVC: Face to face Knowledge transfer on narrow tasks	Limited use of GVC: Face to face Transfer of knowledge on narrow tasks Standard pressure
Outside GVC learning	Selected use of extra-GVC: In-house R&D Imitation Learning from local actors	Strong use of extra-GVC: In-house R&D Hiring skilled employees	Very weak use of extra-GVC
GVC governance patterns	Multi-chain governance	Multi-chain governance Relational Hierarchical	Exclusively Captive Exclusively Hierarchical

APPENDIX

The cluster analysis

We have performed k-means and hierarchical cluster analyses to identify possible groupings in our data. We ended up with three groups. The variables used for the analyses are the following:

- *Innovation* measured on a scale ranging from 0 (no innovation) to 1 (high innovation) based on the types of innovation performed (product, process, organizational and market), plus one whether product innovation was new-to-the-world;
- *Learning within the GVC* measured summing the number of the GVC channels used by the firm on the total possible cases (i.e. mutual learning from face-to-face interactions; training by GVC lead companies; knowledge transfer from lead firms confined to a narrow range of tasks; GVC pressure to adopt international standards (codified on a 0-1 scale);
- *Learning outside the GVC* measured summing the number of channels used by the firm outside the GVC on the total possible cases (i.e. internal R&D effort, turnover of skilled managers and workers, learning through acquisition/joint venture/licensing, collective learning at the local level, learning from actors such as suppliers, universities, business associations, imitation from competitors(codified on a 0-1 scale).

Table A-1 GVCs cases

Sector	Location	Methodology	Clusters	Article	
Complex products manufacturing	Aeronautics	Brazil	Qualitative	GVCi	Cafaggi et al. (2012)
	Automotive	India	Quantitative	WI	Kumar & Subrahmanya (2010)
	Automotive	India	Qualitative	WI	Krishna et al. (2014)
	Automotive	China	Qualitative	II	Altenburg et al. (2008)
	Automotive	China	Qualitative	WI	Hatani (2009)
	Automotive	Argentina	Quantitative	WI	McDermott & Corredoira (2010)
	Automotive	India	Quantitative	WI	Kumaraswamy et al. (2012)
	Electronics	China	Qualitative	GVCi	Sturgeon & Kawakami (2011)
	Electronics	China	Qualitative	II	Altenburg et al. (2008)
	Electronics	China	Quantitative	WI	Dennis Wei et al. (2011)
	Electronics	India	Quantitative	WI	Krishna et al. (2012)
	Electronics	Indonesia	Quantitative	GVCi	Kadariusman (2012)
	Electronics	Indonesia	Qualitative	GVCi	Kadariusman & Khalid (2013)
	Electronics	Malaysia	Qualitative	II	Athukoral (2014)
	Electronics	Mexico	Qualitative	WI	Sturgeon & Kawakami (2012)
	Handset	China	Qualitative	GVCi	Brandt, Thun (2011)
	ICT	China	Quantitative	WI	Sun et al. (2013)
	LCD Screens	China	Qualitative	II	Yang (2014)
	PC	China	Qualitative	WI	Yang & Liao (2010)
	Pharmaceuticals	India	Quantitative	II	Krishna et al. (2012)
Pharmaceuticals	Uganda	Qualitative	II	Haakonsson (2009)	
Space Industry	India	Qualitative	II	Altenburg et al. (2008)	
Wind Turbine	China	Qualitative	II	Lema et al. (2013)	
Traditional manufacturing	Construction	Ghana	Quantitative	II	Fu et al. (2014)
	Diamond Cutting	Botswana	Qualitative	WI	Mbayi (2011)
	Food processing	Colombia	Qualitative	II	Meléndez, Uribe (2012)
	Food Processing	Ghana	Quantitative	II	Fu et al. (2014)
	Football	China	Qualitative	II	Nadvi (2011)
	Football	Pakistan	Qualitative	WI	Nadvi (2011)
	Footwear	Brazil	Qualitative	WI	Navas-Aleman, (2012)
	Footwear	Vietnam	Quantitative	WI	Tencati et al. (2008)
	Furniture	Brazil	Qualitative	WI	Navas-Aleman, (2011)
	Garment	Indonesia	Qualitative	GVCi	Kadariusman & Khalid (2013)
	Garment	Kenya	Quantitative	WI	Kaplinsky & Wamae (2010)
	Garment	Madagascar	Quantitative	WI	Kaplinsky & Wamae (2011)
	Garment	Vietnam	Qualitative	II	Goto (2012)
	Garment and Textile	Ghana	Quantitative	II	Fu et al. (2014)
	Surgical Instrument	Pakistan	Quantitative	GVCi	Nadvi & Halder (2005)
	Textile	India	Qualitative	WI	Padmanand & Kurian (2014)

Natural resources	Coffee	Brazil	Qualitative	GVC	Cafaggi et al. (2012)
	Floriculture	South-Africa	Quantitative	GVC	Matthee et al. (2006)
	Fresh Fruits	Brazil	Qualitative	WI	de Castro Souza & Neto (2010)
	Seafood	Vietnam	Quantitative	WI	Tencati et al. (2010)
	Vegetables	Guatemala	Qualitative	WI	Padilla-Perez (2014)
	Wine	South-Africa	Qualitative	WI	Ponte & Ewert (2009)
	Wood	Gabon	Qualitative	WI	Kaplinsky et al. (2011)
	Wood	Thailand	Qualitative	WI	Kaplinsky et al. (2011)
Services	Film	South-Africa	Qualitative	WI	Barnard & Tuomi (2008)
	Software	India	Qualitative	II	Altenburg et al. (2008)
	Software	Bangalore (India)	Qualitative	WI	Chaminade & Vang (2008)

Table A-2 Geographical distribution of the GVCs

	#	%
Asia (China)	30 (11)	60.0 (22.0)
Africa	11	22.0
Latin America	9	18.0
Total	50	100.0

Table A-3 Sectorial Specialization of the GVCs

		#	%
Traditional manufacturing	Clothing, Footwear, Furniture, Sport Goods, Diamond Cutting, Food Processing, Surgical Instruments, Construction	16	32.0
Natural resource-based	Coffee, Wine, Floriculture, Seafood, Fruits and Vegetables, Wood	8	16.0
Complex products	ICTs, Pharmaceutical, Aeronautics, Space Industry, Wind Energy, Automotive	23	46.0
Services	Software, Movies	3	6.0

Table A-4 Main focus of the papers included in the review

	#	%
Firms	10	20.0
Cluster	12	24.0
Regional	5	10.0
National	23	46.0
Total	50	100.0

Table A-5 GVC groups

	Innovation (0-1)	Learning within the GVC (0-1)	Learning outside the GVC (0-1)	ANOVA p-values
GVC-led Innovators	0.69	0.69	0.43	0.000
Independent Innovators	0.68	0.16	0.50	0.000
Weak Innovators	0.33	0.27	0.14	0.000

Table A-6 Local Innovation Systems across GVC groups

	Local Innovation Systems			Chi-Square Sign.
	Weak	Medium	Strong	
GVC-led Innovators	12.5%	75%	12.5%	0.014
Independent Innovators	54%	38%	8%	
Weak Innovators	94%	6%	0%	
Total valid cases	22	12	2	

Note: Percentages in the table refers to the number of cases in each GVC types with weak, medium or strong local innovation systems (LSI) on the total number of cases where LIS have been codified in the reviewed papers.

Table A-7 Learning mechanisms across GVC groups

	GVC-led Innovators # (%)	Independent Innovators # (%)	Weak Innovators # (%)
Within the GVC			
Mutual learning from face-to-face interactions	6 (67%)	4 (29%)	7 (26%)
Training by GVC lead companies	6 (67%)	0 (0%)	5 (19%)
Knowledge transfer from lead firms confined to a narrow range of tasks	5 (56%)	5 (36%)	8 (30%)
GVC pressure to adopt international standards	8 (89%)	0 (0%)	9 (33%)
Outside the GVC			
Internal R&D effort	6 (67%)	13 (93%)	5 (19%)
Turnover of skilled managers and workers	3 (33%)	8 (57%)	2 (7.4%)
Learning through acquisition/joint venture/licensing	2 (22%)	6 (43%)	2 (7.4%)
Collective learning at the local level	2 (22%)	5 (36%)	5 (19%)
Learning from suppliers, universities, business associations	5 (56%)	5 (36%)	5 (19%)
Imitation from competitor	5 (56%)	5 (36%)	3 (11%)

Note: The numbers refer to the number of cases observed in each GVC typology and the percentage refers to the share of firms that uses a given learning mechanisms in each GVC typology.

Table A-8 Governance patterns across GVC groups

	GVC-led Innovators # (%)	Independent Innovators # (%)	Weak Innovators # (%)
Market	4 (44%)	1 (14%)	8 (36%)
Modular	2 (22%)	2 (29%)	1 (5%)
Captive	4 (44%)	1 (14%)	12 (55%)
Relational	2 (22%)	4 (57%)	5 (23%)
Hierarchical	4 (44%)	4 (57%)	8 (36%)
Multi-chain	6 (67%)	4 (57%)	10 (45%)

Note: The numbers refer to the number of cases observed in each GVC typology and the percentage refers to the share of firms that falls in each kind of governance in each GVC typology.

Table A-9 Upgrading across GVC groups

	GVC-led Innovators # (%)	Independent Innovators # (%)	Weak Innovators # (%)
Upgrading (any kind)	7 (78%)	10 (100%)	9 (45%)
Functional Upgrading	6 (67%)	6 (60%)	4 (20%)
Inter-chain Upgrading	2 (22%)	1 (10%)	1 (5%)
Social Upgrading	1 (11%)	4 (29%)	8 (30%)
Environmental Upgrading	2 (22%)	4 (29%)	9 (33%)

Note: The numbers refer to the number of cases observed in each GVC typology and the percentage refers to the share of firms by type of upgrading in each GVC typology.

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