



Deliverable 1.2

Windows of Opportunities, Global Value Chain and Catching Up

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**Catching–Up along the Global Value Chain: Models, Determinants and Policy
Implications in the Era of the Fourth Industrial Revolution**

Windows of Opportunities, Global Value Chain and Catching Up

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Key Findings

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WINDOWS OF OPPORTUNITIES, GVCs AND CATCHING UP

How the restructuring of GVCs opens windows of opportunities

Abstract

The rise of GVC has revolution the way that production process are carried out: production processes are sliced up and activities are dispersed to locations and firms that can produce products most efficiently. Innovation increasingly take place in global networks and due to the crucial impact on international information exchange and collaboration on the generation and diffusion of knowledge and innovation, the literature has stresses the needs to bring together the national innovation system and global value chain framework. A the same time, GVC and the related globalization of innovation could be seen as a relevant “window of opportunity” for firms and industry in developing countries that could trigger a catching up process. This work reviews the contributions that represent the main references in this debate.

Introduction

In the 1990s, some changes in the organization of production as far back as the 1960s converged towards a new configuration of production processes and international division of labour (Arrighetti and Ninni, 2014). One of the dominant features of this new paradigm is international fragmentation of production which is defined as the segmentation and reorganization of previously integrated production activities over a network of production plants located in different countries (Jones and Kierzkowski, 1990). Consequently, several multi-country and inter-industry networks of supply and production – the so-called Global Value Chains (GVC) – arise with a relevant impact on trade and production.

Starting with Jones and Kierzkowski (1990), both theoretical and applied economic literature has devoted increasing attention to the effects of this new production paradigm on different fields of economic research. Besides changing the nature of international trade “from trade in goods to trade in tasks” (Grossman and Rossi-Hansberg, 2008) or “from selling things to making things” (Baldwin, 2011), the new

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production paradigm also modified the industrialization process (Baldwin, 2011) and changed substantially the nature of the catching-up process¹ by firms in latecomer countries (Iizuka and Soete, 2011).

Specifically, in the late 20th and early 21st centuries, for developing nations industrialization and participation in the international production systems became easier and faster: they could industrialize by joining a sectorial supply chain as a supplier of intermediate goods and services used in other countries' production rather than building the whole supply chain of a final product (Baldwin, 2011).

Moreover, according to some authors (Feenstra and Hanson, 1996; Deardorff, 2011; Grossman and Rossi-Hansberg, 2008), international fragmentation of production can be considered a specific technological change, being an effective vehicle of international diffusion of technological innovation through the adoption of new production techniques and the exchanges of tacit and codified knowledge and ideas. An emerging empirical evidence (Farole and Winkler, 2014) suggests that also in developing countries supply chain linkages are one of the main transmission channels of knowledge and technology spillovers between foreign and domestic firms.

Therefore, the catching up process can no longer be disentangled from the rapid internationalization of science, technology and innovation that occurs within GVC (Iizuka and Soete, 2011).

In particular, international fragmentation of production and the strictly related globalization of innovation could be seen as a relevant "window of opportunity" for firms and industry in developing countries that could trigger a catching up process. Indeed, according to Lee and Malerba (2017), a "windows of opportunity" is a turning point that allow latecomers to departure from the path followed by leaders. The opening of the window may occur as a result of changes to the prevailing production paradigm or because of major modifications in government regulations or policy interventions.

¹ Lee and Malerba (2017) define "catch- up" as the process of closing the gap in global market shares between firms in leading countries and firms in latecomer countries.

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New lines of research are emerging that aims to reconcile development research on GVCs with innovation studies, also from a catch up perspective. The purpose of this work is to provide a review of this rich intellectual work, focusing on the contributions that represent the main references of the current debate.

2. GVC participation and innovation at country level

The relationship between GVC participation and innovation depends on the stage of development of the partners involved in the GVC and on how far they are from the technological frontier. In particular, according to Tajoli and Felice (2018), although the participation in a GVC is a potential source of knowledge and innovation spillovers also for developing countries, due to the involvement in very specialized stage of production, but it needs not to be innovation-fostering for everyone. These authors empirically investigate the relationship between participation in GVCs and the innovation performance of countries that differ in terms of development stage.

Following Malerba et al. (2013), they proxy a country's innovation performance by patent per capita and build spillover variables by weighting the aggregate R&D stock of partners supplying inputs with two measures of participation in GVCs (the share of foreign value added in a country's gross exports and the offshoring index). They obtain these "trade in value-added"² measures using the 2016 release of the World Input-Output Database (WIOD)³ and splitting developed and developing countries based on World Bank classification for "higher income" and "lower- and upper-middle income" respectively.

² In the early 21st century, trade in value added has emerged as a novel, relevant topic of research in international economics. This field of study seeks to allocate the value added in gross trade flows to its country and sector of origin and destination in order to quantify more appropriately a country's engagement in international production and provide a better understanding of the nature and extent of global supply and production networks.

³ The 2016 release of the World Input Output Database provides global input-output tables for 43 countries and 58 sectors of activity (2-digit, according to the ISIC nomenclature rev.3) for the period 2000-2014.

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Their country-level analysis shows that on average the involvement of a country in GVCs is positively related with its innovation performance when the R&D stock level of the partners is taken into account, suggesting that international fragmentation of production can be a channel of international knowledge spillovers. In particular, considering the stage of development of partners involved in the GVC, they find that significant international knowledge spillovers in GVC emerge for developing countries sourcing inputs from advanced ones.

Finally, their country-level analysis confirms that the potential benefits of participation of developing countries' firms in GVC originated in advanced countries depend crucially on the specific economic environment of the participating countries. That result confirms the observation by Kowalski et al (2015), according which in developing countries improving institutions directly involved in the business environment is relevant to maximize the benefits from GVC participation.

3. GVC participation and innovation at firm level

Numerous empirical studies investigating the innovation process in GVCs also from a firm-level perspective. Recently most of this literature has been ably reviewed and synthesized by De Marchi et al. (2018), in order to offer some general preliminary conclusions about to what extent, and under what conditions, developing country firms benefit from being part of a GVCs in terms of their capacity to innovate.

Analysing 31 papers covering 50 GVCs in different sectors and developing countries, De Marchi et al. (2018) observe that the patterns of innovation among firms located in developing countries and involved in GVCs are heterogeneous. Therefore, using cluster analysis to classify the cases, they suggest a novel typology of local GVC innovators.

In order to explore how innovation takes place in firms from developing countries involved in GVCs, these authors propose to look at this issue through the learning mechanism of the firms, both within and outside the GVC (firm level, collective level and other external).

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Based on firm's innovativeness and main learning mechanisms used, De Marchi et al. (2018) identified 3 groups of local innovators in GVCs, within the 50 GVCs analysed: (a) *GVC-led Innovators*, characterized by high levels of innovativeness and use of all possible learning channels within the GVCs; (b) *Autonomous Innovators*, including GVCs with local innovative firms, whose sources of learning are mainly outside the GVC and (c) *Marginal Innovators*, which includes GVCs displaying low to moderate innovative performance, whose firms draw on some sources of knowledge inside the GVC but rarely use external sources of learning.

Although the analysis is based on empirical evidence from studies of GVCs and innovation, the results of the cluster analysis show that, overall, just under a fifth (18%) of the cases analysed fall into the *GVC-led innovators* group and under a third (28%) into the *Autonomous Innovators*. The large majority (54%) of the GVCs analyzed belong to the Marginal Innovators group, leading De Marchi et al. (2018) to conclude that the GVCs might be the locus of innovation, but the presence local level and extra-GVC learning mechanisms seems to be a fundamental condition for the achievement of local innovation.

4. GVC participation and innovation at sectoral level

A sectoral perspective is relevant to analyse the determinants of the catch-up process because it identifies the different key elements that are specific to each industry, and emphasizes the international, national and local conditions that may amplify or hinder sector-specific evolutionary mechanisms.

While in the past catch-up was concentrated mostly in traditional industries in which low labour cost was the main determinant of integration in GVC, more recently firms from emerging economies are catching up in high-technology industries in which innovation plays a major role. Focus on China's mobile communications industry, Li et al. (2019) observes that the catch-up of latecomer firms has been associated with R&D, capability accumulation and an institutional context conducive to learning and innovation.

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However, according to Tajoli and Felice (2018), innovation through knowledge spillovers can occur also in traditional sectors - such as textiles or agriculture - thanks to the use of new production techniques adopted by participating in GVCs and it can diffuse to other industries of the economy through domestic value chains that receive inputs produced with new technologies. Previous empirical literature supports the view that catch-up innovation can occur in traditional industries.

A relevant example is presented by Nadvi (2011) that analyses a football manufacturing by a Taiwanese-owned company based in Dongguan, China, which patented a machine to stitch high-quality footballs in the mid-1990s. Due to this new machinery China boosted its productivity and ousted traditional Pakistani hand-stitching firms from the market. The results has been a shift in export leadership in the football manufacturing market from Pakistan to China.

Another significant case of a new-to-the-world innovation in a traditional sector is described by Cafaggi et al. (2012), analysing the development of new varieties of coffee, obtained via genetics research conducted in a joint venture involving some local companies and the GVC lead firm – Illycaffè from Italy.

5. GVC and innovation system

The conclusion by Tajoli and Felice (2018) and De Marchi et al. (2018) are strictly in line with the new line of research on innovation systems (IS) that suggest that innovation in local firms may be influenced by external sources, based on their links to other organizations in the national and/or regional innovation system. Indeed, traditional literature on IS did not to emphasize the crucial impact of international knowledge and innovation exchange and collaboration through, for example, inter-firm and intra-firm networks and global value chains (GVCs)⁴.

⁴ A lot of insight from both GVC and IS literature is in debt with Abramovitz (1986), according which catch up is a process going far beyond the mere adoption of new technologies and depends on the ability of latecomers countries to build some 'technological congruence' with leaders as well as on their own 'social capabilities'. This latter concept refers to issues such as technical competence, education, infrastructure and the broader institutions supporting the building up of technological capabilities.

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Pietrobelli and Rabellotti (2011) was a pioneering attempt at dealing with the analysis of how innovation systems and GVCs interact or how this interaction is likely to affect enterprise learning. Three are the main conclusions that emerge from their analysis: (i) learning mechanisms can vary widely within the various forms of governance of GVC; (ii) as innovations systems are “opened” to foreign sources of knowledge, the relationship between GVC and IS allows all actors involved to benefit, reducing transaction complexity and enabling transactions based on relational forms of GVC governance; (iii) the internal governance of a GVC is a dynamic phenomenon that is subject to continuous adjustments and changes and the nature of the innovation system affects this co-evolution.

These authors has opened up a new line of research on innovation systems, that highlights that the innovation process in firms involved in GVCs may not depend only on the GVCs’ and firms characteristics but also from the aptitudes of developing countries of investing in their own capability-building institutional apparatus and encouraging and promoting firm-level learning via targeted innovation policy interventions.

This line of research encounter catch up perspective in Malerba and Nelson (2011), which studied catching-up’ in six sectoral innovation systems. These authors find that industries differ regarding how they link up with international firms. In some successful cases of catching up (automobiles in Korea), access to foreign technology was crucial, while in other cases (software, semiconductors and agro-food), multinationals operated as customer lead firms in global value chains. However, what is worth noting for the present work is that to explain success and failure in catching-up Malerba and Nelson (2011) argue that it is necessary to link the analysis of sector characteristics to the analysis of the national innovation system.

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More recently, in the attempt to seek a linkage between the GVC and IS approaches, Lee et al. (2018) offers relevant contributes to the debate from a catch-up perspective⁵.

First, the authors aim at verify a hypothesis stating that: (i) at the initial stage of growth by a latecomer, increased participation in the global value chain (GVC) is necessary to learn foreign knowledge and production skills; (ii) then, functional upgrading at middle-income stage requires effort to seek separation and independence from existing foreign-dominated GVCs and (iii) finally, that latecomer firms and economies might have to seek reintegration back into the GVC after establishing their own local value chains.

Following one of the pioneering attempt in empirical literature on trade in value added dealing with measurement issues related to the international fragmentation of production Hummels et al. (2001), Lee et al. (2018) measure participation in the global value chain (GVC) in terms of share of foreign value-added (FVA) in gross exports.

Therefore, according to his hypothesis, the trend of the FVA of latecomer countries would increase initially. However, that share would decline at the upper-middle middle-income stage when countries attempt to create more domestic value-added (DVA), reducing the FVA component of exports⁶. Finally, the share of FVA in

⁵ Thanks to Abramovitz (1986)'s pioneering contribution, the literature on innovation systems in developing countries has shifted the emphasis in the catch-up debate from resource endowments and comparative advantages, to institutional variables, capabilities, and the dynamic creation of competitive advantage. In this literature, catch up requires creative adaptation and innovation along and beyond the pathways followed by leaders, skipping some stages or create their own development trajectory (Lee and Lim, 2001).

⁶ Hummels et al. (2001) measure the imported input content of exports (or foreign value added embodied in exports), proposing a primary index of vertical specialization (VS) at sectoral level. More recently, Koopman, Wang and Wei (2014) have introduced the first rigorous decomposition of gross exports at country level. Their accounting framework disentangles gross aggregated exports into the sum of three basic components: domestic value added destined for direct importing partners or third countries (DVA), domestic value added in intermediate exports that returns home from abroad (RDV), and foreign value added embodied via imports of intermediate inputs in the country's gross exports (FVA).

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gross exports increase again at the high-income stage with the enhanced innovation capabilities and reintegration into the GVC. The empirical analysis of the trends of FVA in successful catching-up economies of Korea and Taiwan, including China recently, are consistent with this pattern.

Second, Lee et al. (2018) analyse the linkage between local knowledge (one of the key variables in innovation system) and the GVC variable of the FVA. The aim is to verify if this linkage could explain the positive relation between the level of local knowledge and the economic growth, proven by Lee (2013; Chapter 3). The regression results in Lee (2018) confirm the negative correlation between the degree of local creation and diffusion of knowledge and the values of FVA, arguing that the increasing DVA creation is the intermediate links between local knowledge and economic growth.

This finding implies that building national innovation systems (NIS) is one of the keys to enable the upgrading and DVA creation during integration in the GVC and the role of the NIS changes at each stage of the catch-up process. According to Lee et al. (2018), at the first stage the role of the NIS is to supply the workforce with primary and secondary education, as well as physical and social infrastructure to attract FDI. At the upper-middle middle-income stage the NIS role is to involve the government in helping domestic firms to seek independence, including strengthening local education and training systems, promoting inhouse (and public–private) R&D and offering help in the case of disputes with incumbent firms.

6. Conclusion

This overview has selected the main contributions by the most recent literature to identify a *fil rouge* that links GVC participation, innovation systems and catch up, covering the frontiers of current knowledge on all these issues in a world that is characterized by international fragmentation of production.

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From both country and firm perspective, the relationship between GVC participation and innovation does not depend only on the GVCs' and firms characteristics but the national innovation systems has a key role to enable the upgrading and DVA creation during integration in the GVC in both traditional and high-tech sectors.

This role is recognized also adopting a catch-up perspective, observing how this role of the innovation system evolves at each stage of the catch-up process.

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