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Global Value Chains in the Era of 4IR: New Paradigm of Business Models for SMEs

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This paper presents a brief literature review of previous studies methodologies, models, and contexts in studying firms' upgrading in Global Value Chains (GVCs). The key context of this paper is set within Fourth Industrial Revolution (4IR). Through the literature review, this paper offers to identify the opportunities of theoretical novelty and ways to elaborate on understanding firm dynamics in Global Value Chains in the context of 4IR. The approach based on Business Model (BM) innovations and new forms of organizing for business (such as platforms) is used to synthesize from previous research findings and build on to newer explanations of firms' entry, learning, and upgrading within GVCs.

Keywords: Fourth Industrial Revolution, Business Models, Global Value Chains

Unlike the previous industrial revolutions which were characterized by mechanization, electrification, and digitization respectively, the Fourth Industrial Revolution (4IR) is characterized by the integration of cyber-physical systems, drawing on such core technologies as 3D printing, big data, sensor networks, and intelligent real-time processing (Moavenzadeh, 2015).

4IR relies on the integration of physical processes with (cyber) digital ones, and the consequent connection of different functions within a Value Chain (VC). Yet, like in the previous industrial revolutions, 4IR will transform how goods and services are produced and delivered. Notably, the digitization of certain products, as well as the ability to collect and track vast amounts of customer data and 3D printing technology, has made it easier to meet customer demand more accurately and efficiently.

By making the borderline between the physical, digital, and biological spheres even fuzzier, 4IR might lead to the shift in the form in which human and economic interactions occur and consequently how value will be created and distributed. Besides the implications for how firms do business, most likely it will create opportunities to upend industries, emerge, and grow (Müller, Buliga, & Voigt, 2018).

Global Value Chains (GVCs) have emerged as a significant means by which powerful Multinational

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Corporations (MNCs) organize their operations amongst multiple suppliers (Laplume, Petersen, & Pearce, 2016). Thus, GVCs are a form of international trade in intermediate goods between an MNC and its globally dispersed suppliers or buyers. This sort of trade in the intermediaries accounts for two-thirds of all global trade (World Bank and World Trade Organization, 2019). Often but not always, GVCs take the form of offshoring labour-intensive processes to lower-cost regions, particularly developing countries, where MNCs may partner with local firms, including SMEs. This has facilitated the economic rise of many such SMEs, particularly in Asia, as well as MNCs for whom GVCs are central to their Business Model (BM). However, widespread availability of standardised intermediaries can lead to the proliferation of homologous products in a market and intense price-based competition (World Bank and World Trade Organization, 2019).

In GVCs, 4IR advancements could lead to strategic on-shoring and near-shoring as automation and 3D printing reduce the incentive to seek out low-labour cost production sites. Furthermore, shipping services might decline in importance as homes or local communities acquire 3D printing capabilities (Moavenzadeh, 2015). Furthermore, 4IR can affect how VCs are interconnected, enabling greater transparency and real-time automated coordination between VC members (Müller et al., 2018). This would have the consequence of weakening the importance of a major source of competitive advantage for multinational firms—their ability to coordinate production internationally—thus perhaps making room for SMEs to be more competitive in consolidated industries (Laplume et al., 2016).

Until now, catching up processes have been based on labor costs differentials and on the development of export-oriented manufacturing and their ability to develop national linkages. These same factors that were critical for the catching up development story in emerging economies also determined the limits of that same catching up process. Indeed, many countries are stuck into the so-called “middle income trap” as the domestic wages rise but the local products remain in low-end segment (Lee, 2013). In this context, the “Industry 4.0” and the “smart factory” may create even further challenges for developing countries, as they permit significant reductions of the waste and production costs, in particular of labor costs. These have permitted the manufacturing of several commodity products to be brought back to developed countries and to be produced at similar or lower costs than in developing countries. Yet, the 4IR may also uncover new opportunities for entry and for proceeding with catching up. For example, China is the leader in the number of robot factories installed. In sum, the 4IR may reveal both the prospect for further catching up and an additional limitation for emerging economies.

Prior literature also falls short in explaining learning and upgrading in GVCs on the verge of a major technological disruption that will affect the traditional forms in which firms interact with their ecosystem in the process of creating, sharing and appropriating value. International business literature has focused on explaining how firms become part of GVC, the sources of their competitive advantage, and best practices in international markets. The innovation and the organizational literatures have focused on the process by which firms learn and innovate, in particular on how firms deal with technological disruptions.

Despite taking a different theoretical focus and evidence being scattered and sometimes contradictory, it seems consensual to affirm that this process of entry, learning, and upgrade is not uniform across firms, industries or countries or sequential, i.e., the fact that a firm enters in a GVC or that it learns and innovates is not automatically leading to upgrade. Due to their distinct theoretical and empirical approaches, we still know little about how participation in GVC may foster firms’ ability to learn and innovate, as well as the organizational strategies that enhance possibility of upgrading in GVC that is on the verge of a major technological disruption, the form in which firms in a GVC create and appropriate value.

We propose to address this gap in the literature by linking both the international business and the innovation and organizational approaches. We will do that by taking a BM perspective of the firms in GVC.

Theoretical Background

International Business Literature

The Ricardo and Heckscher-Ohlin traditional models of comparative advantage of countries stress that countries may trade even if they are more efficient to produce internally, and that they tend to export products that use inputs that are abundant and cheap in the country, while importing products that use inputs relatively scarce in the country. These traditional models were however unable to explain intra-trade. More recent contributions stressed the importance of tariffs, transportation costs, demand tastes and regulations, in particular environmental regulations in understanding trade, but also of countries' technology and competences.

Being more empirical and focusing on firms rather than on countries as actors of trade, the international business literature focuses on explaining the international comparative advantage of firms. It tries to explain why some firms than others are more likely to participate in international trade, how knowledge is transferred across countries and plants, and how best practices emerge and diffuse in international markets. Specifically on participation in the international markets, prior literature shows that not all firms export because exporting involves sunk cost and only the most productive firms venture into exporting (Greenaway & Kneller, 2007). Additionally, exporting firms seem to differ significantly from those that only trade in domestic markets, which concerns their competencies to face greater competition and more demanding customers, and to innovate (Cooper & Kleinschmidt, 1985; Roper & Love, 2002).

Some efforts have also been in examining GVCs' decisions and performance. In particular, recently, borrowing from the on-going debate on the transaction costs and resource based-view approach to governance, the theoretical contributions have been discussing the governance mode of the interactions with external and foreign partners. Benito, Petersen, and Welch (2019) argue that dynamic considerations, such as learning across the GVC, are difficult to be encompassed in decisions related to efficiency and foreign operation mode.

This is most in line with some empirical evidence on the two main sources of learning, and ultimately upgrading, for an SME in a GVC context. First, SMEs that engage in direct GVC participation benefit from the direct transfer of knowledge from MNCs, often either by pressure to attain corporate standards (including the adoption of 4IR technologies for greater VC integration) or by the direct involvement of VC leaders (MNCs) in the operation of the SME when competence is low (Ernst & Kim, 2002; Lensson et al., 2006). This transfer of knowledge, observed when a firm introduces a new (to firm) product or process, occurs for two main reasons.

First, MNCs often have a greater breadth and depth of experience than SMEs, gained from operating over long periods in multiple locations and countries at the technological frontier; and, MNCs or large firms in general are often better (financially) equipped to invest in the R&D, high skilled talent, risk etc., necessary to experiment with and develop applications for 4IR (Shefer & Frenkel, 2005).

Second, an SME may attain upgrading from a GVC through spillovers. "Spillovers are externalities that accrue from one firm to another, and […] imply a process of learning by the recipient firm…" (Narula & Marin, 2005, p. 2). Spillover effects are most clearly observed in industrial clusters (Giuliani, Pietrobelli, & Rabellotti, 2005; Lema, Quadros, & Schmitz, 2015; Oyelaran-Oyeyinka, 2005); yet there is evidence in the wider international business literature that hints that such externalities may extend beyond localised effects to affect much of an industrial sector. Durand (2007) for instance shows that by applying supply chain practices

developed in the US to its Mexican operations, the MNC Wal-Mart accelerated the modernisation of Mexican SME retail firms while driving down worker remuneration across the industry. These externalities may be due to competitive pressures, imitation, and informal knowledge flows (for example through the movement of workers) (Durand, 2007). They have also been attributed to demonstration effects, copying, and reverse engineering (Roper, Love, & Bonner, 2017).

Hence, some social mechanisms such as inclusion of non-business intermediaries, joint strategizing, multilateral feedback, or rules for equitable value distribution may become relevant to coordinate routine and innovation activities across multiple external and foreign partners, and consequently to foster innovation capability development across GVC (Kano, 2018).

In sum, taking an international business approach, prior literature had documented extensively on why some firms participate in international trade and others not, as well as on difficulties of knowledge transfer and coordination of activities across a GVC, with multiple external and foreign partners. Still, when considering the issues of coordination of innovation and knowledge transfer, it has often taken the view of the multinational lead firm, and it has often focused on processes associated with innovation in the products and their associated production techniques. Hence, it does not tell us much about how firms can enter, learn, and upgrade within a GVC, especially when new technologies are revolutionizing the mode in which firms conceive production and consequently the interaction with partners along the VC.

Innovation and Organizational Approaches

The innovation literature has provided extensive evidence on the continuous and radical processes of innovation, as well as on how firms react to technological disruptions. This literature has stressed the particular relevanance in the process of innovation development, of the (vertical) supply-chain partners, customers, and suppliers, which are sources of technological and market knowledge (Bodas Freitas & Fontana, 2018; Clark & Fujimoto, 1991), but also of horizontal partners, such as universities or firms in other industries that extend the possibilities of firms to access to new knowledge and resources (Belderbos, Carree, & Lokshin, 2004).

This literature has also examined extensively the effects of technological disruptions. Evidence suggests that technological disruptions are a challenge for existing firms if they are not able to accommodate them in their product architecture (Henderson & Clark, 1990) and if their value-chain partners are slow to accommodate the required changes (Tsai, 2004). Overcoming technological disruptions seems associated with firms' ability to identify the nature of the challenge, to identify the relevant lead users, and to established relationships that allow early access to resources and markets.

More recent contributions have examined platforms, as a specific new mode of organizing relationships in the ecosystem, which has become possible due to improvements and wide diffusion of digitalization and IT. A platform-based organization of firm and its VC partners includes a focal hub firm that coordinates and orchestrates activities between the firms and facilitates for the production of an integrated product or service (Iansiti & Levien, 2004). That is, this organization between firms leverages contributions from a firm's horizontal VC partners and integrates it with contributions from its vertical supply chain partners. This permits the generation greater value for the end user (Van Alstyne, Parker, & Choudary, 2016). Additionally, digitalization has enabled these platforms as new forms of intermediaries that could reduce transaction costs (Hagiu & Yoffie, 2009).

These approaches however have focused on the set of relationships, and on the strategies to innovate by the lead firms. While some efforts have been made to test the performance of firms within and outside the platforms, no attempt has been to examine the BM of the SME in the platform, and how they innovate their BM to accommodate technological disruption. In addition, this literature tends to focus on very specific industries such as semi-conductors, video games, which are not those ones where manufacturing and production activities are prevalent, hence GVCs are less relevant.

Moreover, it is well-known that firms operating in different technological regimes face different innovation challenges. Examining the benefits of high R&D spending and the innovation rates in situations with different levels of difficulty to innovate and imitate, Nelson and Winter (1982) argue that the possibility to attain higher productivity rates and the imitator achieving higher productivity depends on the technological regimes in which the firms operate. Hence, we simply know little about how firms operating in different industries can enter, learn, and upgrade in GVC in the face of a technological disruption.

Business Models

"At a very general and intuitive level, a BM is a description of an organization and how that organization functions in achieving its goals (e.g., profitability, growth, social impact, …)" (Massa, Tucci, & Afuah, 2017, p. 73). BMs thus encompass value creation, offer, and capture. Value creation refers to all the production steps that a firm undertakes. Value offer is often thought of as lying in a spectrum ranging from services-only to product-only including products that are delivered as services. Value capture refers to how a firm is paid for its offer, whether the product is sold outright, as a subscription, per-feature, etc. (Müller et al., 2018).

The BM represents interactions across firm boundaries along the VC (Zott & Amit, 2007; 2008). This representation of the processes emerges as firms interact with each other, providing a network of firms according to their roles in the capture and distribution of value (Hacklin, Björkdahl, & Wallin, 2018). As the VC involves key partners in the process of capturing and distributing value, they might be difficult to substitute. This forms a network of partner firms that play a role in the evolution of a given BM according to their various interests (Tikkanen, Lamberg, Parvinen, & Kallunki, 2005; Ansari, Garud, & Kumaraswamy, 2016). Thus, while describing how the firm "does business", by describing routines and actions, the BM necessarily implies a set of relationships (Zott & Amit, 2013).

This raises an important question of: When faced with constant technological and market changes, how do firms' network of partners and their BM reflect firms' learning and innovation? It is through this network of interactions that value generation processes are problematized, and thereby lead to the potential of innovation and stagnation, which is then encapsulated as changes to the BM (Garud, Gehman, & Tharchen, 2018). At times, severe overhaul to the BM can become necessary due to drastic changes in the dynamic surrounding environment (Cavalcante, Kesting, & Ulhøi, 2011). The literature on BM stresses that, faced with disruptive technologies or demand changes, current relationships run the risk of being mutated, or dropped entirely, while new relationships can be forged, upon the grounds of the new, innovated, BM (Lorenzoni & Baden-Fuller, 1995). Empirically, relying mostly on case studies of large corporation, previous studies stress how IT permitted interaction throughout a network of partnered firms to cumulate into a particular BM. However, it has mostly neglected that the BM that a SME can devise might not be similar to those of large corporations, as well as that SME in developed and developing countries might be able to devise different BMs.

Conceptual Model to Examine Entry, Learning, and Upgrade in GVC in the Era of the 4IR

As elaborated before, the BM of a firm describes how the firm "does business" and the set of relationships that firms maintain with value-chain partners and other intermediaries. Given the analytical focus of the BM approach, we argue that it permits to bridge international business and innovation literatures, and consequently to conceptualize the process of change and learning in responding to disruptive technologies in the context of their GVC linkages. In doing so, we highlight how newer ways to organize for business (or production), such as in platforms, facilitate coordinated actions and responses from a firm and its network of VC partners.

Taking a firm's changes to its BM (BM innovation) and new ways of organizing for value generation (such as platforms) as the approaches may permit us to better understand how firms can accommodate changes in the products, in organization of the production and in the interaction with value-chain partners and other intermediaries. This approach will allow as well in elaborating how specific BMs may facilitate firms' entry, learning, and process of upgrading in GVC in the 4IR era than others.

4IR is expected to trigger new paradigms of BM and organizing for business, in particular within SME firms. Some of the challenges and opportunities associated with 4IR are described in Appendix A.

Conclusions

In this paper, we reviewed the various approaches in literature that serve as a lens into VC analysis pertinent to most SMEs with specific focus on the final markets, buyers, suppliers within various sectors. This review made clear that prior literature also falls short in explaining learning and upgrading in GVCs on the verge of a major technological disruption that will affect the traditional forms in which firms interact with their ecosystem in the process of creating, sharing, and appropriating value. This mainly results from fact that the international business literature, on the one hand, and the innovation and the organizational literatures have distinct theoretical and empirical approaches. This paper concludes by proposing to link the international business and the innovation and organizational approaches by taking a BM perspective of the firms in GVC.

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Appendix A

4IR challenges and opportunities for SMEs: 4IR is expected to trigger new paradigms of BM, in particular SME firms, a process known as business model innovation. The core technologies driving 4IR also underlay megatrends that are changing industrial production. Such trends include globalization, mass product customization, shorter product lifecycles and generally markets that are more volatile (Schlick, 2012). Examining these core technologies highlights BMI in a more specific manner.

Internet of things (IoT): IoT is often regarded as the core of 4IR. This is because the proliferation of cheap sensors as well as high-speed connectivity is accelerating the availability of data in production and underlies much of the cyber-physical integration characteristic of 4IR. In fact, the economics for the adoption of IoT in manufacturing, even for SMEs are so favourable that know-how, not cost, is usually the limiting factor for adoption (Quigley & Burke, 2013). IoT is the result of enabling devices with internet connectivity, thus permitting them to interact with each other, services and operators worldwide. Numerous sensors attached to machinery and feeding back to control systems enable machinery to respond real-time and independently. Production equipment thus becomes an intelligent cyber-physical system (Falkenthal et al., 2016). In advanced applications, IoT allows customers to effectively control the manufacturing process, by inputting their specifications which is fed directly to production machinery, through to delivery (Skilton & Hovsepian, 2017). In a Global Value Chain (GVC), machines can now signal their own depreciation and thus permit efficient management of preventive maintenance scheduling. Inventory can also be monitored automatically, and changes communicated to the relevant supply chain partners, thus enabling better capacity planning. Automated communication across a supply chain can reduce transaction costs, permitting the expansion of a value chain across partners and across the globe. The use of IoT in GVCs however increases the risk of systematic catastrophe whether through malicious breaches or through malfunctioning sensors (Strange & Zucchella, 2017). Furthermore, as indicated, adopting IoTs increases the reliance of firms on skilled labour. This may put SMEs up against larger firms in a struggle for talent that may prove to be too expensive for them.

Big data and analytics: The proliferation of sensors that accompanies the development of IoT, as well as the abundance of data from other sources, such as web tracking of customers, has provided firms with a trove of data. Unlike in the third Industrial Revolution (3IR) where data analysis was mainly used to monitor processes and detect analytics, in 4IR, the focus of analytics is more forward looking. Big data and analytics are increasingly used to anticipate events, opportunities, and even targeted customer behaviour. For SMEs operating in foreign markets, they can now monitor trends and patterns in overseas markets without having to invest in local marketing subsidiaries. This thus creates a new business model for firms that can track vast amounts of data who can thus sell this data to firms that cannot.

Robotics: A direct result of the proliferation of sensors that can support highly accurate control systems as well as advances in electro-mechanical design has been the ushering in of a new age of robotics in production. The reduction in communication costs that accompanied 3IR as well as advances in transportation had earlier encouraged firms to seek out efficiency by outsourcing labour-intensive practice to lower cost developing countries, leading to the rise of GVCs. Advances in robotics stand to shift the economics of GVCs. As robots get more advanced and increasingly capable of carrying out complex and delicate tasks and coordinating amongst themselves without human intervention, the importance of low labour costs is expected to dwindle. 4IR is therefore expected to be accompanied by a wave of onshoring as the importance of labour cost differentials narrows (Strange & Zucchella, 2017). The capital-intensive nature of robot-level automation and the costs of the highly skilled engineers required to maintain them will however likely keep SMEs at bay for a while.

3D printing: Advances in material science have led to the fusion of digital and printing technology in a process called additive manufacturing. This has permitted manufacturer in industries ranging from aerospace to footwear, to “print” parts used in their commercial products. This also reduces the need for far-flung factories, as these parts can simply be printed and fitted close

to the end customer base (Skilton & Hovsepian, 2017). Similarly, to robotics, 3D printing reduces the pertinence of low-cost labour, as much of the manufacturing process can be consolidated into printing, leaving only the assembly step. The need for international trade in intermediaries, a key component of GVCs, is therefore reduced. Rather, design may be done in a central facility and sent digitally to subsidiaries close to the consumer for final printing and assembly. 3D printing in its current form is however not susceptible to economies of scale or consequently, mass production, given its current speed. This therefore makes it more relevant for SMEs seeking to tap into demand for less commonly manufactured products or product configurations (Strange & Zucchella, 2017). 3D printing is already transforming much of how production is done, particularly for products that are small, made almost or entirely from one material and that do not have many parts. As familiarity with the technology grows, its applications are gradually extending to the production of components with complex shapes such as car parts and shoe soles, and even edibles such as rose flower-shaped cakes. 3D printing is unlikely to affect much of the industries based on the production of organic materials such as solid wood, leather, and paper; or productive activities based on the purification or refining of naturally occurring substances. These organic or naturally occurring substances are usually valued for their physical properties and these may be difficult to replicate in 3D printing (Laplume et al., 2016).

Cloud computing: The widespread availability of high-speed internet along with other computational and hardware advances has led to the servitisation of computing resources. Rather than invest in hardware that is capital intensive, expensive to maintain, and probably under-utilised for the most time especially during the low season, firms may instead contract access to computing resources, such that they only pay for what they use, and computing capability can be scaled up and down in response to real-time demand (Skilton & Hovsepian, 2017). Cloud computing gives SME access to similar computing resources as larger firms, enabling them to take advantage of other 4IR developments like big data and analytics. MNCs can also use cloud computing technology to share computing resources with SME in their GVC.

Virtual and augmented reality: VR is three-dimensional space modelled by software, aiming to represent a real or imaginary setting. Augmented or mixed reality (AR) on the other hand involves introducing digital objects into a physical space which can then be viewed using equipment possessing specialized lenses. AR and VR are being used to model and tweak new products across a GVC without the need for shipping prototypes or labour back and forth—with the attendant cost and time implications (Skilton & Hovsepian, 2017).

Quantum computing: Quantum computers differ from classical computers in that they are based on qbits. Unlike the bits in classical computers which can exist in a 1 (on) or 0 (off) state, qbits can exist in a superposition of both 1 and 0 at the same moment. Although this technology is still in its infancy, it has been demonstrated to exceed the capabilities of classical computers in some respects, and is expected to have broad application in cryptography, simulations, and optimisation (Brooks, 2019; Mohseni et al., 2017).