

Global Value Chains and Technological Capabilities: A Framework to Study Industrial Innovation in Developing Countries ^{*}

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ABSTRACT

This paper presents a critical review of the Global Value Chain literature in light of the “Technological Capabilities” approach to innovation and learning in LDCs. It intends to contribute to the GVC approach by setting out an original research agenda for studying their impact on upgrading technological capability building. This form of industrial organization may be particularly beneficial for firms located in LDCs, which are bound to source technology internationally. However, the issues of learning, technological efforts and investments to create and improve technological capabilities at the firm-level remain largely uncovered by this strand of literature.

We argue that explicitly addressing these issues within the global value chains literature by using the concepts developed by the technological capabilities literature may importantly contribute to explain developing countries’ firms performance, and why and how they benefit in different degrees from participating in global value chains.

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1 Introduction

In these days nobody would resist the contention that learning and innovation are key determinants of competitiveness and growth of nations, regions, clusters and firms. Sometimes, more refined observers would stress that competitiveness is affected by firm-specific attitudes and actions and also by the industrial, organizational, meso and macroeconomic contexts in which firms are inserted. Yet, these ideas need to be integrated and encompassed in a consistent fashion, and this has been achieved only occasionally, and perhaps more effectively by business scholars than by conventional economists.

In developing countries (LDCs), following an established line of thought on the international sources of development – e.g. “learning by exporting, FDI spillovers - the Global Value Chain (GVC) approach has recently shown how international linkages play a crucial role to access technological knowledge and enhance learning and innovation (Gereffi, 1994 and 1999; Kaplinsky, 2000; Humphrey and Schmitz, 2002 a and b). Within this framework, several empirical studies have shown that the interaction between global buyers and local producers in LDCs may generate learning and innovation activities (Nadvi and Schmitz, 1999; Schmitz and Knorringa, 2001; Gereffi *et al.*, 2005; Giuliani *et al.*, 2005). In this respect, the GVC literature has focused on how different patterns of governance may enhance or hinder different types (i.e. process, product or functional) of firms upgrading, that are themselves the result of learning and innovation activities. However, as partly recognized by some scholars (Bell and Albu, 1999; Canijels and Romijn, 2003; Schmitz, 2004), most of the studies within the GVC approach do not explicitly study how upgrading occurs at the firm-level through the external linkages taking place within value chains (i.e. the pre-conditions, the mechanics, the investments and the strategic behaviour required).

At the same time however, technological change and innovation at the firm level in developing countries have been the focus of a very fruitful school of thought developed around the concept of “Technological Capabilities” (TC) (Bell and Pavitt, 1993, Dahlman *et al.*, 1987, Katz, 1987, Lall, 1987, 1992, 2001, Pack and Westphal, 1986).

In this paper adopting an analytical framework based on the TC approach, we review how some selected GVC studies address issues of learning and innovation. We argue that, despite its widespread use, the concept of upgrading and its mechanisms within global value chains is still ambiguous. On the one hand, it suggests the idea that entering GVCs causes a sharp and automatic positive impact on local producers, neglecting that local actors have to invest in learning and building technological capability to effectively upgrade. On the other hand,

shifting the research agenda on how local firms can join value chains and on the governance structure, which is better suited for upgrading, produces a harmful neglect of the analysis of the detailed mechanisms linking value chain with learning and TC development.

In this study we propose a shift in the research agenda at the theoretical and empirical level. First of all, we argue that research should focus on the endogenous process of technological capability development, on the specific firm-level efforts, and on the contextual factors enhancing and/or hindering the process. Secondly, we claim that it is necessary to study the mechanisms allowing knowledge to flow *within* and *between* different global value chains, which in turn will make easier to unravel why some firms and/or clusters benefit more or less from being part of the GVCs. Thirdly, innovation theories and the study of the features of knowledge in the mechanisms described above may substantially contribute to improve our understanding of these complex and multidimensional phenomena. Different degrees of complexity, tacitness and appropriability of knowledge affect the GVC governance structure, the opportunity and speed of upgrading and its intensity and direction. In particular we suggest to pay attention to chain leaders' appropriability strategies and to their effect on producers' learning activities. Incidentally, these strategies can increase the private returns of individual producers who join value chains, but they can also hinder collective learning processes and have negative social effects on the cluster as a whole.

The paper is organized as follows. In the next two sections we present a brief survey of the GVC literature and of the TC approach. Section 4 is a critical review of how some selected GVC studies analyze learning, innovation and knowledge diffusion. In this section, we outline a framework of analysis by bringing explicitly the TC framework into the GVC approach. Section 5 summarizes and concludes.

2 The Global Value Chain Approach

As initially defined by international business scholars, a value-added chain is "*the process by which technology is combined with material and labor inputs and then processed inputs are assembled, marketed and distributed. A single firm may consist of only one link in this process, or it may be extensively vertically integrated...*" (Kogut, 1985). In this literature, the key issues regard which activities and technologies a firm keeps in-house and which are outsourced to other firms, and where the various activities are located.

More recently, Gereffi (1994 and 1999) and other scholars (Gereffi and Kaplinsky, 2001; Humphrey and Schmitz, 2002 a and b; Kaplinsky, 2000; Kaplinsky and Morris, 2001) developed a framework that tied the concept of value-added chain directly to the

globalization of industries with a focus on developing countries, stressing the growing importance of global buyers and producers as key drivers in the formation of globally dispersed and organizationally fragmented production and distribution networks. For firms in LDCs these external linkages represent key channels for learning and innovation.

From an analytical point of view, the value chain perspective is useful because the focus moves from manufacturing only to the other activities involved in the supply of goods and services, including distribution and marketing (Kaplinsky, 2000). All these activities contribute to add value. Moreover, the ability to identify the activities providing higher returns along the value chain is key to understand the global appropriation of the returns to economic activities.

Value chain research focuses on the nature of the relationships among the various actors involved in the chain, and on their implications for development (Humphrey and Schmitz, 2002b). The concept of '*governance*' is central to the analysis. At any point in the chain, some degree of governance is required in order to take decisions not only on 'what' or 'how' a good/service should be produced but sometimes also 'when', 'how much' and even 'at what price'. We deem necessary to write of governance, rather than only coordination, as the proactive involvement and participation of all the actors within the value chain is crucial. Governance may occur through arm's-length market linkages or non-market relationships. In the latter case, Humphrey and Schmitz (2000) distinguish three possible types of governance: a) *network* implying co-operation between firms of more or less equal power which share their competencies within the chain; b) *quasi-hierarchy* involving relationships between legally independent firms in which one is subordinated to the other, with a leader in the chain defining the rules to which the rest of the actors have to comply with and c) *hierarchy* when a firm is owned by an external firm.

This literature also stresses the role played by the GVC leaders, particularly by the buyers, in transferring knowledge along the chains. For small firms in less developed countries, participation in value chains is a way to obtain information on the need and mode to gain access to global markets and, more generally, to upgrade.

Upgrading is here intended as a strategy to augment per-unit value of products (product upgrading) or to increase the efficiency of production processes (process upgrading). More sophisticated strategies of upgrading concern the implementation of new functions in the chain (e.g. the transition from pure assembling to design activities, i.e. "functional upgrading") or the entry into new sectors (i.e. inter-sectoral upgrading). Humphrey and Schmitz (2000) discuss the relationship between upgrading and the different patterns of GVC

governance, and suggest that global buyers tend to hinder the two latter forms of upgrading. This appears to be confirmed by the evidence presented by Giuliani et al., 2005. Global buyers have indeed a clear incentive to keep their suppliers dependent on them and not to disclose their core competencies, and accordingly to discourage their attempts at developing strategic competencies, in particular those concerning design and marketing (Schmitz and Knorringa, 2001; Bazan and Navas-Aleman, 2004).

Humphrey and Schmitz (2000) conclude that insertion in a quasi-hierarchical chain offers very favorable conditions for process and product upgrading, but hinders functional upgrading. Networks offer ideal upgrading conditions, but they are the least likely to occur in developing countries. In addition, a more dynamic approach suggests that chain governance is not given forever and may change because (Humphrey and Schmitz, 2002b): a) power relationships may evolve when existing producers, or their spin-offs, acquire new capabilities; b) establishing and maintaining quasi-hierarchical governance is costly for the lead firm and heads to inflexibility because of transaction specific investments and c) firms and clusters often do not operate only in one chain but simultaneously in several types of chains, and they may apply competencies learned in one chain to supply other chains. In sum, upgrading of firms participating in a value chain depends on the nature of the relationships (governance patterns and power asymmetries) among the various actors within the chain.

Notwithstanding its important advances, in this literature there a number of issues that needs to be further addressed. Let us see them in a sequence. First of all, the concept of upgrading is rather fuzzy: is it a synonym for innovation or rather the result of it? Although “...at first glance the issue of upgrading appears to be straightforward enough. For a firm, upgrading means getting better – i.e. producing better products and producing them in a more efficient way. However, things are more difficult than that” (Meyer-Stamer et al., 2004: 328). Thus, the GVC literature has “to rethink the concept of upgrading and acknowledge that it must be a relational category” (p.330).

In international trade theory the concept of “upgrading” is frequently used in studies on the dynamics of countries’ specialization, where upgrading is meant to represent a shift towards a specialization in higher value-added goods *within the same sector*. This is different from diversification, i.e. specialization in new areas of comparative advantage *in different sectors* (Guerrieri et al., 2001). However, this notion hardly translates into a useful definition at the firm-level, and it does not reflect the current use of this term in most economics and management literature.

Indeed, in many empirical studies of upgrading we perceive a strong temptation of mixing causes and effects. Although some recent contributions advocate that upgrading needs investments and efforts at firm level (Kishimoto, 2004; Schmitz and Knorriga, 2001; Schmitz, 2004), most of the empirical analyses still lack a systematic attempt to investigate learning and innovation at the firm- and cluster- level.

For instance, when authors detect the occurrence of upgrading, they tend to invariably associate this outcome to some activity aimed at building capacity; yet this activity is at best only mentioned but not fully examined. Moreover, we claim that such an attitude impedes to provide any analytical treatment of the concept and may lead to misleading policy suggestions, as it assumes the presence of upgrading whenever a “good” outcome emerges from a buyer-producer interaction.

Moreover, if upgrading is crudely defined as an increase in per-unit value of products, then it may be the result of various forms of innovation but also of squeezing wages, itself a short-term strategy insofar as lower-wage firms and countries continuously emerge in international markets. In light of all these considerations, we argue that it is advisable to stick to the concept of innovation, whenever it produces an increase in the value added. The study of innovation in LDCs has been at the center of a stream of literature focused around the concept of Technological Capabilities (TCs). According to this approach which is spelled out in the next section, it is indeed the level and depth of TCs that determine local firms’ industrial and innovation performance; therefore TCs and their determinants should be the explicit object of analysis.

Second, a more explicit and thoroughly spelled out reference to innovation is useful in drawing the attention to some key knowledge features such as codifiability and complexity. Only very recently some studies (Gereffi *et al.*, 2005; Giuliani *et al.*, 2005) drawing on innovation theories, have stressed that differences in knowledge may crucially help to elaborate a theory of value chain governance. Along these lines, learning hindrances are also generated by specific knowledge characteristics, such as complexity and tacitness, which in turn influence knowledge transferability with effects on the balance of power. This implies that local producers have to face several obstacles, besides power asymmetries, when dealing with external knowledge. Although this latter point has been partly recognised by the GVC literature, we claim that it requires further investigation. Firstly, because it may be that most of the upgrading activities supported by buyers are more related to their appropriability strategies (e.g. to reduce leakages and to speed up process or product development) rather than to provide innovation opportunities to local producers. Secondly, because the nature of

knowledge changes along the value chain, hence absorption capabilities of local producers need to change accordingly.

Our third concern claims that the GVC literature pays little attention to linkages established between producers joining global networks and other clustered firms. Thus, any proposition stating that *any* form and extent of firms' insertion into global value chain is beneficial to *all* the other clustered firms implicitly assumes that knowledge can be freely acquired by other cluster's members. This assumption produces rather undesirable implications, as already pointed out by recent studies on proximity and knowledge flows in local innovations systems that focus on the suboptimal incentive to innovate in a framework of free appropriability of knowledge (Breschi and Lissoni, 2001). Moreover, knowledge does *not* freely flow within a cluster, it is not evenly distributed therein and some (local) actors may enjoy locational or other advantages to get access, absorb, and use knowledge (Giuliani, 2005)

In order to address these critical issues in the GVC literature, we suggest to consider the well-established tradition of studies on Technological Capabilities in developing countries. We claim that this may help to move forward the GVC research agenda and to reach a more comprehensive and integrated approach for explaining industrial development and innovation in emerging countries.

3 Technological Capabilities in Developing Countries

The "Technological Capability" approach represents a radical alternative to the neoclassical approach, that rests on a particular conceptualization of technology at the enterprise level. It assumes that technology is freely available from a known 'shelf' on which there is full information. Firms optimize by choosing from this shelf according to their factor and product prices. Any intervention is necessarily distorting resource allocation. The selected technology is absorbed costlessly and risklessly by the enterprise and used at efficient ('best practice') levels. As a necessary consequence, no learning is required and the underlying assumption is that any observed industrial inefficiency is due to government interventions.

In contrast, the technological capabilities approach draws upon the evolutionary approach of Nelson and Winter (1982), and locates learning in markets prone to imperfections, satisfying behavior and widespread failures.¹ It is an approach that intentionally looks at developing countries and formulates a theory of innovation and learning.

¹ Among the main contributions to this approach, see Bell and Pavitt, 1993 and 1995, Dahlman et al., 1987, Enos, 1991, Fransman and King, 1984, Figueredo, 2001, Katz, 1987, Lall, 1992, 1993 and 2001, Pack and Westphal, 1986, Pietrobelli, 1994, 1997 and 1998, Wignaraja, 1998.

Technological capabilities are the skills - technical, managerial or organizational - firms need to utilize efficiently the hardware (equipment) and software (information) of technology, and accomplish any process of technological change. Capabilities are firm-specific, institutional knowledge made up of individual skills and experience accumulated over time. Technological change is the result of purposeful activities undertaken by firms ("Technological Efforts"). It is neither exogenous nor automatic. Individual effort is required to make the many tacit elements of technology explicit, and most technological effort does not take place at the frontier of technology at all. It covers a much broader range of effort that every enterprise must undertake to access, implement, absorb and build upon the knowledge required in production.

Technology cannot simply be transferred to a developing country or to a firm like a physical product: its effective implantation has to include important elements of capability building. Simply providing equipment and operating instructions, patents, designs or blueprints does not ensure that the technology will be effectively utilized. Substantial efforts to improve technical skills, acquire the necessary equipment and relevant knowledge are continuously needed. Learning plays a central role in this approach, and its success depends on the efficacy with which markets and institutions function, uncertainty is coped with, externalities tapped, and coordination achieved. If the learning period, costs, uncertainties and leakages are very high, coordination with other firms in the supply chain exceptionally difficult, or information, labour and capital markets particularly unresponsive, 'difficult' knowledge may not be absorbed – even where it would be efficient to do so.

Following Lall (1990, 1992 and 2001) a useful categorisation of TC considers the functions they perform and the degree of complexity as the two classificatory principles.² Thus, it is possible to single out "investment", "production" and "linkage" capabilities. When industries are started, many of the TCs necessary at the firm-level are absent. These missing TCs may be temporarily obtained at home or imported in an "unbundled" form, but some "core" capabilities have to be developed by firms and expanded over time. Moreover, many of these TCs are inter-related and partly over-lapping, and there is often strong inter-dependence among them

Investment capabilities refer to all the skills required before the investment is undertaken and needed to carry it out. They include the capabilities to assess the feasibility and profitability

² The complexity and the variety of TCs does not pretend to be portrayed exhaustively here. Other categorisations have been proposed by Bell and Pavitt, 1995, Dahlman *et al.*, 1987, Enos and Park, 1988, Figueredo, 2002, Katz, 1987.

of a project, to define its detailed specification, the technology required and the selection of its best sourcing, the negotiations of the purchase (cost and terms), the skills to erect the civil constructions and the equipment, to draw its detailed engineering, to recruit and train the skilled personnel required, and eventually to design the basic process and supply the equipment.

Production capabilities include the skills necessary for the efficient operation of a plant with a given technology, and its improvement over time. Process, product and industrial engineering capabilities are part of this subset. Among the infinite number of operations that require adequate skills are: the assimilation of process and of product technology, their adaptation and improvement, trouble-shooting, quality control, equipment stretching, work-flow scheduling, inventory control, monitoring productivity and co-ordination of different production stages and departments, finally process and product innovations following basic research activity.

Linkage capabilities are required because of high transaction costs; in narrow and inefficient markets, the setting up of extra-market linkages often corresponds to an efficient and rational strategy. Therefore special skills are needed to establish technology linkages among enterprises, between them and service suppliers, and with the science and technology infrastructures.

In each group there are TCs with different degrees of technological complexity. These are used for "routine", "adaptive and replicative", or "innovative and risky" activities. Different levels and depth of technological capabilities indeed explain different levels of industrial performance across countries (Lall, 1990, Pietrobelli, 1998). However, the approach does not presume that all firms will necessarily build up capabilities in a linear sequenced process, neither does it imply that firms will start and end at the same stages (Figueiredo, 2006:5).

The policy implications of this approach are straightforward: policies need to adopt a firm-level focus, and must target the building and strengthening of technological capabilities. Clusters, (global) value chains, production networks or other forms of industrial organization may contribute to a different extent in different circumstances, but firm-level efforts to build and improve TCs are the *sine qua non* of industrial development (Lall, 2001).

4. Learning and Upgrading in GVC: a Critical Review of Selected Empirical Studies

The GVC literature encompasses a wide range of issues and disciplines rooted in rather different theoretical backgrounds, and this forced us to select and focus on a number of

approaches and papers in a burgeoning literature. However, although the list is necessarily incomplete, it still includes most influential studies of GVC in developing countries that explore the perspective of developing countries' firms upgrading.

All the studies considered are centrally focused on *upgrading* processes in GVC, that is they explicitly investigate to what extent different GVCs affect upgrading processes in firms. The concept of upgrading assumes slightly different meanings throughout these studies, although in most of them upgrading refers to either improvements in products, processes or functions. In general, what is termed upgrading in most studies is the outcome of an innovation process. Indeed the two concepts, upgrading and innovation, frequently overlap and are used as synonymous, although the analysis of the innovation process itself never appears as a core issue in this literature. Few studies put some emphasis on the distinction between upgrading and innovation and clearly define the upgrading concept in terms of the rents accruing from entering higher stages of the value chain. Thus: *"the concept of upgrading (as distinct from innovation) explicitly recognizes relative endowments, and hence the existence of rent (...) thus innovation has to be placed in a relative context – how fast compared to competitors - and this is a process, which can be referred to as one of upgrading"* (Kaplinsky and Morris, 2001: 37).

The *unit of analysis* varies to a large extent, ranging from clusters to industries and nations. The individual firm is never the central focus in all the studies analyzed, although all of them implicitly incorporate this dimension into the analysis.

The *governance* of the value chain - i.e. the rules governing 'what', 'how', 'when', 'at what price' goods/services should be produced and the proactive involvement and participation of all the actors within the value chain - is central to the analysis. Governance structures differ to a great extent, from arm's-length relationships to networks, according to their different entry requirements, degrees of hierarchy, internal cooperation and so forth. A key question is to what extent these different patterns of governance contribute to reinforce, or conversely hamper, upgrading in firms or clusters. There is some consensus on the effect that different modes of governance would have on upgrading, but these differences seem to emerge when firm- and sector-specific factors come into the picture.

From a geographical point of view, the studies analyzed cover a wide and differentiated set of experiences of GVC in developing countries. Some focus on Newly Industrializing Countries (NICs), such as Taiwan, Brazil and Mexico (Bair and Gereffi, 2001; Gereffi, 1999; Kishimoto, 2004; Quadros, 2004), others are more concerned with countries at a lower stage of development (Barnes and Kaplinsky, 2000; Gibbon, 2003; Nadvi, 2004). Many of the case

studies focus on traditional industries (e.g. garment, furniture) inserted in quasi-hierarchical value chains (Bazan and Navas-Aleman, 2004; Kaplinsky and Readman, 2005; Schmitz and Knorringa, 2001).

Based on the main focus of analysis of these papers, their theoretical background and their methodology, we identify two different “schools” or approaches within the broad GVC literature (Table 1): the *internationalist* approach, which includes the North-American school on GVCs, well represented by Gereffi and colleagues, and scholars like Kaplinsky, Gibbon and colleagues at the Danish Centre for Development Research, and the *industrialist* approach, represented by Humphrey, Schmitz and their colleagues at the Institute of Development Studies, at the University of Sussex. The labels proposed - *internationalist* and *industrialist* - roughly identify the early background and/or the methodology of research prevalent in each approach, albeit differences can be found within each of them, and the two approaches overlap in some instances. *Internationalists* privilege a macro perspective, both in terms of level of analysis and in terms of policy focus; conversely the *industrialists* adopt a micro founded framework of analysis with a policy focus oriented towards issues of local and cluster development.

This classification is helpful to highlight diversities between groups and similarities within each class, although we are aware that scholars of both schools substantially share similar thinking and frequently interact among each other, as exemplified by several co-authored papers. Thus, it is worth stressing that boundaries between these groups are indeed quite loose, and the grouping we propose mainly serves the purpose of an expositional device. Nevertheless, what clearly marks the difference between them is the method of inquiry: the *internationalists* mostly concentrate on the industry as a whole, while the *industrialists* mainly investigate specific clusters, and adopt case-study methodology.

Table 1: Different approaches to GVC

	<i>Internationalists</i>	<i>Industrialists</i>
<i>Main focus</i>	GVCs governance mainly in LDCS	Upgrading and GVCs mainly in LDCS
<i>Methodology</i>	Macro approach Industry level data/trade data	Micro approach Case-study, qualitative data
<i>Policy focus</i>	International division of labour role of bilateral/multilateral trade agreements, FDI	Competitiveness of firms and clusters; Local development policies

<i>Theoretical background</i>	International economics; political economy; TNCs theory	Industry studies; development studies
<i>Authors frequently contributing</i>	Gereffi, Sturgeon, Kaplinsky, Gibbon..	Schmitz, Humphrey, IDS group....

Source: Authors' own research.

The original contribution of this paper is to complement the GVC approach by proposing an analytical framework to study how knowledge generation and diffusion processes occur in GVC, as well as how mechanisms of building capabilities are implemented. This effort explicitly hinges on the TC literature, and Table 2 briefly sketches the main categories and issues we intend to analyze within the GVC context. These cover all the relevant dimensions outlined by the evolutionary and TC literature on innovation and learning at the firm-level.

The role played by “(...) *indigenous technological effort in mastering new technologies, adapting them to local conditions, improving upon them, diffusing them within the economy and exploiting them overseas by manufactured export growth and diversification and by exporting technologies themselves*” (Lall, 1992:166) is central. All these processes (e.g. mastering, adapting, diffusing) to some extent vary according to cluster and GVC features, but also and more importantly according to firm, sectoral and technological idiosyncrasies. Thus, the properties of knowledge (e.g. complexity, cumulateness, appropriability), the channels of technology transmission (e.g. technical assistance, labour mobility; licenses; turn-key plants) and the firms' differences in absorptive capacity influence the path, speed and direction of learning and innovation (Cohen and Levinthal, 1990; Breschi *et al.*, 2000; Nelson and Winter, 1982).

Table 2: The framework of analysis

Main issues	Extent/Depth of analysis (<i>opposite extremes</i>)
<i>1. Knowledge features and transfers in GVC</i>	Key role of knowledge features for transfer (e.g. complexity, tacitness appropriability) vs. No role (knowledge seen as public good)
<i>2. GVCs and nature of TCs</i>	Detailed analysis of TCs in firms vs. Black boxes (sketchy analysis)

Mechanisms at work in GVC: implications for *governance and upgrading*

Different degrees of complexity or tacitness, combined with different TCs and different sources of technological knowledge may affect:

- the GVC governance structure (relational vs. captive governance);
- the opportunity/speed of upgrading (localised learning; absorptive capacity);
- the intensiveness/direction of upgrading (active vs. passive learning)

All these elements have deep implications not only for firms' upgrading but also in turn affect GVCs governance and strategies. In other words, the direction of causality is two-way. Thus, for example, we may expect that a higher (lower) degree of knowledge complexity will induce global buyers to establish closer (more distant) relationships with local producers, and consequently contribute to the emergence of specific modes of governance (more relational or more captive). Similarly, the absorptive capacity of local producers may affect GVCs opportunities to convey information and knowledge. In other words, different degrees of absorptive capacity allow firms to identify and explore close/distant knowledge and technological channels to a different extent. In turn, this contributes to explain why firms embedded in similar GVC may upgrade at different rates or following different patterns. Table 2 summarizes our conceptual framework to analyze the studies selected.

4.1 Knowledge features and transfers in GVC

Most of the studies considered admit the existence of factors binding the spread of knowledge within GVCs and influencing their pattern of governance. In particular, the studies within the *industrialist* approach often mention the presence of hampering factors like the power asymmetries emerging out of buyer-driven relationships: "*power asymmetry is central to value chain governance. That is, there are key actors in the chain who take responsibility for the inter-firm division of labour, and for the capacities of particular participants to upgrade their activities*" (Kaplinsky and Morris, 2001:29). Chain leaders are those who coordinate and govern the GVC², whose members, in many respects, depend upon them for setting up their own strategies. GVCs are shaped by governance structures (e.g. arm's length relations, quasi-hierarchy, networks), which define how local producers participate to the distribution of rents

² Kaplinsky and Morris argue that different actors are engaged in the coordination and management of the value chains. These nodal points may change over time, and the power over the chain can be exercised in different ways: those who are "ensuring consequences along the chain" can be different from those who are "actively managing or coordinating the operations" (2001: 29-30).

produced in the value chain. Thus, the main aim of this literature is to identify “*whether some types of chains offer local producers better upgrading prospect than others*” (Humphrey and Schmitz, 2004: 352).

From the available empirical studies it appears that “*buyers do not always provide support for this upgrading*” (Humphrey and Schmitz, 2004: 358), due to the asymmetry of power between them and local producers. In another empirical work Schmitz and Knorringa (2001) stress the links between GVC leaders and upgrading looking at the obstacles and enabling conditions affecting the buyer-producer relation in the shoe sector in different countries. They note that “*the problem is that marketing and often design, are part of the buyers’ own guarded core competence*” so, they conclude that “*there is conflict*”, and this is particularly evident in non production activities, where “*one would therefore not expect the lead firm to share their core competence with others in the value chain*”(p.197).

In the same vein, Bazan and Navas-Aleman (2004), studying the shoe cluster of Sinos Valley in Brazil, observe that “*buyers are the undisputed leaders in the chain, exerting control over intermediaries, local producers and often input suppliers as well*” (p.115). Furthermore, the authors write that “*buyers have resisted sharing their knowledge on higher valued added activities such as design, branding, marketing and chain coordination*” (p.115).

In other studies, the crucial role played by leaders in transferring knowledge and information is emphasised. For example in a study on the Taiwanese ICT industry, Poon (2004) looks at the relationships between global leaders and first-tier suppliers and notes that: “*Taiwanese suppliers gradually upgraded their technological capabilities through technology transfer and knowledge diffusion (by playing the OEM/OBM role for network flagships)*” (pag.134). Further on this point, she argues that knowledge spill-overs have been quite pervasive in the industry as a whole, in fact “*various type and levels of technological knowledge and skills absorbed from network flagships by the first tier (...) were then diffused to smaller firms, resulting in the upgrading of all manufacturers operating within the IT Global Production Network*” (pag134). Similar patterns of diffusion have been envisaged also by Gereffi in his seminal work on Asian countries (Gereffi, 1994).

The evidence presented above is useful to single out the main regularities in GVCs' modes of governance, but it should not be given a normative meaning or even used (or misused) to draw policy implications. That is, it cannot be assumed that the specific governance structure is the only determinant of the leaders’ inherent ability or interest to convey (or not to convey) knowledge to local producers. Nevertheless, and with a high dose of determinism, in the literature it is sometimes argued that network-based chains “*support an open-ended*

upgrading path” (Humphrey and Schmitz, 2004:354). Although less frequent in LDCs, network-based chains would be more beneficial for upgrading than quasi-hierarchical value chains, which in turn are better than market-based relationships in fostering process and product upgrading. Central to this line of reasoning is the idea that knowledge transfers and upgrading are constrained mainly by the institutional settings (i.e. governance structure), with GVC structures and chain leaders’ strategies setting the pace and direction of knowledge flows and upgrading (either in favor or against the interest of local producers). Little or no regard is explicitly given to other issues like sectoral specificity and knowledge features, and to the consequences of these for local firms’ upgrading.

In sum, whatever the role played by leaders (i.e. supporters or obstacles to technology transfer), technology and knowledge transmission – and their effectiveness - often appear as exogenous to the local firms involved. That is, they would be either determined by the leader strategy (i.e. GVC governance) or by other forces like for example clusters’ external economies and collective efficiency. The leader’s strategy is seldom understood and explained – among other things – by the features of knowledge involved. In most of this literature, knowledge features and firms’ idiosyncrasies and endogenous TC-building strategies inevitably play a minor role. Yet, as discussed above, the latter affect the pace and direction of learning and knowledge absorption. Innovation theory in the Schumpeterian tradition taught us that different technological regimes showing different combinations of complexity and appropriability of knowledge, set the conditions in which firms can absorb and transfer it (Malerba and Orsenigo, 1993). Thus, for example we may claim that the higher the complexity of knowledge, the greater the need for integrated forms of governance/interaction. On the other hand, simple technology may be easily transferred/absorbed through market based relationships (see beyond on absorptive capacity).

The TC framework, drawing on the evolutionary theory of technological change, can help integrate and better focus GVC approaches on these issues. It is worth to point out that we do not underplay the importance of ‘conflicts’, power asymmetries and GVC governance in knowledge transfers. All these elements should be combined within a framework where technological regimes are also included, to jointly help explaining how knowledge transfers occur, and how they may be put to a productive use. In this new perspective, different modes of governance may produce similar outcomes, in terms of knowledge generation, and *viceversa* similar governance structures may differently affect the transfer of technology depending on the specificity of technology, sector and knowledge. We claim that these aspects have to be taken into account to complete the picture.

In the next section we focus on the role of firms' efforts in building technological capabilities, i.e. the strategies and tools needed to absorb external knowledge and to effectively employ and implement it in order to upgrade successfully.³

4.2 GVCs and technological capabilities: nature and modes of acquisition

Technological capabilities, although often cited as important, do not constitute a core issue in the GVC studies we are reviewing. Most papers mention them but do not address the details of their nature, of their dynamics, and of their acquisition. Thus for example, in summing up the main results of an extensive research project on upgrading in clusters, Schmitz (2004) stresses that upgrading “*requires continuous investment by the local firms themselves in people, organisation and equipments*” (Schmitz, 2004: 356), probably having in mind some notion of technological capabilities. Along the same lines, Kishimoto (2004) points out the importance of pre-existing capabilities in sustaining functional upgrading in the Taiwanese computer industry. He observes that: “*Taiwanese producers already possessed basic production skills and some design capabilities*” and that “*holding enough technological capability is a necessary condition for getting orders*” (Kishimoto, 2004: 247).

The issue of capability is somehow implicit also in the early *internationalists* studies on GVC, for example Gereffi argues that East Asian countries, after entering GVC as first-tier suppliers of large international buyers, became full-package suppliers and “*thereby forged an innovative entrepreneurial capability that involved the coordination of complex production, trade and financial networks*” (Gereffi, 1999: 55). According to Gereffi, the transition from OEM (Original Equipment Manufacturer) to OBM (Original Brand Manufacturer) in East Asian countries was made possible by the extensive organisational learning occurred at the firm level, and prompted by the insertion in GVCs. In a recent analysis about the de-commoditisation process occurring in the coffee industry, Kaplinsky and Fitter (2004:20) claim that the “*more durable and substantial way of enhancing producers incomes lies in the systematic application of knowledge to the coffee value chain*”, and that firms need to enhance their ‘branding’ and ‘blending’ capabilities – that is they have to learn how “*to promote the virtues of location-specific ‘images’ and tastes*” (Kaplinsky and Fitter, 2004:18).

The above examples hint that the authors perceive the strategic relationship between upgrading and technological capabilities in GVCs, but they do not really venture into a thorough analysis of these relationships, and of the nature, dynamics, and acquisition of TCs.

³ Gereffi *et al.* (2005) start to recognise the importance of knowledge features and incorporate them in their theoretical framework. We will further discuss this issue later.

To test the statement that GVC studies generally lack an explicit and detailed focus on TCs, it is useful to try to read them through the lenses of Lall's categorisation of technological capabilities (Lall, 1992, 2001 and above). There are at least two interrelated aspects to address: the *nature* of capabilities, as outlined by Lall (1992) and the *acquisition* of capabilities, which can be either internal or external (Romijn, 1999; Bell and Albu, 1999).

The nature of technological capabilities

Overall, the studies reviewed do not explicitly explore the nature of firms' capabilities in terms of the differences between investment, production, and linkage capabilities, as suggested by Lall. They mainly refer to investments undertaken in the production process, or generally refer to "capabilities" without further categorizations and details. A partial exception is Kishimoto (2004), who explicitly accounts for the importance of capabilities and considers the different forms they may take for the upgrading trajectory in the Taiwanese personal computer value chain. In this paper, he presents evidence on the *linkage capabilities* accumulated by local manufacturers through intensive collaboration with IBM and other TNCs. The recruitment of experienced engineers trained by multinationals is one of the main mechanisms of interaction mentioned. Quoting Ernst (1998), Kishimoto also stresses the role of technological and managerial assistance provided by TNCs in improving *production capabilities*, both in the form of skill upgrading and by forcing subcontractors to upgrade product quality (Kishimoto, 2004: 243).

However, apart from Kishimoto, most other studies only mention the issue, quote it in their introductory section, or eventually provide some evidence on how chain leaders assist local producers in upgrading (Gibbon, 2003; Barnes and Kaplinsky, 2000; Kaplinsky *et al.*, 2002; Meyer-Stamer *et al.*, 2004; Schmitz and Knorrige, 2001).

Some of the studies focusing on the adoption of international standards by local producers in LDCs (Ponte and Gibbon, 2005; Nadvi, 2004; Nadvi and Waltring, 2004; Quadros, 2004), explore the issue of capabilities. Most notably, Quadros (2004) provides detailed evidence on how producers intervene in the production and design phases in order both to accomplish with standards' requirements and to collaborate with international buyers. By investigating the organisational setting of the design and engineering phases, he also explains why suppliers have developed rather low capabilities in planning and design, and how this restrained their chances to acquire new technologies from outside.

To a lesser extent, the *internationalist* approach also provides evidence of some *linkage capabilities*. This can be somehow envisaged in Gereffi's analysis of the 'triangle

manufacturing' system developed by Taiwanese firms in the '90s in order to cope with decreasing profits and pressures from foreign buyers on reducing delivery time (Gereffi, 1994 and 1999). This system, as also stressed by Kishimoto (2004), enhances firms capability of coordinating, searching and procuring external goods and services.

However, none of the above studies makes explicit reference and explore the vertical dimension of capabilities. Lall (1992) rightly reminds that this is a key element for classifying and assessing the nature of the mechanisms to build capabilities, since it allows to rank them according to their degree of complexity. The perception that the GVC framework considers certain types of capabilities intrinsically superior to others since they allow firms to climb upstream on the value added ladder (e.g. from production to design) is left implicit.

This is inherently related to the notion of "upgrading" that is often used in the GVC approach. A vivid way to illustrate this concept has led several authors to write that upgrading within a value chain implies "going up the value ladder", moving away from activities in which competition is of the "low road" type and entry barriers are low. However, although this description is certainly stunning and eye-catching, and offers some advantages, it is not very accurate. First of all, GVCs are hardly so linear as they are often described. Indeed, this assumed linearity – often for the sake of simplifying their description - often drives the attention away from all the detailed and equally important efforts to build and deepen TCs *at the same stage* of the value chain. We argue that the key issue is not always "functionally upgrading" and moving to more advanced functions "along the value chain", but often deepening the specific capabilities required to explore new opportunities offered "on the side" of the stage of the value chain where the firm is currently engaged. Moving from natural resources to their exploitation, manufacturing, packaging, distribution and branding is indeed very important, and would be described as somehow "climbing the ladder". But deepening capabilities to explore new original features and varieties *at each stage of the GVC* (e.g. from new flower varieties via biotechnological research to new packages with original highly-valued characteristics) is indeed also important, and clearly requires creation and deepening of higher skills and more complex TCs.

This view is consistent and provides a microeconomic ground for the newly-emerging approach that describes economic development as a process of "self-discovery" (Hausman and Rodrik, 2003), where the diversification of the productive structure through a process of discovery – often supported by new forms of industrial policy - of which new activities have low enough cost to be profitable plays a central role.

The studies reviewed say little or nothing about the vertical dimension of TCs and their different levels of complexity: they do not analyse whether the new capabilities are either routine, basic capabilities or rather of higher, innovative and advanced order. Without any clear distinction between the degree of innovativeness of capabilities, that is between the *knowledge using* and *knowledge changing* elements in capabilities (Bell and Albu, 1999), little can be said about the dynamics of the system (i.e. GVC), and similarly about the contribution of the chain leaders to strengthening local producers' capabilities. In addition, in order to explore the dynamics of learning and accumulation, it would be desirable to introduce a time dimension, and consequently to conduct longitudinal analyses of these capability building processes. Notable efforts in this sense were made, for example, by Figueiredo, 2001 and 2002 and Katz, 1987.

Firms' efforts and acquisition of technological capabilities

Firms acquire technological capabilities getting access to technological knowledge from a variety of possible sources (e.g. FDI, joint ventures, licensing, imported equipment), and integrating it with in-house efforts and costly investments in learning, R&D, technical assistance. Strategies may differ but need to be internally consistent.⁴ Although external sources of knowledge are essential, the creation and improvement of technological capabilities essentially require some previous accumulation of skills, coupled with substantial firm-level efforts.

In the empirical GVC literature, the idea that “*technological change is the result of purposeful, well-directed effort conducted inside the firm*” (Pietrobelli, 1997:4) is often implicit in theoretical discussions, but nearly absent in most of the empirical analyses. In most of these studies it is hardly explored what occurs within firms, what makes firm differ even if they belong to the same sector or the same cluster, and how firm-level efforts to develop TCs have added to (or compensated for the lack of) the opportunities offered by GVCs.

In spite of this weakness however, we have found some indirect and sketchy discussion over the role of specific actors (mostly GVCs leaders) in sustaining local producers' upgrading at the cluster or at the industry level. However, we claim that some studies put an excessive emphasis on the role of external actors. Of course this is partially a consequence of the research agenda set by this literature, which by definition focuses on global actors, but this

⁴ See Lall, 1996, on the different strategies followed by different Asian countries to get access to technology and develop technological capabilities. On this also Pietrobelli, 2000.

focus ends up neglecting more careful analyses of in-house domestic technological and learning activities, that in the end substantially explain inter-firm differences in performance.

Thus, some studies notice the importance of learning within domestic markets, in particular for functional upgrading, and outline the viability of a strategy based on “*prior apprenticeship in the national market and ... operating in several chains simultaneously*” (Bazan and Navas-Aleman, 2004:136). Others stress the role of industry associations and technical schools in enhancing skills and more broadly local capabilities (Meyer-Stamer, 1998, and Meyer-Stamer *et al.*, 2004). Therefore, none of these authors clearly focus on the firm-level dynamics leading to TC development. However, they - and with them others in the “*industrialist*” group - pay attention to local sources and in particular to collective actions developed in clusters for sustaining firms’ efforts to develop TCs and achieve competitiveness.

In the *internationalist* approach detailed references on local actors and their role for upgrading and TC development are indeed less frequent. This is clear in Gereffi (1999:38), who investigates how GVCs contributed to upgrading processes in the East Asian apparel industry and argues that leading firms (i.e. international buyers) play a prominent role: “*they are the primary sources of material input, technology transfer and knowledge in these organisational networks*”. Similarly, other studies pay attention to the role of international buyers, retailers, branded marketers and intermediaries, but say little on domestic actors, and less about TC development *within* firms’ boundaries (Kaplinsky, 2001; Palpacuer *et al.*, 2005).

Local actors may supposedly play a minor role, but still their analysis would help understand how firms acquire technology from outside, and if and how they are supported in their efforts to develop TCs. Thus, it would be useful to know which actors - firms or science and technology institutions - are involved, how they do master and adapt foreign technologies, how they influence the level and direction of investments in TCs, and so forth.

In other words indigenous learning, and the firms’ activities related to it, should be more explicitly observed and studied – and policies should inevitably focus on them -. Differences in inter-firm (and inter-cluster) performance are in fact strictly related to their ability to build internal domestic knowledge bases, which in turn allows them to access external sources of knowledge, and to exploit them efficiently. Foreign sources of technology are clearly strategic and essential sources of technological knowledge for firms in developing countries – and this makes openness desirable (Bell and Albu, 1999, Giuliani *et al.*, 2005). However it is

necessary to stress once again that selection, adaptation and improvements are not mechanical, straightforward processes, but they require specific activities and investments.

The evidence discussed so far suggests that the TCs approach has not been duly taken into account in the GVC framework, and this might powerfully help it to better explain upgrading and performance in developing countries' firms. This is probably due to the central focus of this literature, that is GVCs and their leaders, but as it is now the GVC approach is still far from presenting a micro analysis of the nature of knowledge, the capacity building mechanisms and efforts conducted by local manufacturers and international buyers. A more comprehensive approach should encompass the analysis of in-house activities, and integrate the process of transfer and acquisition of foreign technologies with the in-house efforts of local producers to create and develop TCs.

5. Conclusions

Global value chains represent the new form of industrial organization that is widely prevailing in many industries across countries. Therefore, an analysis of its potential implications and consequences for firms in developing countries is of utmost relevance. However, recent efforts in this sense have not fully clarified how global value chains foster upgrading processes in developing countries' firms. On the one hand, it has often been hinted that entering GVCs causes a sharp and automatic positive impact on local producers. On the other hand, the research agenda has shifted to the analysis of how local firms can join value chains, and on the influence of governance structures on upgrading. All this produces a harmful neglect of the analysis of the detailed mechanisms linking value chains with local firms' learning and innovation.

It is obviously false that entering global value chains – by itself – will lead to upgrading and better industrial performance in developing countries. This is not a mechanistic and risk less process, and local firms need to invest in learning and building technological capabilities to effectively upgrade. The direction and extent of these investments may also vary in relation to features of knowledge such as its degree of complexity, tacitness and appropriability, and this has been insufficiently studied so far.

The insights offered by the Technological Capabilities approach, and discussed at length in this paper, may usefully integrated the GVC approach, providing original conceptual insights to study technology and innovation in a GVC context. This has potential implications also for the definition of upgrading itself, and leads us to question whether this is the relevant concept to apply. A renovated approach may have implications for future research questions and

strategies, and we propose that GVC research should more carefully study the details of the learning and innovation processes within firms in developing countries, and that TC theories may offer useful tools and concepts to this aim.

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Appendix. The GVC studies reviewed

Authors and studies	Main focus and results	Extent/Depth of Analysis of	
		Knowledge features*	TCs, nature & acquisition*
L.Bazan and L.Navas-Aleman (2004) Footwear industry in the Sinos Valley cluster (Brazil)	Cluster study: clusters' insertion into GVC and upgrading strategies. Functional upgrading prevails in market based value chains. Process and product upgrading are supported by quasi-hierarchical value chains.	LOW	MED-LOW
C.Kishimoto (2004) Computer industry, Taipei and Hsinchu area (Taiwan)	Cluster study :it adopts an historical perspective to study the upgrading process in the industry. There is an explicit distinction between production and knowledge systems. Product and functional upgrading are widely diffused in the cluster.	MED-LOW	MEDIUM
J. Meyer-Stamner, C. Maggi, S. Seible (2004) Tile industry, clusters in Italy, Spain, Brazil	Cluster study :analysis of the insertion of clusters into GVC and its effect on local collective action. Besides cluster and GVC approaches, it highlights the importance of sectoral factors.	LOW	MED-LOW
R. Quadros (2004) Automobile component industry, San Paolo (Brazil)	Cluster study: role of global quality standards for the upgrading strategies of local manufacturers and their effects on local and international linkages. Diffusion of global standard has improved local suppliers production processes but not engineering capabilities.	LOW	MEDIUM
K. Nadvi (2004) Surgical instrumental industry, Sialkot (Pakistan)	Cluster study: analysis of the adoption of global standards by local producers. Quality standards favoured upgrading but did not extend to subcontractors. Besides, they seem to have weakened relationships with global buyers.	MED-LOW	MED-LOW
H. Schmitz and P. Knorringa, (2001) Footwear industry in China, India Brazil, Italy	Industry study: empirical analysis from a buyer perspective. It examines the role of buyers in fostering/hindering learning opportunities of producers. Buyers do not search only price competitiveness, but also quality, flexibility etc.	LOW	MED-LOW
T.Shuk-Ching Poon (2004) ICT industry in Taiwan.	Industry study: analysis of GVC as channels of knowledge and sources of upgrading. There is substantial evidence of upgrading fostered by GVC. Local capability is a precondition for industrial upgrading.	LOW	MEDIUM
R. Kaplinsky (2001) Canned deciduous fruit and car component sector, South Africa.	Industry study: analyses of the dynamics of rents distribution along the GVC in different sectors. GVC approach allows to identify the main drivers governing these chains and who accrue major benefits from them.	LOW	LOW
J. Barnes and R.Kaplinsky (2000) Car component sector, South Africa.	Industry study: it examines how local component producers respond to increasing external competition. MNC increasingly integrated their local subsidiaries, reducing the space for locally owned suppliers.	LOW	MED-LOW

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R Kaplinsky and R.Fitter (2004) Horticulture and coffee sectors in LDCs.	Industry study: it examines how LDCs can exploit changes in global market by entering new phases of the GVCs. Investing in knowledge is a winning strategy to accrue innovation rents.	LOW	MED-LOW
R Kaplinsky, M.Morris and Readman (2002) Furniture industry, South Africa	Industry study: role of buyers in fostering upgrading for their local suppliers. Production capabilities are increasingly widespread while buyers erect entry barriers for high value added activities.	LOW	MED-LOW
R Kaplinsky and J.Readman (2005) Furniture sector,comparative study	Industry study: measurement of comparative performance of several countries using data on unit prices and market share. Analysis of upgrading and downgrading trends.	LOW	LOW
G. Gereffi (1999) Apparel industry , East Asia	Industry study: analysis of the insertion and evolution of East Asian countries in GVC. Theoretical distinction between different chains (buyer vs. producers driven). Core-periphery patterns emerges in the US apparel suppliers system.	LOW	LOW
G. Gereffi, J Humphrey , T. Sturgeon (2005) Apparel, bicycle, electronics and fresh vegetables industries. LDCs	Industry study: governance patters differ according to three main theoretical perspectives: transaction costs; production networks; technological capabilities. Three factors allows to build a GVC theory: complexity of knowledge; codifiability knowledge; capabilities of suppliers.	MEDIUM	MEDIUM
J. Bair and G. Gereffi (2001) Apparel sector, Mexico.	Clusters study role of GVC in sustaining local upgrading. The arrival of global buyers has prompted local upgrading at industry and firm level. Institutional failures impeded further spill-overs.	LOW	MED-LOW
P. Gibbon (2001) Primary sector, Tanzania	Industry study: upgrading in primary sector GVC. It suggests a new agenda for upgrading strategies and policy intervention.	LOW	MED-LOW
P. Gibbon (2003) Clothing sector, sub-Saharan Africa	Industry study: response of clothing sector to new trade agreements (African Growth and Opportunity Act) and upgrading consequences for local producers.	LOW	LOW
F. Palpacuer, P. Gibbon, L. Thomsen (2005) Clothing sector in European countries	Industry study: to what extent clothing GVCs offer upgrading opportunities for DCs. Analysis of the buyers strategies. They raise doubts about the worthiness of entering GVCs for DCs.	LOW	MED-LOW
(*) High: fully examined; Medium: partially examined; Med-Low: mentioned and sketchily analysed; Low: only mentioned or not taken into account at all			