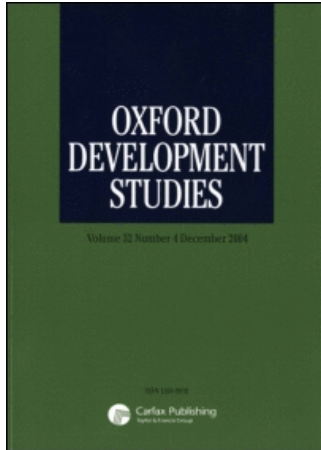


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### Global Value Chains and Technological Capabilities: A Framework to Study Learning and Innovation in Developing Countries

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# Global Value Chains and Technological Capabilities: A Framework to Study Learning and Innovation in Developing Countries

ANDREA MORRISON, CARLO PIETROBELLI & ROBERTA RABELLOTTI

**ABSTRACT** *This paper presents a critical review of the global value chain (GVC) literature in light of the “technological capabilities” approach to innovation in less developed countries (LDCs). Participation in GVC is beneficial for firms in LDCs, which are bound to source technology internationally. However, the issues of learning and technological efforts at the firm level remain largely hidden in the GVC literature. We propose a shift in the empirical and theoretical agenda, arguing that research should integrate the analysis of the endogenous process of technological capability development, including specific firm level efforts, and of the mechanisms allowing knowledge to flow within and between different global value chains into the GVC literature.*

## 1. Introduction

Nowadays, nobody would resist the contention that learning and innovation are key determinants of competitiveness and growth for nations, regions, clusters and firms. Sometimes, more sophisticated observers might stress that competitiveness is affected by firm-specific attitudes and actions together with the meso and macroeconomic contexts in which firms are located. Yet, these ideas need to be incorporated into analysis in a consistent fashion, and this has been achieved only occasionally, and perhaps more effectively by business scholars than by economists.

In developing countries (LDCs), following an established line of research exploring the international sources of development e.g. learning by exporting, foreign direct investment (FDI) spillover (Barba Navaretti & Venables, 2004) the global value chain

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(GVC) approach has shown recently how international linkages can play a crucial role in accessing technological knowledge and enhancing learning and innovation (Altenburg, 2006; Gereffi, 1994, 1999; Gereffi & Kaplinsky, 2001; Giuliani *et al.*, 2005; Kaplinsky, 2000; Humphrey & Schmitz, 2002a, b; Pietrobelli & Rabellotti, 2007).<sup>1</sup>

Value chain research focuses explicitly on the nature of the relationships among the various actors involved in the chain, stressing the role that global buyers and producers may play in supporting LDC producers' learning and innovation activities, and explores their implications for development. 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 also sometimes "when", "how much" and even "at what price". In this literature, governance is more than just co-ordination, 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.<sup>2</sup>

The final aim of this literature is indeed to explore if and how globalization and the specific form it takes within GVCs fosters industrial development and innovation in emerging countries. In this regard, the notion that is most often used is that of *upgrading*, reflecting the urgent need to move beyond the pursuit of higher production efficiency alone. While business scholars use "upgrading" extensively (Porter, 1990), economists are more reluctant to do so, and following the principle of specialization and comparative advantage, focus their attention rather on production efficiency. However, given the existence of imperfections and extra-normal rents in international markets, and considering the different dynamic learning opportunities offered by different sectors and management functions, the idea of upgrading to newer sectors and functions is indeed appealing (Pietrobelli & Rabellotti, 2007).

Nevertheless, if the final goal of GVC theory is to explain industrial development and innovation in developing countries in the context of increased globalization and transnational inter-firm linkages, how can one avoid a central 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? This, indeed, is what the well-established tradition of studies on technological capabilities (TCs) in developing countries proposes (Bell & Pavitt, 1992, 1995; Dahlman *et al.*, 1987; Evenson & Westphal, 1995; Katz, 1987; Lall, 1987, 1992, 2001; Pack & Westphal, 1986; Pietrobelli, 1997, 1998), offering a solid theoretical background for integration of the GVC literature and for building a theoretical framework to explain industrial development in developing countries. Drawing upon the evolutionary approach of Nelson & Winter (1982), the TC literature claims that technological change is the result of purposeful investments undertaken by firms, and therefore transfer and diffusion of knowledge and technology are effective only in so far as they also include elements of capability building.

Moreover, how can GVC literature avoid fully exploiting the theories of innovation and knowledge in a developing context? 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. Of course, chain leaders' appropriability strategies also affect producers' learning activities. For this also the TC approach has a lot to teach us in terms of the micro-level processes of learning, capability building and innovation.<sup>3</sup>

Notwithstanding the important advances achieved by the GVC literature, there are a number of issues that need to be addressed further, and the TC approach may contribute

substantially towards this effort. For example, the concept of upgrading and its use is often rather fuzzy: Is it a synonym for innovation or rather the result of it? Indeed, an explicit account of TCs may enrich and clarify the GVC approach in this regard. Upgrading at the firm level (i.e. the pre-conditions, the mechanics, the investments and the strategic behaviour required) is indeed related to capability development; it does not need to refer to “climbing up” the value chain but essentially to deepening the capabilities within the same functions or in additional functions along the value chain.<sup>4</sup>

Second, a focus on what occurs at the firm level, on the mechanisms of learning, capacity building and innovation, as proposed by the TC approach, draws attention to innovation theories and focuses on some key features of knowledge such as codifiability and complexity. Such an approach has been taken up only recently in GVC studies (Gereffi *et al.*, 2005; Giuliani *et al.*, 2005), showing that differences in knowledge may help crucially to elaborate a theory of value chain governance.

Third, stating that *any* form and extent of firms’ insertion into a GVC is beneficial to *all* firms, the GVC literature implicitly assumes away the need for idiosyncratic and firm-specific learning strategies, which is continuously argued for by the TC approach. Moreover, knowledge does *not* flow freely within a cluster, it is not evenly distributed therein and some (local) actors may enjoy locational or other advantages in accessing, absorbing and using knowledge (Giuliani, 2005), and consequently in developing TC.

In sum, this paper explores how the theory of TCs and the GVC approach may usefully be integrated, focusing on the endogenous processes of technological capability development, on the specific firm-level efforts and on the mechanisms and forms of governance that allow knowledge to flow within and between different GVCs, and foster processes of learning and innovation.

The paper is organized as follows. In the next section we present a brief survey of the TC approach. Section 3 is a critical review of how some selected GVC studies analyse learning, innovation and knowledge diffusion. We outline a framework of analysis by bringing the TC framework explicitly into the GVC approach. Section 4 summarizes and concludes.

## 2. Technological Capabilities in Developing Countries

The TC approach represents a radical alternative to the neoclassical framework, which rests on the well-known conceptualization of technology as freely available, absorbed without any risks and costs and efficiently used by every enterprise. As a necessary consequence, learning is not required and any inefficiency is due to government interventions, or externalities.

In contrast, the TC literature draws upon the evolutionary approach of Nelson & Winter (1982) and stresses the importance of learning in markets prone to imperfections and populated by firms with a satisfying - not optimising - behaviour.<sup>5</sup> Within this framework, the specificity of the TC approach is its focus on innovation and learning in developing countries. In this section, we summarize the main elements of this approach, which we argue may usefully be integrated into GVC theory.

Technological capabilities are the skills - technical, managerial or organizational - that firms need in order to utilize efficiently the hardware (equipment) and software (information) of technology, and to accomplish any process of technological change. Capabilities are firm-specific knowledge, made up of individual skills and experience accumulated

over time. Technological change is neither exogenous nor automatic, but rather it is the result of purposeful activities, or “technological efforts” undertaken by firms. Most technological efforts do not take place at the frontier of technology; they are required to make explicit the many tacit elements of technology and to access, implement, absorb and build upon the knowledge required in undertaking production.

Transferring technology to a firm is not like transferring a physical product, but it includes essential elements of capability building. Simply providing equipment, operating instructions, patents, designs and blueprints does not ensure that the technology will be effectively utilized. 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 co-ordination achieved. If the learning period is long and costly, uncertainties and leakages are very high, co-ordination 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.

These processes of mastering, adapting and diffusing technology vary according to firm, sectoral and technological idiosyncrasies. Thus, the properties of knowledge (e.g. complexity, cumulativity, appropriability), the channels of technology transmission (e.g. technical assistance, labour mobility, licences, turn-key plants) and the firms’ differences in absorptive capacity influence the path, speed and direction of learning and innovation (Cohen & Levinthal, 1990; Breschi *et al.*, 2000; Nelson & Winter, 1982).

Following Lall (1992, 2001), a useful categorization of TC is based on two classificatory principles: the functions they perform and their degree of complexity.<sup>6</sup> On the basis of the first taxonomy, it is possible to single out “investment”, “production” and “linkage” capabilities, which are different although they can be interrelated, partly overlapping and often strongly interdependent.

Investment capabilities refer to the skills required before and during the investment: they include the capabilities to assess the feasibility and profitability of a project and to define its detailed specification, including the technology required, the selection of its best sourcing, the negotiations concerning the purchase (costs and terms) and the recruitment and training of the skilled personnel required.

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 large number of operations that require adequate skills are the assimilation of technology, its adaptation and improvement, quality control, inventory control, the monitoring of productivity, the co-ordination of different production stages and departments and, finally, the process and product innovations related to basic research activity.

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

In each of the categories described above there are TCs with different degrees of technological complexity, which are used for routine, adaptive and replicative activities or for innovative and risky actions. The different degrees of complexity of TCs indeed explain the diverse levels of industrial performance across countries (Lall, 1990; Pietrobelli, 1998). In addition, the approach does not presume that all firms will

necessarily build up their capabilities in a linear sequenced process, nor does it imply that firms will start and end at the same stages (Figueiredo, 2006).

The policy implications of this approach are straightforward: policies are needed at the firm level to support the building and strengthening of TCs. Clusters, (global) value chains, production networks and other forms of industrial organization may influence TC to a different extent in different circumstances, but firm-level efforts to build and improve TC are the *sine qua non* of industrial development (Lall, 2001), and need to be integrated into the analysis of the effects of the various forms of industrial organization in developing countries.

### 3. Learning and Innovation in GVCs: A Critical Review of Some Selected Studies

In this section, we attempt to exploit the analytical framework of TC to study technology and innovation in a GVC context. Indeed, the original contribution of this paper is to reconsider the GVC literature in order to investigate how knowledge generation, diffusion processes and building up of TCs occur in GVCs. This effort explicitly hinges on the TC literature, and Table 1 sketches the main categories and issues we intend to analyse within the GVC context. These cover most of the relevant dimensions outlined by the evolutionary and TC literature on innovation and learning at the firm level.

All these elements have profound implications not only for firms' upgrading but also for 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). For example, in modular systems the greater codifiability of relatively simple technological processes may often induce hierarchical and distant relationships, as in third-tier car component producers in Mexico (Lara *et al.*, 2005). Similarly, the absorptive capacity of local producers may affect GVCs' opportunities to convey information and knowledge and provide opportunities for learning. Thus, we may expect GVC leaders to search for efficient and capable local producers and select them accordingly, as has been shown in many electronics GVCs in East Asia (Ernst *et al.*, 1998; Guerrieri *et al.*, 2001). Looking at the same issue from the

**Table 1.** The framework of analysis

Key issues in the TC approach	Relationships with <i>governance</i> and <i>upgrading</i> in the GVC
1. Knowledge features relevant for transfer (i.e. complexity, tacitness appropriability)	Issues to explore: Different degrees of complexity and tacitness of knowledge, combined with different TCs and different sources of technological knowledge affect:
2. Nature of TCs in firms (i.e. investment, production and linkage capabilities)	<ul style="list-style-type: none"> <li>• the GVC governance structure (relational versus captive governance): two way relationship between GVC governance and TCs</li> <li>• the opportunity/speed of upgrading (localized learning; absorptive capacity)</li> </ul>
3. Firms' efforts and acquisition of TCs in firms (internal and external sources and channels of knowledge)	<ul style="list-style-type: none"> <li>• the intensiveness/direction of upgrading (active versus passive learning)</li> </ul>

perspective of a developing country's suppliers implies that 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 explaining why firms embedded in similar GVCs may upgrade at different rates or following different patterns.

Given that the GVC literature encompasses a wide range of issues and disciplines rooted in rather different theoretical backgrounds, we have conducted our analysis on some selected papers within this burgeoning literature.<sup>7</sup> These include the most influential contributions on GVCs in developing countries, and their effects on firms' upgrading.<sup>8</sup> All the studies analysed interpret the concept of *upgrading* in terms of improvements in either products, processes or functions, and analyse to what extent different patterns of governance contribute to reinforcing, or conversely hampering, upgrading in firms and clusters. The studies share some consensus on the effect that different modes of governance would have on upgrading.

In terms of the *unit of analysis* adopted, the studies differ to a large extent, ranging from clusters to industries and nations. The individual firm is never the central focus, although the majority of studies implicitly assume this dimension is present in the analysis.

From a *geographical* point of view, the studies cover a wide and differentiated set of experiences of GVCs in developing countries. Some focus on newly industrializing countries (NICs), such as Brazil, Mexico and Taiwan (Bair & Gereffi, 2001; Gereffi, 1999; Kishimoto, 2004; Quadros, 2004), others are more concerned with countries at a lower stage of development (Barnes & Kaplinsky, 2000; Gibbon, 2003; Gibbon & Ponte, 2005; Nadvi, 2004).

For the sake of simplification, we identify two different "schools" or approaches within the broad GVC literature (Table 2): the *internationalist* approach, which includes the North American school on GVCs, well represented by Gereffi and some Europe-based scholars such as Kaplinsky and Gibbon and colleagues at the Danish Institute for International Studies; and the *industrialist* approach, mainly represented by Humphrey, Schmitz and 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: *internationalists* privilege a macro perspective, in terms of both level of analysis and policy focus; conversely, the *industrialists* adopt a micro-founded framework of analysis with a policy focus oriented towards local and cluster development.

**Table 2.** Different GVC schools

	Internationalists	Industrialists
Main focus	GVCs' governance and upgrading mainly in LDCs	GVCs' governance and upgrading mainly in LDCs
Methodology	Macro approach Industry level data/trade data	Micro approach Case studies, qualitative data
Policy focus	International division of labour, role of bilateral/multilateral trade agreements, FDI	Competitiveness of clusters, local and cluster development policies
Theoretical background	International economics, political economy, TNC theories	Industry studies, local development, cluster studies

This classification is helpful in highlighting diversities and similarities in the two schools, although we are aware that differences can be found within each group and the two approaches often overlap, given 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 rather loose, but the grouping we propose may none the less be helpful as 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 a case study methodology.

### 3.1. *Upgrading and/or Innovation: Synonymous or Different Concepts?*

The concept of “upgrading” has its origin in international trade theory where it is used to indicate a shift towards a specialization in higher value-added goods *within the same sector* in studies on the dynamics of countries’ specialization. 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.<sup>9</sup>

In the studies examined, the concept of upgrading suffers from some logical contradictions: it is used as a synonym for innovation, yet it is also intended as the outcome of an innovation process.<sup>10</sup> Thus, the two concepts, upgrading and innovation, frequently overlap and are used interchangeably, although the innovation process itself is never investigated directly in this literature.

Indeed, in many empirical studies of upgrading there is a mixing up of causes and effects. Although some recent contributions argue that upgrading needs investments and effort at the firm level (Kishimoto, 2004; Schmitz & Knorrington, 2000; Schmitz, 2004), in most of the empirical analyses there is no systematic attempt to investigate learning and innovation at the firm and cluster levels. When upgrading is identified, it is often stressed that this is the outcome of some activity aimed at building capacity; yet this activity is at best only mentioned, never fully examined. Such an attitude hampers an analytical treatment of the concept, and besides, it may lead to misleading policy suggestions, as it assumes the presence of upgrading whenever a “good” outcome emerges from a buyer-producer interaction.<sup>11</sup> 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 and also of cost reductions, as, for example, through squeezing wages, itself a short-term strategy and a vulnerable one in so far 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 upgrading defined as innovation producing an increase in the value added; indeed, innovation is affected by the level and depth of TC, together with the industrial and organizational context in which firms in developing countries are inserted.

### 3.2. *Knowledge Features and Transfers in GVCs*

As already emphasized in the Introduction, a more explicit reference to innovation allows one to stress that differences in codifiability, complexity and tacitness may influence how



knowledge is transferred within GVCs, and may affect the balance of power and the patterns of governance. This implies that local producers face several obstacles, besides power asymmetries, when dealing with external sources of knowledge. Although this latter point has been partly recognized by the GVC literature (Schmitz, 2004), we claim that it requires further investigation: first, 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, as in the shoe cluster in Brazil (Bazan & Navas-Aleman, 2004)) than to providing innovation opportunities to local producers; and second, because the nature of knowledge changes along the value chain, and hence absorption capabilities of local producers need to change accordingly.

Most of the studies considered admit the existence of factors limiting the spread of knowledge within GVCs and influencing their pattern of governance. In particular, the studies in the *industrialist* approach often mention the presence of constraining 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 labor, and for the capacities of particular participants to upgrade their activities” (Kaplinsky & Morris, 2001, p. 29). Chain leaders are those who co-ordinate and govern the GVC,<sup>12</sup> 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 in the distribution of rents produced in the value chain.

Clearly, “buyers do not always provide support for this upgrading” (Humphrey & Schmitz, 2004, p. 358). In a study on the shoe sector in various countries, Schmitz & Knorringa (2000) stressed the links between GVC leaders and upgrading, looking at the obstacles and enabling conditions affecting the buyer–producer relation. They noted that “the problem is that marketing and often design, are part of the buyers’ own guarded core competence”, so, they concluded 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 & Navas-Aleman (2004) and Navas-Aleman (2006), studying the shoe cluster of Sinos Valley in Brazil, observed that “buyers are the undisputed leaders in the chain, exerting control over intermediaries, local producers and often input suppliers as well” (Bazan & Navas-Aleman, 2004: p. 115). Furthermore, the authors wrote that “buyers have resisted sharing their knowledge on higher value added activities such as design, branding, marketing and chain coordination” (p. 115). Therefore, it is the asymmetry of power between them and local producers that often prevents buyers from supporting local suppliers’ upgrading.

This is not always the case, however, and in other studies the emphasis is on how global leaders transfer knowledge and information to local producers. For example, in a study on the Taiwanese ICT industry, Poon (2004, p. 134) noted that: “Taiwanese suppliers gradually upgraded their technological capabilities through technology transfer and knowledge diffusion (by playing the OEM/OBM role for network flagships)”. Further on this point, she argued that knowledge spillovers 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.” (p. 134). Similar patterns of diffusion have also been envisaged by Gereffi (1994), in his seminal work on various Asian countries.

The evidence presented above is useful for singling out the main regularities in GVC patterns of governance, but it should not be given a normative meaning or even used (or misused) to draw straightforward policy implications. That is, it cannot be assumed that the specific governance structure is the *only* determinant of the leaders' inherent ability or interest in conveying knowledge to local producers and providing learning opportunities. For the latter, technological efforts and absorption capabilities are also crucial, and the GVC literature often underplays them and, with a high dose of determinism, suggests that knowledge transfers and upgrading are influenced mainly by the institutional settings, with GVC structures and chain leaders' strategies setting the pace and direction of knowledge flows and upgrading (either in favour or against the interests of local producers). Indeed, as argued in the GVC literature, 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.<sup>13</sup> Little or no regard is explicitly given to other issues such as 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 of or obstacles to technology transfer and learning), 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, such as, for example, clusters' external economies and collective efficiency. The level of the firm and the differences in technological regimes and sectoral systems of innovation tend to be overshadowed. Yet, as discussed in Section 2, knowledge features and firms' TC-building strategies affect the pace and direction of learning and knowledge absorption. Moreover, innovation theory in the Schumpeterian tradition has 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 technology (Malerba & 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.

It is worth pointing out that we do not underplay the importance of "conflicts", power asymmetries and GVC governance in knowledge transfers. Yet, this dimension has been notably weak in the TC literature, and is often explicit in papers on GVCs. All these elements should be combined within a framework where firm-level dimensions as well as technological regimes are included in order to explain how knowledge is transferred within GVCs and how it can be used.<sup>14</sup>

### *3.3. GVCs and Technological Capabilities: Nature and Modes of Acquisition*

Firm-level analyses of the learning and innovation processes in local small and medium-sized enterprises (SMEs), and their technological capabilities, although often cited as important, do not constitute a core issue in the GVC studies reviewed. Most papers mention them but do not address the details of their nature, their dynamics and their acquisition. Thus, for example, in summing up the main results of an extensive research project on clusters and GVCs, Schmitz (2004, p. 356) stressed that upgrading "requires continuous investment by the local firms themselves in people, organisation and equipments", probably having in mind some notion of technological capabilities. Along the same lines, Kishimoto (2004) pointed out the importance of pre-existing capabilities

in sustaining functional upgrading in the Taiwanese computer industry. He observed 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, p. 247).

The issue of capability is somehow implicit also in the early “internationalists” studies on GVCs. For example, Gereffi argued that East Asian countries, after entering GVCs 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, p. 55). According to Gereffi, the transition from OEM (original equipment manufacturing) to OBM (original brand manufacturing) in East Asian countries was made possible by the extensive organizational learning occurring at the firm level, prompted by the insertion into GVCs. In a recent analysis about the de-commoditization process occurring in the coffee industry, Kaplinsky & Fitter (2004, p. 20) claimed 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” (p. 18).

The above examples hint that although in GVC studies there is a clear perception of a strategic relationship between upgrading and technological capabilities, they generally lack an explicit and detailed focus on TCs. In what follows, we analyse this relationship through the lenses of Lall’s categorization of technological capabilities (Lall, 1992, 2001), addressing two interrelated issues: the *nature* of capabilities and the *acquisition* of capabilities, which can be either internal or external (Romijn, 1999; Bell & Albu, 1999).

*The nature of technological capabilities and the limits of the notion of upgrading.* In general, the *industrialists’* studies reviewed do not explicitly explore the nature of firms’ capabilities in terms of the differences between investment, production and linkage capabilities. 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 his study, Kishimoto presents some empirical evidence on the *linkage capabilities* accumulated by local manufacturers through intensive collaboration with IBM and other transnational corporations (TNCs). The recruitment of experienced engineers trained by multinationals is one of the main mechanisms of interaction he mentions. Quoting Ernst *et al.* (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.

Moreover, some studies on the adoption of international standards by local producers in LDCs (Nadvi, 2004; Nadvi & Waltring, 2004; Ponte & Gibbon, 2005; Quadros, 2004), also 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 standards’ requirements and to collaborate with international buyers. By investigating the organizational setting of the design and engineering phases, he also

explains why suppliers developed rather low capabilities in planning and design, and how this constrained their chances of acquiring new technologies from outside.

Most other studies, however, lack a firm-level (TC-based) focus, but provide some evidence on how chain leaders assist local producers in upgrading (Barnes & Kaplinsky, 2000; Gibbon, 2003; Kaplinsky *et al.*, 2002; Meyer-Stamer *et al.*, 2004; Schmitz & Knorringa, 2000).

The *internationalist* approach provides some reasoning and evidence of *linkage capabilities*. This can be envisaged in Gereffi's analysis of the "triangle manufacturing" system developed by the Taiwanese firms in the 1990s in order to cope with decreasing profits and pressures from foreign buyers on reducing delivery time (Gereffi, 1994, 1999). This system, as also stressed by Kishimoto (2004), enhances firms' capability of co-ordinating, searching and procuring external goods and services.

None of the above studies, however, makes explicit reference to or explores the *vertical* dimension of capabilities. Lall (1992) rightly reminds us that this is a key element for classifying and assessing the nature of the mechanisms to build capabilities, since it allows one 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 unexplored.

This is inherently related to the fuzzy notion of upgrading, whose limits have been discussed above. A vivid way of illustrating this concept has been the description by several authors of upgrading within a value chain as "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 eye-catching and has some advantages, it is not very accurate. GVCs are hardly as linear as they are often described; indeed, this assumed linearity – often for the sake of simplifying their description – drives 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 into 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 very important and can 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 packaging with original highly valued characteristics) is indeed also important, and clearly requires creation and deepening and more complex TC.

This view is consistent with and provides a microeconomic basis for the newly emerging approach that describes economic development as a process of "self-discovery" (Hausmann & Rodrik, 2003), where the diversification of the productive structure through a process of discovery plays a central role, often supported by new forms of industrial policy.

As argued before, 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 & Albu, 1999), little can be said about the contribution of the chain

leaders to strengthening local producers' capabilities. In addition, in order to explore the dynamics of learning and innovation, it would be desirable to introduce a time dimension, and consequently to conduct longitudinal analyses of these capability-building processes.<sup>15</sup>

*Firms' efforts and acquisition of technological capabilities.* Firms acquire TCs for getting access to technological knowledge from a variety of possible sources (e.g. FDI, joint ventures, licensing, imported equipment) and for integrating it with in-house efforts, including costly investments in learning, R&D and technical assistance. Strategies may differ but need to be internally consistent.<sup>16</sup> Although external sources of knowledge are essential, the creation and improvement of technological capabilities require some previous accumulation of skills in the firm, 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, p. 4) is often implicit in theoretical discussions, but mostly absent in empirical analyses. In most of these studies, what occurs within firms is hardly explored, nor what makes firms differ even if they belong to the same sector or the same cluster, or 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, there is some indirect and sketchy discussion of the role of specific actors (mostly GVC leaders) in sustaining local producers' upgrading at the cluster or at the industry level. However, we argue 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 focus ends up neglecting more careful analyses of in-house domestic technological and learning activities that 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 & Navas-Aleman, 2004, p. 136). Others stress the role of industry associations and technical schools in enhancing skills and more broadly local capabilities (Meyer-Stamer, 1998; Meyer-Stamer *et al.*, 2004). Overall, these latter contributions – 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. Nevertheless, none of these authors focuses clearly on the firm-level dynamics leading to TC development.

In the *internationalist* approach, detailed references to local actors and their role for upgrading and TC development are less frequent. This is clear in Gereffi (1999, p. 38), who investigated how GVCs contributed to the upgrading processes in the East Asian apparel industry and argued that leading firms (i.e. international buyers) played a prominent role: "*they are the primary sources of material input, technology transfer and knowledge in these organizational 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, 2004; 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 TC. Thus, it would be useful to know which actors – firms,

business associations or science and technology institutions are involved, how they master and adapt foreign technologies, how they influence the level and direction of investments in TCs, and so forth.

In so far as the objective shared by the different branches of literature considered here is to understand the determinants of innovation and industrial performance in LDCs, then the analysis of indigenous learning, and the firms' activities related to it, should not be underplayed, and policies should focus appropriately 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 to accessing technological knowledge, and this makes openness desirable (Bell & Albu, 1999; Giuliani *et al.*, 2005). However, technology selection, adaptation and improvements are not mechanical, straightforward processes, but require specific activities and investments.

The evidence discussed so far suggests that an incorporation of the analysis of the processes that lead to the creation of TCs, and of their microeconomic foundations, into the GVC framework could substantially improve our understanding. A more comprehensive approach should encompass the analysis of in-house activities, and integrate the process of transfer and acquisition of technologies with the in-house efforts of local producers. Within this framework, the TC approach may powerfully explain upgrading and performance in GVCs.

#### **4. Conclusions and Implications for Future Research**

Global value chains represent a new form of industrial organization that is rapidly diffusing in many industries across countries. Therefore, an analysis of their potential implications for firms in developing countries is of utmost relevance. However, recent research efforts in this direction have not fully clarified how GVCs foster innovation and learning processes in developing countries' firms. On the one hand, it has often been hinted that entering GVCs causes a sharp and automatic impact, either positive or negative, on local producers, in a deterministic fashion. On the other hand, the research agenda has focused on 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. The TC literature may usefully remedy this.

It is obviously untrue that entering GVCs by itself will lead to innovation and better industrial performance in developing countries. This is not a mechanistic and riskless process, and local firms need to invest in learning and building TCs to innovate effectively. The direction, extent and strategy of these investments may also vary in relation to features of knowledge such as the degree of complexity, tacitness and appropriability of the technology that in turn affect GVC leaders' strategies, and this has been insufficiently studied so far.<sup>17</sup> At the same time, the GVC approach adds a focus on the role of the balance of power between actors in development that the TC approach does not have.

The insights offered by the TC approach, discussed at length in this paper, may usefully be integrated with the GVC approach, providing original conceptual insights for the study of innovation in a GVC context. This also has potential implications for the definition of upgrading itself, and leads us to question whether this is the relevant concept to apply,

or whether we should continue to think in terms of strengthening and deepening technological capabilities.

There is a large agenda that future research should address following these considerations. Let us stress only three major points here. First of all, firm-level surveys and questionnaires should be employed to explore the impact of GVCs on local firms' competitiveness and upgrading. There is an extensive empirical literature on how to measure TCs at the firm level and how to study their determinants, which could fruitfully be used for this aim.<sup>18</sup> The wealth of surveys and questionnaires increasingly produced by multilateral organizations, among others, could be exploited to address the issues that are most relevant for developing countries' industrial development along the lines described in this paper.<sup>19</sup> Research should contribute to improving the design of these surveys and to helping them capture the relevant issues.

Second, future studies should explicitly explore the *vertical* dimension of capabilities (Lall, 1992). This implies studying the different levels of complexity of capabilities, i.e. whether the new capabilities are either routine, basic capabilities or rather of higher, innovative and advanced order. This is a key element for classifying and assessing the nature of the mechanisms to build capabilities, and exploring whether some capabilities are intrinsically superior to others.

Third, these same studies should take a longitudinal approach to analysing TC accumulation and GVC governance over time. The learning and innovation processes, which may be fostered by these inter-firm arrangements and linkages, can only be properly studied with a dynamic approach. This would have useful implications for future research and policy design and implementation.

## Notes

<sup>1</sup> 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 concern which activities and technologies a firm keeps in house and which are outsourced to other firms, and where the various activities are located.

<sup>2</sup> Humphrey & Schmitz (2000) distinguish among three possible types of non market governance: network, quasi hierarchy and hierarchy. They suggest that global buyers tend to hinder functional and inter sectoral upgrading. This is confirmed by a number of other studies showing that 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 (Bazan & Navas Aleman, 2004; Giuliani *et al.*, 2005; Schmitz & Knorringa, 2000).

<sup>3</sup> 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 producers belong to.

<sup>4</sup> The work of some scholars has partly recognized this (Bell & Albu, 1999; Caniëls & Romijn, 2003; Schmitz, 2004).

<sup>5</sup> Among the main contributions to this approach, see Bell & Pavitt (1992, 1995), Dahlman *et al.*, (1987), Enos (1991), Evenson & Westphal (1995), Fransman & King (1984), Figueiredo (2001), Katz (1987), Lall (1992, 1993, 2001), Pack & Westphal (1986), Pietrobelli (1997, 1998) and Wignaraja (1998).

<sup>6</sup> It is not pretended that the complexity and variety of TCs have been portrayed exhaustively here. Other categorizations have been proposed by Bell & Pavitt (1995), Dahlman *et al.*, (1987), Enos & Park (1988), Figueiredo (2002) and Katz (1987).

- <sup>7</sup> The complete list of all the studies analysed is presented in the Appendix.
- <sup>8</sup> A useful source of information about this approach is the web site of the Global Value Chain Initiative at <http://www.globalvaluechains.org>
- <sup>9</sup> In this literature, the use of this concept clearly has its merits, as it represents a useful sophistication compared with the mere notion of production efficiency, to include product diversification, the acquisition of new skills and capabilities for different functions and even sectors, and so on (Porter, 1990; Pietrobelli & Rabellotti, 2007).
- <sup>10</sup> An exception is in Kaplinsky & Morris (2001, p. 37), in their view: “the concept of upgrading (as distinct from innovation) explicitly recognises 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”.
- <sup>11</sup> This incongruence is partly recognized by the GVC literature; for example, Meyer Stamer *et al.* (2004, p. 328) comment that “. . . at first glance the issue of upgrading appears to be straightforward enough. For a firm, upgrading means getting better producing better products and producing them in a more efficient way. However, things are more difficult than that” and they add that the GVC literature has “to rethink the concept of upgrading and acknowledge that it must be a relational category” (p. 330).
- <sup>12</sup> Kaplinsky & Morris (2001, pp. 29–30) notice 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”.
- <sup>13</sup> Network based chains would “support an open ended upgrading path” (Humphrey & Schmitz, 2004).
- <sup>14</sup> Gereffi *et al.*, (2005) have made a recent interesting effort to incorporate knowledge features in their theoretical framework. We shall discuss this issue further later.
- <sup>15</sup> Notable efforts in this sense are in Figueiredo (2001, 2002) and Katz (1987).
- <sup>16</sup> See Lall (1996) on the different strategies followed by various Asian countries to get access to technology and develop technological capabilities. On this, see also Pietrobelli (2000).
- <sup>17</sup> A notable exception is Gereffi *et al.*, (2005).
- <sup>18</sup> See, for example, the papers in the special issue on technological capabilities in developing countries of the *International Journal of Technology Management*, edited by Figueiredo (2006).
- <sup>19</sup> See, for example, the recent attempt to use the existing World Bank firm level surveys in Pietrobelli & Saliola (2007).

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**Table A1.** The GVC studies reviewed

Authors and studies	Main focus and results	Extent/depth of analysis of:	
		Knowledge features <sup>a</sup>	TCS, nature and acquisition <sup>a</sup>
	<i>Industrialists</i>		
Bazan & Navas Aleman (2004) and Navas Aleman (2006) 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
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
Meyer Stammer, Maggi & Sieble (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
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
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

Table A1. Continued

Authors and studies	Main focus and results	Extent/depth of analysis of:	
		Knowledge features <sup>a</sup>	TCs, nature and acquisition <sup>a</sup>
Schmitz & Knorrina (2000) 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 not only search price competitiveness, but also quality, flexibility, etc.	Low	Med low
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
Kaplinsky (2000, 2004) Canned deciduous fruit and car component sector, South Africa	<i>Internationalists</i> Industry study: analyses of the dynamics of rents distribution along the GVC in different sectors. GVC approach makes it possible to identify the main drivers governing these chains and who accrue major benefits from them	Low	Low
Barnes & Kaplinsky (2000) Car component sector, South Africa	Industry study: it examines how local component producers respond to increasing external competition. Multinational corporations increasingly integrated their local subsidiaries, reducing the space for locally owned suppliers	Low	Med low
Kaplinsky & Fitter (2004) Horticulture and coffee sectors in LDCs	Industry study: it examines how LDCs can exploit changes in the global market by entering new phases of the GVCs. Investing in knowledge is a winning strategy to accrue innovation rents	Low	Med low
Kaplinsky, Morris & 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
Kaplinsky & 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

**Table A1.** *Continued*

Authors and studies	Main focus and results	Extent/depth of analysis of:	
		Knowledge features <sup>a</sup>	TCS, nature and acquisition <sup>a</sup>
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 versus producer driven). Core periphery patterns emerge in the USA apparel suppliers system	Low	Low
Gereffi, Humphrey & Sturgeon (2005) Apparel, bicycle, electronics and fresh vegetables industries. LDCs	Industry study: governance patterns differ according to three main theoretical perspectives: transaction costs; production networks; and technological capabilities. Three factors make it possible to build a GVC theory: complexity of transactions; codifiability of transactions; and capabilities of suppliers	Medium	Medium
Bair & 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 spillover	Low	Med low
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
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
Palpacuer, Gibbon & Thomsen (2005) Clothing sector in European countries	Industry study: to what extent clothing GVCs offer upgrading opportunities for developing countries. Analysis of the buyers' strategies. They raise doubts about the worthiness of entering GVCs for developing countries	Low	Med low

<sup>a</sup> High: fully examined; medium: partially examined; med low: mentioned and sketchily analysed; low: only mentioned or not taken into account at all.