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Catching up in the 21st century: Globalization, knowledge & capabilities in Latin America, a case for natural resource based activities

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CATCHING UP IN THE 21ST CENTURY: GLOBALIZATION, KNOWLEDGE & CAPABILITIES IN LATIN AMERICA, A CASE FOR NATURAL RESOURCE BASED ACTIVITIES

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Abstract
The nature of the catching-up process has changed substantially at both the global and local levels over the last decade. The catching up process can no longer be disentangled from the rapid internationalization of science and technology and the globalization of innovation, in which the developing countries have an increasingly important role to play. In the first section, we focus on setting the global scene within which the catching up process operates today. In a second section we study the increasing complexity in the knowledge creation process caused by this dynamic interaction between the global and local levels. We then introduce the relevant types of capacities and explain why different capabilities are required in specific situations, times and locations. In section four, we place these theoretical discussions in a Latin American context to understand catching up opportunities from a regional perspective, focusing on activities based on natural resources.

Key words: Catching up, Globalization, Knowledge, Capabilities, Natural Resources, Latin America.
JEL code: O24, O5, Q00

Introduction

In this paper, we reassess the nature of the catching-up processes of developing countries, which has in our view changed substantially both at the global and local levels over the last decade. Catching up today can no longer be disentangled from the rapid internationalization of science and technology and the globalization of innovation, following the emergence of new digital information and communication technologies at the end of the last century. Those technologies have radically broadened the scope for international research collaboration and the international exchange of ideas. The importance of new global communication opportunities and of digital access for traditional science and technology activities of researchers worldwide cannot be easily overestimated.

The advent of ICTs over the last two decades has radically altered the international accessibility to what has been called “codified knowledge”. This new, easy global access to knowledge in various forms and formats has altered the internal and external organization of such knowledge activities within firms, knowledge institutions and even universities. It has also become a major engine for the international trading of various high and low-tech components across the globe, and for foreign investments of all sorts. However the extent to which such knowledge globalization has been instrumental in ‘upgrading’ the knowledge base of firms in emerging and developing countries remains an issue of debate. While the economic performance of firms in many developing countries is likely to improve as they become integrated into global production systems, it does not necessarily mean that their long-term competitiveness or capability will automatically become ‘upgraded’ through just benefiting from the new opportunities of “codified knowledge” interaction. The shifts in and complexity of the current global production system is such that at the local level opposite tendencies might well occur.

In this paper we focus on what the new context of globalization means for developing countries, particularly in Latin American economies. We focus on two concepts that seem to act today as ‘engines’ for catching up, namely capabilities and knowledge in the global context. These concepts are interrelated, bridging the different scenes present at the global and local levels. In the first section we focus on setting the global scene within which catching-up processes operate today. In the second section we study the

increasing complexity in the knowledge creation process caused by this dynamic interaction between global and local levels. Section 3 then introduces the relevant types of capacities and explains why different capabilities are required in specific situations, times and locations. In section 4, we place these theoretical discussions in a Latin American context to understand catching up opportunities from a regional perspective focusing on activities based on natural resources.

2. "Globalization" of economic activities to knowledge creation

Economic globalization[1] implies a growing interdependence of locations and economic units across countries and regions (Narula and Zanfei, 2005). This may create new opportunities for stakeholders in 'catching up' countries to participate in global economic activities. In this section, the transformation of economic activities at global level is reviewed with particular attention to its governance structure and knowledge flows.

There are two forms of economic interactions: international trade and foreign direct investment (FDI). FDI, compare to trade, would create the stronger links between investors and local producers via interacting through production processes. Moreover, it is considered to allow greater and better flow of information and knowledge between the two. Earlier theories (such as product cycle and eclectic theory) on FDI; nevertheless, did not pay much attention to how the flow of knowledge would take place. These assumed that diffusion of knowledge would take place automatically through interaction while multinational companies (MNCs) take operational and technological leadership in managing subsidiaries.

The global commodity chain (GCC) approach (Gereffi and Korzeniewicz, 1994; Gereffi, 1994) as well as global value chain (GVC) approach (Schmitz and Knorringa, 2000; Humphrey and Schmitz, 2000, 2002a, 2002b; Kaplinsky, 2001; Kaplinsky and Morris, 2001) create a productive network in which MNCs (in developed countries) govern producers (in developing countries) in hierarchical manner. Here the function of MNCs may differ from production manager to buyers and they focus more in creating value via variable niche products of higher quality than on the conventional cost reduction via scale economies and technological advances.

The GVC approach differs from the GCC approach in the following respects. First, in the GVC approach, suppliers/producers in developing countries can 'upgrade' their product quality, production process and its function in the value chain. Secondly, it recognizes the presence of capability and learning abilities of the suppliers/producers in developing countries despite setting a limit to their learning capability at the level of meeting the standards set by the buyers. Third, it pays attention to the horizontal relationships in developing countries within the context of global integration through bridging the local industrial district and cluster literature with the global integration literature thereby bringing in the horizontal dimension to vertical linkage.

Despite opening wider possibilities for the producers in developing countries, GVC assumes that knowledge would flow only from buyers/producers to producers/suppliers as a consequence of 'learning by doing'. In actual case studies in developing countries, process and product upgrading was confirmed by the evidence except for functional upgrading,[2] which is of fundamental importance in terms of power relationships. The limitation of GVC approach is thus this rather static view on governance. Also, the GVC approach considers knowledge as exogenous from the interactions between buyers/producers and producers/suppliers.

The Global production network (GPN) approach takes one step beyond the GVC approach and suggests a more flexible and egalitarian relationship between buyers and suppliers. Ernst (2001), demonstrates that

[1] Gereffi (1994) differentiates 'international' from 'global' as follows: International = simple geographical spread of economic activities. Global = degree of functional integration between internationally dispersed activities.

[2] Kishimoto (2003) states the presence of functional upgrading; however, he mentions that this had more to do with the willingness of buyers to let suppliers engage in more complex activities to simplify their operations than the suppliers trying to go upward in their functions along the value chain.

present-day production systems as global production network (GPN) with a flagship in the centre, leading the formation of surrounding firms. While still possibly hierarchical as the flagship leads the formation, surrounding actors take a no less important role. In other words, the flagship firms would take the responsibility for coordinating production through networks of suppliers while the task of innovation, knowledge creation and learning processes, would rely more on each supplier's capability than being tightly controlled by the flagship. The GPN approach thereby acknowledges and accepts a more networked formation of knowledge creation. In this way, GPNs can create three impacts on knowledge: first, the frontier knowledge transfer in management, product and process technology; second, the catalyst for knowledge creation and capability development within the local environment; third, the future rise in joint knowledge creation between the flagship and the producers in developing countries. The first two outcomes are similar to the GVC approach of product and process upgrading through interaction; however, this joint knowledge creation through the third mechanism implies the local system (or cluster) is integrated not only in the production process but also for the knowledge creation process.

Another feature of the GPN model is its claim that innovation increasingly depends on the variety and strength of the network external to the cluster, focusing on the capacity to identify the necessary knowledge rather than creating new knowledge from scratch. This view shares some similarities with the recent attempt of linking GVC and the Innovation system concept to create a new Global system of Innovation framework to facilitate examining the learning and innovation mechanism at global level (Pietrobelli and Rabellotti, 2010).

The International Business (IB) literature conventionally examined hub-type and other configurations revolving around the multinational company (MNC), where subsidiaries basically played a 'passive' role as already observed. However, the relationship between the MNC and local subsidiaries has recently been transformed due to a shift towards mutual knowledge creation. Cantwell and Iammarino (2003) claim that in the new context, this relationship could provide: (1) mutual technology systems, (2) knowledge spillovers, and (3) joint stimulation of industry/demand connected with local firms. They also suggest that MNCs today, as compared to the past, are seeking different and diversified technology from outside via subsidiaries. This means that the role of subsidiaries is changing from being submissive, providing labour and access to natural resources, to a more participatory counterpart for innovation giving more importance to the Regional System of Innovation (RSI). They further claim that the relationships with subsidiaries have changed from conventional hierarchical relationships between the owner and the user of technology to a more collaborative kind. While in the past there was 'one technology' that made a product, which is then differentiated into different markets, today it is a range of different technologies owned by different production segments that collaborate and make 'a product' for the global market.

This approach takes a step forward from the GPN approach and opens more opportunities to local subsidiaries. This, at the same time, requires subsidiaries in developing countries to build up their own capabilities to utilize opportunities created from global interaction, by optimizing the local network of knowledge. The recent IB literature also suggests a shift towards network-type innovation, which emphasises a more equal positioning of different stakeholders rather than a strictly hierarchical one. Birkinshaw and Hood (1998), for instance, illustrate how today's innovation process has been transformed into multi-stakeholder activity.

The fundamental difference of present-day interdependence from older interpretations emerges from the content of what is being shared between stakeholders. The content has evolved from merely a production process of tangible products or services to a 'knowledge creation' process, as the world heads towards the 'knowledge based economy' (Lundvall and Johnson, 1994). Such a shift in the importance of the factor of competitiveness from 'product' to 'knowledge' has greatly affected the formation of industrial organization and resulted in a transition from the conventional static view of the firm to a dynamic one.

The changing theories of economic globalization illustrate the shift from hierarchical 'internationalization' of industrial production systems to the egalitarian 'globalization' of knowledge creation. These transitions portrayed by the theories point out several other significant changes, which are interlinked, as all dynamically interact with the evolution of economic activities. In terms of governance, this means that relationships among stakeholders have evolved from being one-directional to multi-directional from

vertical to horizontal. The transitions also demonstrate the increasing importance of the network form of governance as the role of local capability increased. It is important to mention that the role and scope for developing countries to participate this network of knowledge creation has increased. The new situation requires more than just the technological capability but the capability to create an innovative combination of locally existing knowledge with that of external ones, through belonging to different networks and adapting to an increasingly complex and variable global market.

3. Knowledge and horizontal relationships in a globalizing world

We know that knowledge can take shape in various forms, such as employee/labour relations, organizational practices, products, documents, routines, and information (Dosi, Coriat and Pavitt, 2000). These can be generally classified into two groups: 'codified' and 'tacit'. Codified knowledge is defined as "explicit, formal or systematic knowledge, which can be expressed in words and numbers, scientific procedures or universal principles" (Cohendet and Meyer-Krahmer, 2001:1568). Tacit knowledge is considered as skills and know-how associated with implicit and unsystematic routines or procedural rules embedded in specific locations, personnel or groups, which can be shared via learning, imitation and practical examples. As numerous works on codified and tacit knowledge suggest (Ancori, Bureth and Cohendet, 2000; Cowan, David and Foray, 2000; Amin and Cohendet, 2004; Nonaka and Takeuchi, 1995), interactions between each type of knowledge are essential for knowledge to function.

Similarly, knowledge can also be divided into 'generic' and 'specific' (Amin and Cohendet, 2004). In the innovation literature, not only is knowledge increasingly considered as a bundle of information that is 'organized' and 'designed' but it is also considered to have a 'specific' character to match a certain time or geographical location rather than being solely 'generic' knowledge. In evolutionary economics, the implicit side of knowledge is the focus, while the knowledge creation process is considered as fundamentally localized, path-dependent and interactive. Knowledge transformation, from 'specific' to 'generic' and vice versa, is considered necessary not only for knowledge to diffuse and function but also for the creation process. In this way, knowledge and its creation process is now considered as the non-linear, endogenous process involving various stakeholders (Aghion and Howitt, 2006; Amin and Cohendert, 2004) (see Table 1).

Table 1: Changes in knowledge creation process: before and after globalization

before	after
Knowledge is simple accumulation of information and pure public good, it is not possible to exclude anyone from using	Knowledge is not pure public good, whether being in the network can change the accessibility to knowledge
Incentive for knowledge acquisition is its ownership	Incentive for knowledge acquisition is not limited to its ownership
There is only one producer of knowledge	Production of knowledge is not solitary, it is work with community
Producer of knowledge interacts with market	Producer of knowledge faces the specific structure of interaction of economic agents
Epistemic content of knowledge does not matter	Epistemic content of knowledge matters
All agents have full capability in understanding knowledge	There are differences in utilizing knowledge depending up absorptive capabilities

Source: based on Amin and Cohendet, 2004

Maskell and Malmberg (1999) use the term 'collective learning' to emphasise the advantage of having national/regional systems of innovation, which brings in social relations and institutions at the local, regional and national levels in promoting knowledge creation through interaction. This leads to the creation of specific national and regional systems of knowledge creation (Lundvall, 1992). These

knowledge creating systems retain their role as key factors in the ascending global knowledge-based economy and influence the firm's location setting significantly" (Maskell and Malmberg, 1999: 168). Also Keeble et al. (1999: 296), using the definition of Lorenz, define collective learning as "the creation and further development of a base of common or shared knowledge among individuals making up a productive system which allows them to co-ordinate their actions in the resolution of the technological and organizational problems they confront (Lorenz, 1996 quoted in Keeble et al, 1999:296)". The creation and development of such a localized knowledge base can facilitate the local and specific problem to be solved through the learning process. This comes out of interaction rather than the capacity of the individual firm itself but increasingly in collective form. Likewise, Piore (1995 quoted in Perez-Aleman, 2005: 653) defined 'learning by monitoring' as a "relationship in which firms, along or together with government, create institutions that help to meet the demands of learning and monitoring through mechanisms such as setting provisional goals, standards and evaluation" . In other words, the 'learning by monitoring' model, allows challenges to be overcome in a collective way (Perez-Aleman, 2005, 2011). It states that the collective institution can surpass the limit set by path-dependency and absorptive capacity at firm level by complementing the knowledge at the meso level, hence stating that the institution is instructive to collective knowledge building in the context of the global-local interaction (Perez-Aleman, 2011, Sabel 2011 forthcoming).

In the conventional approach, learning in developing countries is considered a linear and 'passive' process through diffusion of knowledge in order for them to 'upgrade' through adapting higher product standards as well as production methods from global buyers. However, the present-day context seems to suggest that such one-directional flow of knowledge is not applicable even with the interaction with developing countries. The literature of the production process and knowledge creation seems to suggest a window of opportunity for the stakeholders to be a part of an endogenous process if they are equipped with sufficient capability, network and institutional structure. The fundamental question in the context of catching-up is therefore whether the developing country in question can establish a local institution, which would enable it to become an endogenous counterpart in knowledge creation. Furthermore, as the global market is now increasingly segmented requiring diversity and variability in both product and services, these local institutions in developing countries should be able to identify the market needs by belonging to different networks and flexibly adjusting their capability at sufficient speed to meet fast-changing demands (Teubal et al, 1996).

4. Capability for catching up

It is evident that capability plays an increasingly vital role in catching up as the world enters into the 'knowledge economy'. Capabilities have been discussed in various literatures on catching up and defined in different ways (Lall, 1992; Bell and Pavitt, 1995; Abramovitz, 1986; Bell and Albu, 1999; Teece, Pisano and Shuen, 2000; Cohen and Levinthal, 1990). Capability addresses different – often overlapping and interrelated – abilities. These can be disaggregated into those which can: (1) identify or recognize the problem/ competence, (2) formulate their own goal or aspiration, (3) imitate or replicate better practices, (4) learn, obtain and acquire new knowledge, (5) coordinate and form a consensus, (6) transform (unlearn), (7) implement and execute actions. These are categorized in different ways; for instance, von Tunzelmann and Wang(2007) analyses them in: (1) levels (firm to global)[3], (2) variety of processes (dynamic and static) and (3) variety of functions (such as technological/organizational capabilities).

Different factors are mentioned as crucial for catching-up at each level. For instance, at country level, Abramovitz (1986) mentions 'social capability' to increase the flexibility of being open to competition and willing to accept 'newness' (in firms, goods and services). Similarly at country level, Hobday (2003), in explaining successful Asian economies, points to the ability of institutions (government, large domestic firms, FDI, global buyers) to fill in the missing 'prerequisites' for development. These demonstrate the

[3] For instance, firm level (Nonaka and Takeuchi, 1995; Lall, 1992), regional level (von Tunzelmann, 2007; Cantwell and Iammarino, 2003; Cooke and Morgan, 1998; Saxenian, 1994; Enright, 1998); industry and cluster level (Bell and Albu, 1999; Porter, 1980, 1990); country level (Lall, 1992; Freeman, 1987); and global level (Schmitz and Knorringa, 2000; Humphrey and Schmitz, 2000, 2002a, 2002b; Kaplinsky, 2001, Kaplinsky and Morris, 2001; Ernst., 2001; Birkinshaw and Hood, 1998).

importance of being able to identify the lacking elements, and to act institutionally by transforming or creating incentives so that missing elements are somehow substituted. At local and regional level, Maskell and Malmberg (1999) mention the importance of 'unlearning' to allow new transformation to take place in local institutions. At the cluster level, Porter (1990) emphasises the importance of competitive advantage, involving the ability to identify the competitive edge and transform through competition. At firm level, Nonaka and Takeuchi (1995) unpack the circular model of knowledge creation that describes the learning, mechanism of coordination and consensus-making inside of the firm which eventually lead to the transformation of the organization.

At all levels, important reference was made with respect to entities' ability to dynamically transform to address rapidly changing environments through interaction, thereby implying the presence of 'dynamic capability' (Teece, Pisano and Shuen, 2000), the ability to recognize competitive advantage and transform accordingly, taking account of given circumstances. This ability is clearly different from static forms of "skills and routines which can be learned and perfected through practice" (Nelson and Winter, 2002: 29). To this end, the accumulated prior knowledge, 'absorptive capacity' (Cohen and Levinthal, 1990: 128), is seen as key as this enables firms "to recognize the value of new, external information, assimilate and apply [it] to commercial ends" (ibid: 128). The emphasis on the cumulativeness of absorptive capacity suggests an extreme case of path dependence, i.e. 'lockout'. "This identifies that if the firm does not develop its absorptive capacity in some initial period, then its beliefs about the technological opportunities present in a given field will tend not to change over time because the firm may not be aware of the significance of signals that would otherwise revise its expectations" (ibid.: 136). Perez (2001) draws attention to this 'lockout' or missing out on the 'window of opportunity' at paradigm level when thinking about 'catching up'. She considers the ability to identify and enter the window of opportunity created by technological change as an important factor for catching up. The firm or country's catching up, therefore, depends very much on the wider notion of ability to transform according to emerging opportunities.

Complementing the technological aspect of capability to catch up by Cohen and Levinthal, (1990), Bell and Albu (1999) and Bell and Pavit, (1995) state that the capability necessary for catching up is not limited to technical know-how but includes organizational aspects of how particular activities are facilitated. Likewise, Lall (1992) considered that the development of capabilities was an outcome of the interplay between institutional sectors (such as different types of incentives and institutional frameworks).

In summary, the changing global landscape of knowledge creation requires different types of capabilities. This is particularly true for developing countries that are in the later stages of 'catching up'. The new context not only requires firms to have absorptive capacities but also the ability to identify key actors and act collectively in the network to overcome the 'lockout' problem.

5. Latin American perspectives of catching-up in the 21st century: looking at natural resource based activities

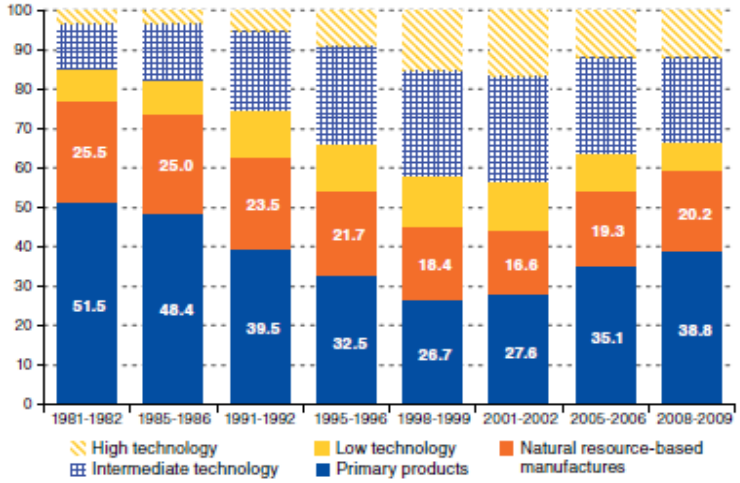
The previous section illustrated how a backdrop of catching up changed dynamically over time. In the present day context, developing countries can play an increasingly important role in knowledge creation at the global level if they are capable of identifying the window of opportunity and rapidly transform. With the above understanding, we will discuss the 'changing' and 'dynamic' nature of development in a Latin American context paying attention to the case of natural resources.

5.1 Recent trends in Latin America with regards to natural resources

A recent publication by the Economic Commission for Latin America and the Caribbean (ECLAC, 2010) shows interesting trends of exports based on natural resources in Latin America. The report demonstrated the relative increase in proportion of natural resource based exports from the region in the 2000s compared to that of the 1990s (Figure 1). One may wonder if this is the "re-commodification" of trade in the Latin America, or a revival of the 'curse' of natural resources. The dependence on natural resources for export was considered an impediment to economic growth by early development economists. This is explained by the long term decay in trade for natural resource exporting developing countries, while the exporter

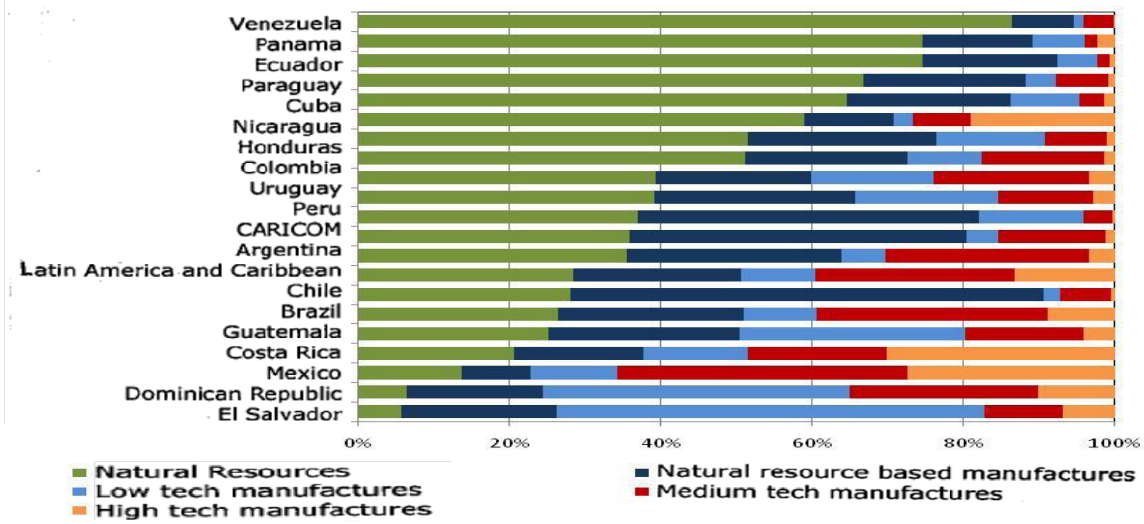
of manufacturing products in industrial nations capture the benefits of productivity growth and technological progress (Prebisch, 1962; Singer, 1950; Sachs and Warner, 1995, 1997, 1999). As a result, the development of the manufacturing sector was considered a better policy for catching up and promoted through import substitution industrialization (ISI) policy. Despite such a pessimistic view towards natural resources, the present day economic performance of Latin America demonstrates a rather contradictory reality: countries with a higher proportion of natural resource based exports (South American countries) are demonstrating better economic performance than the countries with a higher proportion of manufacturing goods (Central American countries, particularly Mexico) (Figure 2 and Table 2).

Figure 1 Latin America and Caribbean: Evolution of the structure of worldwide exports since the early 1980s (% of total by value)



Source: ECLAC (2010) Panorama de la inserción internacional de América Latina y el Caribe, 2009-2010

Figure 2 Latin America: Structure of exports according to technological intensity 2006-2009



Source: ECLAC (2010) Panorama de la inserción internacional de América Latina y el Caribe, 2009-2010

Table 2 GDP growth rate of Latin America between the 1990s and 2000s

		1990-1999	2000-2009
	Latin America and Caribbean	8.5	7.4
	Latin America and Caribbean (without Mexico)	5.4	9.8
	South America	5.2	10.6
More dynamic	Mercosur	5.3	11.0
	Argentine	7.3	8.7
	Brazil	4.8	12.0
	Paraguay	1.1	10.6
	Uruguay	3.4	11.6
	Chile	8.3	12.1
	Andian countries	4.0	9.6
	Bolivia	2.6	16.3
	Colombia	6.1	10.6
	Ecuador	6.0	12.3
	Peru	7.0	16.2
	Venezuela	1.9	6.2
	Mexico	14.4	3.7
Less dynamic	Central American Common Market	14.7	2.6
	Costa Rica	19.2	4.8
	El Salvador	16.4	3.0
	Guatemala	9.7	7.1
	Honduras	12.9	5.3
	Nicaragua	9.4	11.7
	Panama	5.2	7.2
	Caribbean countries	1.8	4.5

Source: ECLAC (2010) Panorama de la inserción internacional de América Latina y el Caribe, 2009-2010.

The new scenario above coincides with the emergence of a new set of literature on 'catching up' based on natural resource. Several reports from international organizations indicated the development potential of natural resources (de Ferranti et al, 2002). Blomstrom and Meller et al(1991) through historical comparison between Latin America and Scandinavian countries, which stated that the different outcomes of natural resource based development had been due to the strategic choice of the countries. Both indicate that Latin America simply 'missed' the 'window of opportunity' to develop capability and expand its economic activities in the late 19th century when the price of commodities was booming. Lederman and Maloney et al (2007) and Sinnoit et al (2010) claimed that natural resources can provide an opportunity for development based on systematic analysis. Furthermore, different streams of literature question existing assumptions of preferring the manufacturing sector in place of the natural resource based sector to promote catching-up. Some of the discussion comes from the criticism on the methodology applied in the existing theory[4] while others present new features of natural resource based economic activities due to the

[4] The literature suggests possible confusion in the embedded assumptions of curse of natural resources. These assumptions are made when most of developing countries are natural resource based "commodity" producers with low labour productivity, organizational development, technological capabilities while manufactured products are produced by developed countries, with high labour productivity and technological capability (Singer, 1975; Saker and Singer, 1991). Nevertheless, these cannot be so clearly grouped in reality today there are examples of countries like Canada, Australia and Finland. Some also suggest that Terms of trade argument is inconclusive. Ellsworth (1956) made criticism that terms of trade had actually improved for his categories of countries except for land scarce developing countries. Lederman and Maloney (2002) by using the net exports of natural resource intensive commodity per worker as against the share of GDP with net resource export (Sachs and Warner, several years) obtained the positive impact of resource from 1820 to 1950, and negative effects are only observed after the WWII. Cuddington (1992) also examined the 26 individual commodity prices over the period 1990 to 1983. He finds that mixed trends or no trends. Hence, the argument may have been due to the impact of specific time period.

changes that had taken place in the globalizing market with emerging new technologies associated with natural resources such as biotechnology and nanotechnology. In this section, we will focus on the latter set of literature to link with the earlier discussion on catching up in the context of changing dynamics of globalization in Latin America, namely the re-emergence of a 'window of opportunity' with the current commodity boom.

The new literature recognizes activities based on natural resources as the 'engine of growth' and contradicts the conventional assumptions made by the 'terms of trade' and 'curse of natural resources' arguments, which were the bases for many Latin American countries to take the Import substitution Industrialization (ISI) policy in the 1960s. Many assumptions made in the 1960s are no longer valid because economic activities based on natural resources had transformed over the years (Table 3). For instance, natural resource based activities no longer form an 'enclave' but involve a wide range of related activities (Ramos, 1998) including forward and backward linkages. The incorporation of a new set of knowledge coming from the biotechnology, nanotechnology and environmental sciences, opened the potential for being knowledge intensive activities (de Ferranti *et al*., 2002, von Tunzelmann and Acha, 2005) when accompanied with relevant human resources (Bravo-Ortega and de Gregorio, 2005). The opportunity of creating new knowledge based on natural resources offers the possibilities to use such knowledge/technology in other sectors, allowing 'lateral migration' (Lorenzen et al, 2006, Walker and Jourdan, 2003) and expands areas of economic activities. Moreover, due to the particular nature of these activities which require one to deal with the local natural and environmental conditions, economic activities can be the locus for local knowledge generation on biodiversity, climate, geography, soil, weather, to name just a few (Katz, 2006). Furthermore, due to the segmentation of the global market, product value added is not determined by the type of product (such as manufacturing or agriculture) but the nature of the product (such as high /quality/specialized/customized/unique to low quality/basic/standardized) (Perez, 2010). Hence, with the strategic marketing, the natural resource based products can be diversified, elastic to income and endogenously priced. The following section will describe the above points in more detail.

Table 3: Assumptions made under the Import Substitution Industrialization Policy

	Manufacturing	**Natural resource based**
Demand side		
Income elasticity	HIGH / ELASTIC	LOW / INELASTIC
Forward linkages	PRESENT / DIFFERENTIATED	ABSENT / STANDARDIZED
Labour productivity	HIGH / IMPROVE	LOW / NO CHANGE
Product diversification	POSSIBLE WITH HIGH VALUE ADDED	NOT POSSIBLE, NOT HIGH VALUE ADDED
Supply side		
Competition	IMPERFECT / ENDOGENOUS PRICE	PERFECT / EXOGENOUS PRICE
Backward linkages	PRESENT / WIDER SCOPE FOR TECH / MORE IMPACT IN ECONOMY	ABSENT / NARROW SCOPE FOR TECH / LESS IMPACT IN ECONOMY
Technology level	HIGH	LOW
Organization	COMPLEX	SIMPLE
Knowledge base	WIDE/IINTENSIVE	NARROW/NOT INTENSIVE
Common missing theme: Learning process--relationship is static		

Source: Iizuka

5. 2 Natural resource based activities—a window of opportunity?

(1) Potential to develop related activities

One of the assumptions made against natural resource based economic activities is its limited capacity to generate related economic activities; namely to extend forward and backward linkages (Hirschman, 1958). Nevertheless, we have learned that the current understanding from the 'catching up' emphasises the importance of a horizontal linkage – particularly forward linkages in the form of a cluster as well as a global integration process through the value chain as well as global production networks (Enright, 1998; Scott, 1998; Maskell and Malmberg, 1999, Pietroburi and Rabellotti, 2010).

Several studies demonstrated evidence to question the above conventional assumption for natural resource based activities. A comparative study of clusters and value chains in Latin America (Pietrobelli and Rabellotti, 2004) demonstrated good performance for natural resource based clusters in terms of collective efficiency and joint action compared to other clusters in manufacturing and service sectors. This result implies that, as far as the extensiveness of the forward and backward linkages is concerned, there are no differences that depend on the types of good produced while sectoral differences exist in terms of learning and innovation. Furthermore, their finding indicates that successful natural resources clusters are often accompanied with local public-private collective action, an important local institution for knowledge creation under the current process of globalization. Other independent case studies also confirm the above findings on the importance of enhancing local capacities. For example, the Finnish forestry sector demonstrated industrial deepening with support of local policy for development of supplier firms and human resources (Ramos, 1998, de Ferreti et al 2002). On the other hand, it has often been found that Export Processing Zones (EPZs) or *maquila* types of manufacturing, despite providing employment, do not extend backward and forward linkages due to a lack of local 'link' (ECLAC, 2005).

In summary, the evidence suggests that natural resource based activities do not always create enclaves but can extend activities both horizontally and vertically. However, as several studies mentioned, the type of local institution seem to hold the key to the successful outcome of the economic activities.

(2) Learning and creating knowledge from interacting with the global market

There is no mention of learning effects in developing countries through interaction in the assumptions made by a conventional approach yet ample evidence exists for potential learning effects through interactions via trade or investment in developing countries, which may dynamically influence the terms of trade in the long term (Humphrey and Schmitz, 2000; Gereffi and Kaplinsky, 2001; Bell and Marin, 2004).

Several theoretical approaches support the importance of learning through economic interactions for developing countries. In the GVC approach, economic interaction through trade and investment is considered important for upgrading the firms' capability in product, process and functional status in the production 'chain' (Humphrey and Schmitz, 2000). East Asian experiences demonstrated that firms could learn and evolve from imitation to innovation by producing for multinational firms and export markets (Hobday, 1995; Hobday, 2003). Nevertheless, interactions between trade and investment and learning processes are not automatic (Kim 1998). The learning process is determined by absorptive, technological and organizational capabilities. Under the global market regime where networks of stakeholders learn through interacting to create highly differentiated products, the learning effect does not seem to differ very much between manufacturing goods and natural resource based goods.

What may matter very much in a learning process is the provision of human resources. Bravo-Ortega and de Gregorio (2005) finds that with the increase in human capital, the marginal effect on growth of the stock of natural resource would rise. It is noteworthy that human capital is measured by the high employment rates of population in knowledge-based activities. Their claim also coincides with the claim made by Howitt and Mayer (2001) which states that in the face of new technological shocks, countries with high innovation effective human capital will be able to implement or adopt technologies developed

elsewhere and create further new technologies while countries with lower stocks of human capital will be unable to adopt and may stagnate (Howitt and Mayer quoted in the Maloney, 2002). Maloney (2002), with the example of Chile, states that it is crucial to have a certain level of human capital to take advantage of 'windows of opportunity' presented by the current natural resource boom and emergence of technology associated with natural resources. He extends the argument to the successful case of the United States and Canada by stating that education and equality exist not only for the quick absorption of knowledge but are also the basis for establishing the right kind of institution to further support the innovation process.

Katz (2006) makes an important argument that natural resource based activities demand 'country-specific' knowledge generation efforts if they are to operate efficiently. He argues that domestic companies cannot rely entirely on imported 'generic' knowledge, know-how and foreign technological blue prints if they are correctly to manage production in local conditions particularly in an environmentally sustainable manner (Iizuka and Katz, 2011). Thus, it is possible that natural resource based activities require even more efforts for internalizing external knowledge with increasing adaptation to local conditions. If utilized well, this would create an opportunity for a highly skilled workforce to create innovative economic activities.

(3) Scope for technical progress in economic activities based on natural resources

Technological capabilities are seen as key to the catching up process. Technological capabilities are more important than labour productivity in predicting shares of world trade (Fagerberg, 1988). Comparisons among catching-up economies indicated factors such as absorptive capacity of indigenous industries, which explain economic growth better than capital accumulation (Nelson and Pack, 1999). These findings made it clear about the importance of technological capability in thinking about developmental potentials. However, under the conventional assumption, the natural resource based industries are considered as low in technological and knowledge contents.

Von Tunzelmann and Acha (2005), in contrast to the conventional thinking, made a case for natural resource based activities being not so different in the technological content from that of manufacturing though different in the composition of type of technology. A study by Mendonça and von Tunzelmann (2004) on low and high-tech industries (as defined by OECD[5]) found that the difference between these two are not the level of technology but its composition. Based on patent analysis, they found that what are commonly known as 'low-tech' industries, which mainly include natural resource based activities, actually utilize a wider range of technologies while so called high-tech sectors (such as aerospace, pharmaceuticals, computers, photography and photocopiers) use a narrower range of technology in a concentrated manner. They state that low-tech industries may provide better opportunities for engaging with emerging technological fields such as ICT and biotechnology.

Moreover, concepts such as "lateral migration" (Lorentzen et al, 2006, Walker and Jourdan, 2003), the phenomenon whereby technologies developed to serve in the natural resource based sector in locally specific conditions are applied ('migrating') to different sectors[6], suggests that the natural resource based sector can provide better bases to build technological capability, as there is intensive interaction between the producer and user of technology at local level.

The emergence of new technological fields created new links between the sectors and blurred the conventional technological demarcations. For instance, manufacturing is merging with services in many areas of ICT, as well as with agriculture, forestry and fishery in biotechnology. In terms of overall productivity upgrading, R&D now has to cut across conventional groupings of technological fields and economic activities. It is also true that manufacturing processes today are detached from technological

[5] The definition of sectors according to technology intensity by the OECD is as follows: aerospace, pharmaceuticals, computers, photography and photocopying are among the high-tech sectors, motor vehicles and parts, chemicals and machinery are regarded as medium-high-tech sectors, mining & petroleum, rubber and plastics materials and metals are medium-low tech, and wood and paper, and food drink and tobacco are in the low-tech sectors.

[6] Some of the examples of lateral migrations are as follows: development of sugar based biodegradable polymer in Brazil using the technology of making bio ethanol. Development of machinery using optic technology to select coffee beans in Costa Rica has been migrated to selection of soya beans, industrial materials etc (Lorentzen et al, 2006)

advancement due to the spread of a global division of labour. In other words, the fact of engaging in manufacturing does not mean that the country owns the technology because the function of 'production' can be separated from the 'creation' of technology or knowledge (Lundvall and Johnson, 1994). In this context, what becomes important is how to coordinate the 'production' process via managing knowledge through institutions and networks based on capable human resources (Teubal et al, 1996). At the same time, the characteristics of local environmental –oriented industry such as agriculture, fishery and forestry would facilitate the local knowledge base to play a larger role in the innovation process (Katz, 2006). The importance of local knowledge can also be emphasised for resource extractive activities where particular topography may influence the extraction process (eg of Brazil Petrobras) as well as local environmental impacts such as water and soil contamination.

Drawing upon the views presented above, the technological changes—ICT, biotechnology, chemical products etc.—that have taken place since the theoretical debate in the 1960s that created the basis of the underlying conventional assumptions have transformed the scope of technological progress. The evidence suggests that the emergence of new technology is creating a window of opportunity for natural resource based activities in the Latin America.

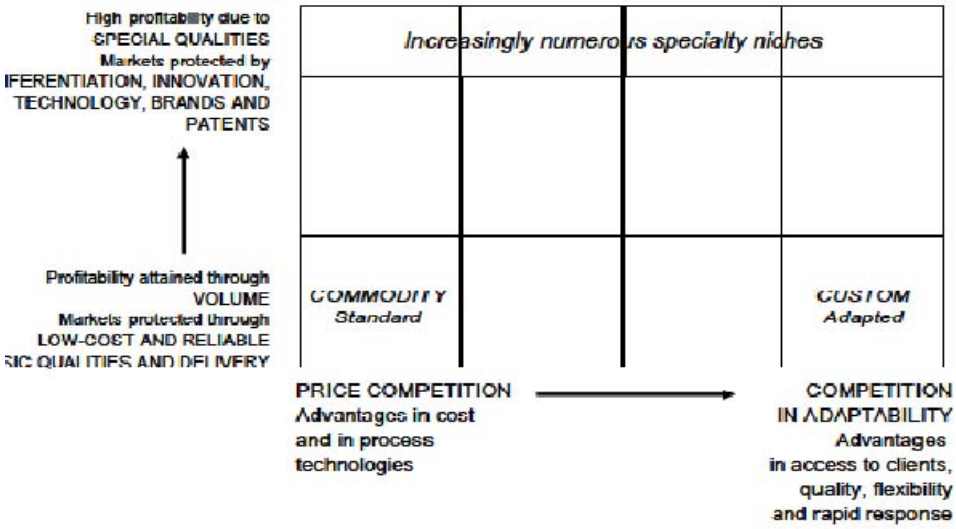
(4) Endogeneity/exogeneity of commodity prices, price elasticity and product diversification

Natural resource products are often considered homogeneous commodities. The price, therefore is determined exogenous to the producers while manufacturing products are not. However, the point on endogeneity of prices has different implications. In economics, the 'small country assumption' presumes that a change in one country/producer would not change the market as a whole. The decreasing terms of trade for manufacturing goods produced by developing countries can be explained by this fallacy of composition assumption, since many countries intended to industrialize through increasing manufacturing during the period from the 1970s to the 80s. As a result, the over-supply of manufacturing sectors at similar levels impacted on the market as a decrease in terms of manufacturing trade for each developing country which industrialized. This means that manufacturing products were not exempted from exogeneity of the price mechanism given that these products are not differentiated. It is based upon the specific situation placed in dynamic interaction.

Meanwhile, agricultural commodity prices can be endogenous to a certain level in the present-day context. From the management or firm strategy point of view, endogeneity in prices implies having control over prices through firm/country strategy, e.g. brand management and formation of inter-firm institutions (markets such as cartels). Two of the most cited cases of de-commodification are horticultural products and coffee. The case of horticulture (Dolan and Humphrey, 2000) as well as coffee (Kaplinsky and Fitter, 2004) demonstrated how differentiated products such as tailor-made vegetable products and premium Blue Mountain coffee can avoid being the subject of price fluctuation due to the usual factors of supply and demand. A key characteristic of these niche markets in primary commodities is high barriers to entry due to specific needs for complying with environmental and other standards throughout the whole process of production, such as traceability in horticulture. The market niche is the key to endogeneity of price (Perez, 2010). Perez (2010) demonstrates three ways in which the products can be differentiated under her ICT paradigm concept: increasing special quality, personalization (customization) and creating unique characteristics. Her concept and examples are shown in the figures below (figures 3 and 4).

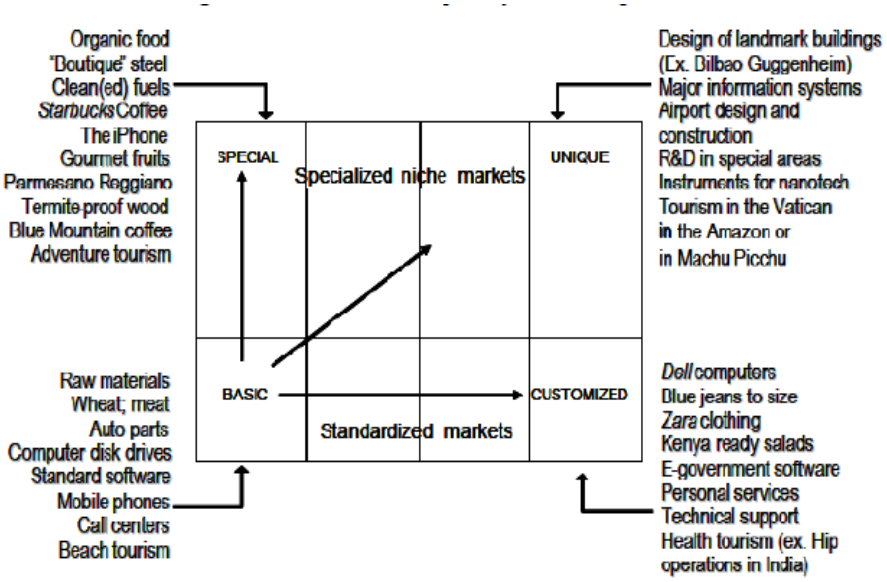
The endogeneity of price also relates to the power of governance (Kaplinsky, 2006). In many cases, issuing standards or codes by creating institutions such as producers' associations can enhance its power of governance. It seems that the price of a commodity is determined not just by quality and efficiency, emerging from conventional technological capability; but also from how governance is exercised through the means of knowledge such as standards and codes, which are shaped by systems and institutions consisting of various stakeholders under collaborative efforts at both local and global levels. The strength and capability of local institution is also required to meet this challenge of governance.

Figure 3 Concept of Market differentiation under ICT regime



Source: Perez, 2010

Figure 4 Example of Market Segmentation



Source: Perez, 2010

6. **Conclusion**

The global integration of economic activities involves diverse stakeholders in the form of networks, requiring various sets of capabilities for 'catching up' in the 21st century. The literature suggests that present day knowledge creation is an increasingly collaborative, heterogeneous and open process where developing countries can play a greater role if they are able to dynamically transform in line with the fast changing global market by developing their competitive niche.

Under such a context, the development of the natural resource sector in Latin America presents an interesting case for discussion. Emerging new technologies such as ICT, nanotechnology, biotechnology and environmental science, the natural resource based activities are now considered to have the potential to provide complex and knowledge intensive activities that can bring together local specific knowledge with global generic knowledge. The emergence of new technologies accompanied by the natural resource boom, due to increasing demands from emerging countries such as China, situate the countries in a different context from that of before. In this process of transformation, capable local institutions with human resources would play a significant role. Some Latin American countries are now seeking alternative paths, focusing on natural resource based activities as their 'engines of growth'. In fact, countries such as Chile and Colombia have invested in the enhancement of knowledge creating components — such as human resources, institutions and research — with funds collected from the use and/or sale of natural resources (royalties). Whether such policy initiatives can shift Latin American economies towards knowledge creation is a subject for further research, as these attempts are still at the incipient phase. Nevertheless, it is clear that these countries are now engaging with the commodity boom through alternative strategic pathways.

Under this new and somewhat positive scenario of structural transformation with a window of opportunity in natural resources, Katz (2011) indicates two areas of concern. One is related to the macro level issue of fluctuation in exchange rates and market prices which influences the way meso and micro — industry and firm — activities develop. This aspect makes the development of natural resource activities a highly complex task of forging a delicate balance among macro, meso and micro, involving exchange rate policy, industrial policy and policy for enhancing firm level competitiveness (Katz, 2011). Another important point is local environmental sustainability. Referring to the case study of the salmon industry (Iizuka and Katz, 2011), he warns of the danger of over-exploitation of local environmental resources due to the rise in global commodity prices where the local regulatory body is weak in effectively managing the sustainable level of extraction. Environmental disasters will undermine the long term development prospects of industry. Hence, enabling the local institution to manage environmental and common pool resources becomes essential. This would require deeper understandings of dynamics among stakeholders, environmental loading capacity and biodiversity at the local level (Katz, 2011).

There are exciting new developments of strategic alliances emerging between local communities, NGOs and multinational firms to generate knowledge and innovation, outside of conventional high tech R&D centres or enclaves. The reverse transfer of technology/knowledge from South to North is increasingly considered as possible under the concept of disruptive innovation (Bower and Christensen, 1995) or 'below the radar innovation' (Kaplinsky, 2011). Strengthening the knowledge capacity of local institutions in developing countries and ensuring interaction at the global level would not only benefit the catching up process of Southern countries but also the economies of Northern countries due to extended networks established under globalization. Catching up in the 21st century is therefore not only an issue for developing countries but increasingly a shared concern among all stakeholders across North and South.

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