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The new context for industrializing around natural resources: an opportunity for Latin America (and other resource rich countries)?[1]

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Abstract

This chapter argues that development is a moving target, and that windows of opportunity to both 'catch up' and 'leap ahead' present themselves at certain times and in specific regions due to technological revolutions and paradigm shifts. Having examined the historical precedents, it observes that the exploitation and processing of natural resources (NR), once seen as a 'curse' for developing nations, present such an opportunity for Latin America and other resource-rich countries at this stage in the diffusion of the ICT revolution. The factors changing the context and conditions around NR are analyzed, from the new nature of markets and the growing influence of environmental factors to the significant increase in technological dynamism and potential for innovation in developing countries brought about by ICT and market segmentation. Examining the specificity of Latin America in its ability to respond to these different conditions, and identifying the capabilities gained in the previous opportunity with import substitution, the article argues that success today would depend upon building natural resource-based networks of innovation aimed at the dynamic Asian markets. Given the low labor intensity of most NR processing industries, a dual-integrated strategy of 'resource-intensive industrialization' is proposed which promotes both top-down economic growth for global positioning and bottom-up wealth creation in each corner of the territory generating employment and well-being for all. It is finally argued that such a converging process of growth and innovation is both possible and necessary to ensure that Latin America benefits from the current window of opportunity while building a platform of innovative potential, networks and social capabilities in order to be able to leap forward with the next technological revolution. The many obstacles and limitations are not ignored; they can only be faced successfully if the nature of the opportunity is fully recognized.

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Those who doubt the potential dynamism of natural resources (NR) assume that there are truths about certain sectors that do not change over time. This is reflected in much of the literature on development, and has filtered into the beliefs of policy makers. Yet evolutionary economists hold that technological change is at the very heart of economic growth, with constant shifts in the relative dynamism of companies, industries and sectors. And indeed, even a cursory glance at the natural resources sector reveals that the context has significantly changed since the post-war period, when many of the current ideas about development evolved. The character of energy, materials and food markets has shifted dramatically; the potential for innovation in developing countries is much greater than before; all markets have segmented into niches; global corporations have changed their behavior; and, last but not least, environmental factors have come into play as a challenge and as a growth opportunity for both developed and developing nations.

This paper will examine the implications of such technological changes for resource-endowed countries, building on the notable shift in the level of awareness, both in theory and in practice, of the role of innovation in growth and development. In line with the neo-Schumpeterian and evolutionary tradition, the article starts from the idea that some industries[3], in some periods, offer more opportunities for innovation and dynamism than others. It will argue that the reasons for not seeing the natural resource industries among those with higher opportunities for most of the twentieth century are largely historical and that the context has changed significantly.

The information and communications technologies (ICT), together with the techno-economic paradigm that has evolved as the optimal way of using their potential to the fullest (Perez 1984, 2002), are changing the opportunity space for innovation in natural resources, increasing technological dynamism in the whole network of activities up and downstream, from initial investment and exploitation to final use. The new opportunity space allows for a more limited type of resource-intensive industrialization strategy than that of the United States between 1880 and 1914, when the country forged ahead to world industrial leadership (Wright 1997). Crucially, though, a resource-intensive industrialization strategy will require innovative economic, financial, and technological policies to promote an institutional arrangement that mitigates the 'resource curse' (Stevens and Dietsche 2008; see also Acemoglu et al. 2002). The task of this chapter will be to identify the opportunity rather than to design the policies that can avoid its shortcomings.

As technology changes, so do opportunities

Examining the historical record from the British 'Industrial Revolution' of the 1770s to the present, one can observe that fast growth and catching-up processes tend to cluster in certain regions or countries, which move in similar directions for a certain period. This reflects the fact that, as indicated in Table 1, technological progress – and accompanying 'development' – in capitalism does not occur along a continuous line; rather it has gone through five technological 'revolutions'. Each of them leads to a new 'techno economic paradigm'—or best practice common sense— that, together with the spread of new infrastructures, leads to a great surge of development every 50-60 years, and drives a leap in potential productivity across all industries (Perez 1985, 2002; Freeman-Perez 1988; Freeman-Louça 2001).

3 Throughout this chapter, 'industry(ies)' and 'industrialization' are broadly conceived, beyond a narrow focus on 'manufactures' and 'manufacturing' in the sense of fabrication by assembly, to encompass not only the processing industries but also high tech-services and, in general, all activities that involve technological advance in any of their stages.

Table 1: The industries and infrastructures of each technological revolution

Technological revolution	New technologies and new or redefined industries	New or redefined
FIRST: From 1771 The 'Industrial Revolution' Britain	Mechanized cotton industry Wrought iron Machinery	infrastructures Canals and waterways Turnpike roads Water power (highly improved water wheels)
SECOND: From 1829 Age of Steam and Railways In Britain and spreading to Continent and USA	Steam engines and machinery (made in iron; fueled by coal) Iron and coal mining (now playing a central role in growth)* Railway construction Rolling stock production Steam power for many industries (including textiles)	Railways (Use of steam engine) Universal postal service Telegraph (mainly nationally along railway lines) Great ports, great depots and worldwide sailing ships City gas
THIRD: From 1875 Age of Steel, Electricity and Heavy Engineering USA and Germany overtaking Britain	Cheap steel (especially Bessemer) Full development of steam engine for steel ships Heavy chemistry and civil engineering Electrical equipment industry Copper and cables Canned and bottled food Paper and packaging	Worldwide shipping in rapid steel steamships (use of Suez Canal) Worldwide railways (use of cheap steel rails and bolts in standard sizes). Great bridges and tunnels Worldwide Telegraph Telephone (mainly nationally) Electrical networks (for illumination and industrial use)
FOURTH: From 1908 Age of Oil, the Automobile and Mass Production In USA and spreading to Europe	Mass-produced automobiles Cheap oil and oil fuels Petrochemicals (synthetics) Internal combustion engine for automobiles, transport, tractors, airplanes, war tanks and electricity Home electrical appliances Refrigerated and frozen foods	Networks of roads, highways, ports and airports Networks of oil ducts Universal electricity (industry and homes) Worldwide analog telecommunications (telephone, telex and cablegram) wire and wireless
FIFTH: From 1971 Age of Information and Telecommunications In USA, spreading to Europe and Asia	The information revolution: Cheap microelectronics. Computers, software Telecommunications Control instruments Computer-aided biotechnology and new materials	World digital telecommunications (cable, fiber optics, radio and satellite) Internet/ Electronic mail and other e-services Multiple source, flexible use, electricity networks High-speed physical transport links (by land, air and water)

* These traditional industries acquire a new role and a new dynamism when serving as the material and the fuel of the world of railways and machinery
Source: Perez 2002, Table 2.2, p.14

Such massive transformations are contingent on context and conditions, both regional and technological. The nature and patterns of diffusion of each technological revolution determine the changing context for development and open successive and different scenarios for action, or 'windows of opportunity', while closing old ones. Each can also change the ranking of countries, when the old leaders remain attached to their traditional knowledge and structures while the new ones can 'leap-frog' and jump directly into the new (Perez-Soete 1988) as long as they have already acquired the social capabilities (Gershenkron 1962, Dore 1989).

In the 1870s, for example, the United States and Germany made a huge leap and 'caught up' to industrial Britain, deploying the heavy engineering that emerged in the Age of Steel. At the same time, Australia, New Zealand, Argentina and others made a leap forward in their development, benefitting from the counter seasonal trade made possible by the steamships and transoceanic telegraph that this engineering produced – as well as from the funding flowing from the City of London. During the next surge, the post-war US displaced the UK as the world leader, promoting a new paradigm of mass consumption based on cheap oil, automobiles and plastics, which was quickly emulated by Western Europe. In the maturity phase of this paradigm (see Perez, 2002; pp. 62-67; 2008 pp 6-9), both Latin America and Asia achieved high rates of growth thanks to protected import substitution industrialization (ISI)[4]. And similar observations can be made about the connection between the process of diffusion of the ICT technologies and the recent (and different) leaps forward made, first by Japan, then by the Four Asian Tigers and subsequently by India and China.

The specific nature of each technological revolution and the successive 'windows of opportunity' that it opens means that development possibilities are a moving target – and that development strategies are therefore temporary and must be updated and redesigned accordingly. Opportunities change not only with each major shift in technology, but also with the contextual legacy of the previous paradigm, and the stage of deployment of the new one (Perez 2001). It is important to underline that the notion of windows of opportunity presented here does not argue on the basis of static comparative advantages. It is rather underpinned by the observation that major surges of technical change radically modify the context and make obsolete not only the old technologies but also the ideas about development that emerged to handle them (*Ibid*). This is why, although here focused on the Latin American case, it should equally be of interest to other resource-rich regions.

This is the same basis for arguing that attempting to directly imitate current (or recent) successes is of little use, as these were achieved with past opportunities. Similarly it is not wise to develop policy theories on the basis of data from recent decades. By contrast, a long view of history can be useful for revealing patterns whose equivalents may be identified in the present. Tomorrow's successes do not depend upon copying what has recently succeeded, but rather on anticipating the future today.

4 The policy was also implemented in Africa, but too late for those nations to fully benefit.

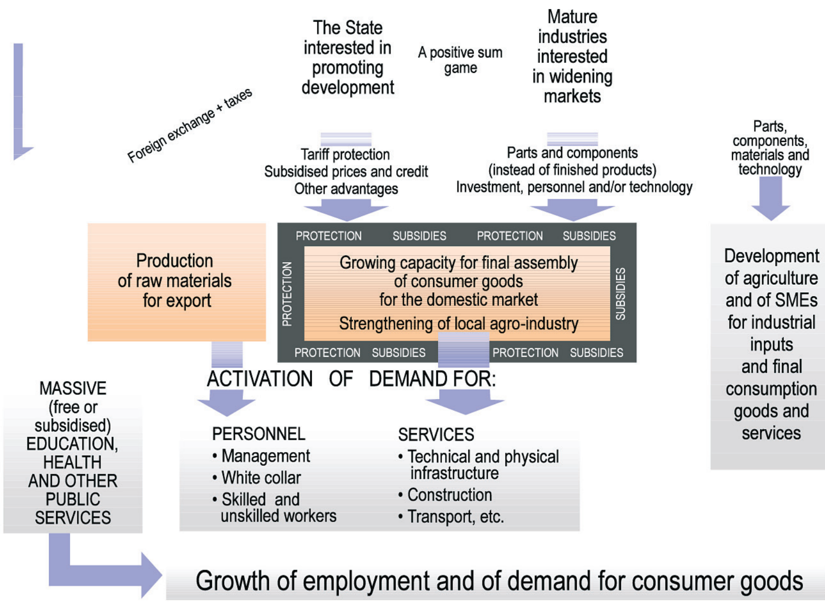
In fact, the current window of opportunity calls for policies that are able to transform *static* comparative advantages in natural resources into *dynamic* advantages, fostering diversification of production in knowledge-intensive activities that are horizontally, vertically, and laterally related to the NR sectors each country chooses to develop. An appropriate policy strategy would promote technical change and would entail creating conditions for learning and innovating that would result in new value-adding processes and in more specialized products with higher and more stable prices and markets. This means that the current opportunity opens up the possibility of adding some of the key characteristics of manufacturing to NR industries in a process of resource-intensive industrialization.

The lessons and legacy of the recent past - Growth with the ISI model

However, in order to make the best of an opportunity, it is also necessary to have previously accumulated a certain level of capabilities – both technological and social (Gershenkron 1962). Good timing is therefore essential, together with the recognition of the opportunity and the political and entrepreneurial determination to take advantage of it. Thus the outcomes can be very different and not all advances are irreversible.

From the late 1950s to the late 1970s, Latin America and the Asian Tigers used the opportunity of Import Substitution Industrialization (ISI). The policy brought together two sets of interests: the mature industries in the advanced world looking for market growth, and the then-called 'third world' governments looking for paths to development. At this point in the mass production revolution, many of the large corporations in the advanced countries were facing two main limits to growth. On the technological front, they were finding it increasingly difficult to innovate either in processes to raise productivity in their established production lines or in products to revive their saturated markets. The consumer-driven 'American Way of Life' which characterized this paradigm had already been adopted by the workforce of the advanced countries and the narrow elites of most of the developing world. Market growth was primarily being achieved through 'planned obsolescence' paired with advertising and credit (consumer debt), inducing and enabling existing consumers to buy new replacement products. At the same time, the nascent developing countries had neither the technology nor the market scale to set up competitive industries and were basically exporting raw materials and importing manufactured products. The price 'scissors' between lower value raw materials and higher value final products, to which Prebisch (1950) and Singer (1950) called attention, got even worse as corporations faced limits to productivity and markets and tried to squeeze raw materials prices and to transfer salary increases to the consumer.

Figure 1: The Latin American model of Import Substitution Industrialization (ISI)



The ISI model offered a dynamic solution. By locating the final assembly stage in potential consumer destinations, it mobilized the economies of the developing countries at the same time as it expanded world markets. In the model applied by the Latin American countries, as shown in Figure 1, the export of raw materials provided the tax and foreign exchange income to finance foreign investment in a fully protected process of industrialization for the domestic market. In the mid-1970s, when international banks lavishly poured OPEC money into Latin America's public and private companies (Marichal 1988), governments shifted to expanding public investment in basic industries and to subsidizing uncompetitive exports.

Sufficient tariff barriers and the acceptance of low productivity and high prices achieved both growth and employment. Although the assembly of products designed elsewhere, under the supervision of foreign experts or following process manuals, led to little technological learning and left scant space for innovation (Bell and Pavitt 1993), the process did generate demand for complementary activities in which real learning and innovation could take place. Local technological capabilities were required – and acquired – in order to build, improve and operate ports, airports, roads, electricity, telephony and water (usually developed with state funds and under state control), as well as in the accessory industries such as cardboard, printing, packaging, glass, plastics, cement and building materials (generally developed by the private sector). This aspect of the model is particularly important given that most of those complementary activities were processing industries (as distinct from fabricating) – precisely the skills that may be required for building dynamic networks around natural resources, as will be discussed shortly. Previous learning also continued – and in some cases intensified – in natural resources themselves: in mining, oil extraction, agriculture, livestock and so on. As Figure 1 indicates, the strategy additionally created demand for a wide professional middle class and a trained workforce to run the assembly plants, organize logistics and manage the business services from banks to distribution. Furthermore, while brands and process technologies were typically imported, they sometimes had to be adapted to the characteristics of local produce and consumer preferences, opening some space for local engineering.

While justifiable criticisms have been leveled at ISI, as implemented in Latin America it can be seen as an adequate strategy for the context at the time. The import of parts for assembly, rather than of products, worked like a starter engine for moving the rest of the economy and created a developmental culture in the public sector, which made major investment in basic industries and infrastructure and improved or established mass education and health systems. Larger countries like Argentina, Mexico and Brazil, with a previously established manufacturing base, went much further in weaving a complete industrial structure, but even the less developed countries were able to make a substantial leap forward in growth. For about fifteen years the average growth of most countries in Latin America was around 4%, with periods when one country or another grew at a 10% average. ISI in this region was a positive-sum strategy, albeit with limited results. However, when world conditions changed and protection was lifted, the lack of technological autonomy doomed the model to collapse.

In Asia, the leap to development also began with ISI – in fact, with less success at the beginning. However, Taiwan, South Korea, Singapore and Hong Kong – the Four Asian Tigers – engaged in much deeper, broader and more systemic learning and growth processes (Amsden 1989; Wade 1992). It is likely that the lack of an independent source of foreign income from raw materials (in contrast to Latin America) played an important role in the difference. The Four Tigers had to devise a way of using import protection and export subsidies to achieve export-led growth. They thus provided sheltered learning time to their 'infant industries' and facilitated the emergence and growth of competitive exporting companies and industrial complexes, uniting high productivity with low-cost labor and producing advanced-country quality goods at developing-country costs. This was exactly what maturing industries were looking for in the 1970s and early 1980s. There was arguably an element of luck in what happened next. Electronics products and components happened to be the core of the next revolution, so their assembly prepared the required capabilities – while the Latin Americans, starting earlier, mainly assembled cars and home electrical appliances. The Asian countries quickly understood the importance of ICT and the trend towards global markets. They constructed – explicitly or implicitly – clear and nationally shared 'visions' for their economic development, and worked on building global alliances.

Yet the key to the Asian success was their huge effort in training and education and the process of intensive technological learning, aided by subsidies only while required.[5] In essence, they were able to make the most of the limited opportunities that presented themselves in the 1960s to build a platform for development that allowed them to take much greater advantage of the next window of opportunity. When the ICT revolution came, they were able to make the leap and innovate their way up.

Could the Latin Americans make such a leap now? It would be fruitless to attempt to replicate the Asian route to development. That particular window of opportunity has passed, and the current context is completely different. The ICT revolution is already mid-way along its diffusion path and the Asian region far ahead in its accumulation of knowledge and experience in technology, production, management and trade. It has also become the most dynamic market, constantly incorporating new industries, new territories and new consumers.

It would make sense to see if the Latin American car can be hitched to Asian growth by finding market complementarity. In their catching up process, the Asians made global alliances and engaged in intense technological learning and training efforts in the *fabricating* industries (electronics, electro-mechanical goods and textile-clothing) when the advanced countries of the West were becoming import markets. Could Latin America do something similar in the NR-related *processing* industries? Can they take advantage of the vast range of inputs and food required by the advancing Asian economies? Is there enough technological dynamism in the energy industry, in materials (basic and special, natural and synthetic, macro and nano) and in biological products (traditional and advanced, ecological and biotechnological) to drive a learning and development process?

5 In Latin America, the tariff level during ISI was customarily calculated in relation to the local cost of producing the equivalent product, so there was no incentive for productivity increases, let alone innovation. As the model moved towards export promotion in the mid-Seventies, subsidies tended to be calculated in a similar manner and had no expected tapering in time.

The remainder of this article will argue that the criticisms raised against NR as a basis for development stem from specific historical conditions and from their narrow identification as *raw* materials (or primary commodities); that the technological complexity in potential innovation networks around NR production is high and growing; and that the knowledge accumulation in the materials and life sciences required for advance in those networks can prepare the continent for making a leap in development in the next technological revolution (which might be some combination of biotech, nanotech, new and 'green' materials). In other words, the conditions are ripe for a new type of natural resource-intensive industrialization process, whereby exploitation of natural resources and, crucially, their processing, are used as the springboard for industrialization and economic development.

Historically changing views on natural resources: from blessing to 'curse' and back?

The prevailing notions about the potential contributions of natural resources to development have changed radically over time, depending on the dominant technologies and the windows of opportunity available. Prior to the era of mass production, during the period that can be recognized as the first globalization (1870s to 1914), natural resources were seen as key to development. The technological revolution that was then taking place, in the age of steel and heavy engineering, was about chemistry and electricity, transcontinental railways and world-trading steamships, metallurgy and major engineering projects. Such global infrastructures enabled counter-seasonal world markets for meat, wheat and other agricultural products. Natural resources were considered a blessing, not a curse, with Australia, New Zealand, Canada, Sweden, the United States and others partly owing their 'catching up' successes to their resource endowment. Argentina in the 1880-90s was seen as the next US. Yet, as Reinert (2004) emphasizes, policy-makers in those countries also understood that raw materials alone – without concomitant highly-skilled, technology-intensive activities – would not result in development.

It was not until the 1950s, during the successful post-war deployment of the mass production paradigm in the West, that criticism grew towards NR. The neoclassical prescription about taking advantage of resource abundance did not convince the structuralists, preoccupied with the poor economic performance of Latin American and African countries. Prebisch (1950) and Singer (1950) emphasized several types of demand and supply rigidities, which would explain the 'price scissors' that increasingly favored manufactured goods over primary commodities. Other scholars, such as Nurkse (1958), noted that prices of commodities were very unstable, thus making NR-reliant countries vulnerable to constant changes in exchange rates, tax revenues and local investment. A third group emphasized problems arising due to the domination of NR activities in developing countries by multi-national corporations (MNCs). Not only were profits repatriated, but local investment and the instigation of backward and forward linkages were very limited, preventing future development (Singer, 1950 and 1975). The assumption thus arose that only manufacturing led to development, with natural resources being a dead end (Singer 1949; Prebisch 1951).

This assumption has been compounded since then. The late 1970s brought concerns about the 'Dutch disease', whereby a booming resource sector strengthens the currency disadvantaging other exports, in particular of manufactured goods (The Economist 1977). Since the 1990s, a wave of empirical studies (Sachs and Warner 1995, 2001; Auty 1990, 1993; Gylfason et al. 1999, Torvik, 2002) suggests the existence of a 'resource curse', that can make development difficult due to the resulting corruption and reduced incentive to invest for wealth creation when the centralized economic rents are generated by these resources. This also has the potential to affect democracy negatively, as government has no need to be accountable to tax-payers.

It is not that those authors were wrong, in either period. It is that the contexts were different – and they therefore provided different conditions for development and led to different views. Today, many manufactured products have become low cost commodities and natural resources have experienced very high prices. These phenomena could make both the Dutch disease and the resource curse even more acute. Addressing those obstacles will require institutional innovation to take those conditions into consideration in the formulation of economic development strategies.

How has the context changed for natural resource producers?: Revisiting the potential for technological catching-up

This chapter rests on the observation that the context around the use of natural resources is now significantly different from that of the post-war era. There are four main dimensions of significant change: price trends, the nature of markets, the conditions for technological dynamism and the new globalized economy.

A change in natural resource price levels

At the most basic level, the consumer behavior of the previous age and the push towards full global development have led to a fast-growing demand for materials, energy and food in the emerging countries, which has increased the overall demand for natural resources. This has been leading to the exhaustion of the most easily accessible sources and pushing marginal costs up. And the impact of climate change will probably intensify that effect. This means that, without losing their customary volatility, raw materials prices are likely to oscillate at much higher average levels (Dobbs et al. 2011; Farooki and Kaplinsky 2012). This makes them both a valuable advantage and an obstacle. They can be used as a source of funding for the 'technologization' of natural resources or be lost in corruption.

The new hyper-segmented nature of all markets

Together with the volume and its impact on supply and on prices, the nature of markets has also changed. As shown in figure 2A there is now a market hyper-segmentation of all products and activities into a wide and varying range, spanning from high-volume, low-price, commodities to an array of low-volume, high-price, niche products. As shown in figure 2B this fracturing of the market applies as much to manufactures as to services and primary sector products and it also affects each activity along the value chain. So, starting from the raw materials, it is possible, with innovation, to move up to higher value products or move along to more adaptable products that can be custom-made for specific clients, increasing both the value and stability of prices.

Figure 2A: The hyper-segmentation of markets and its differing conditions

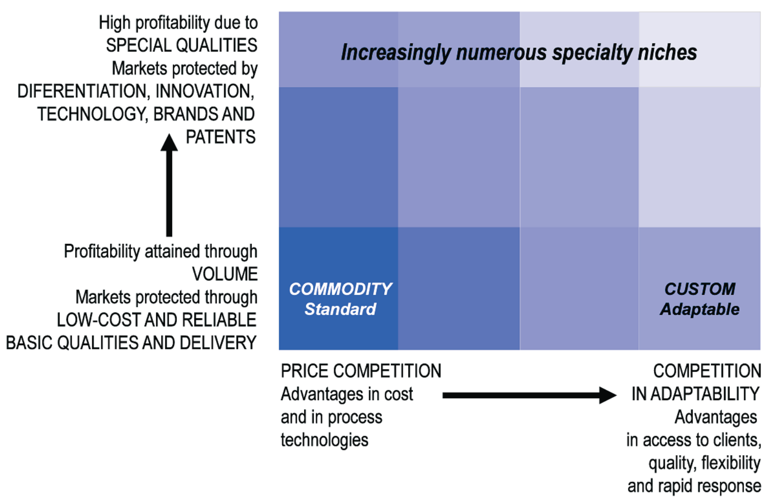
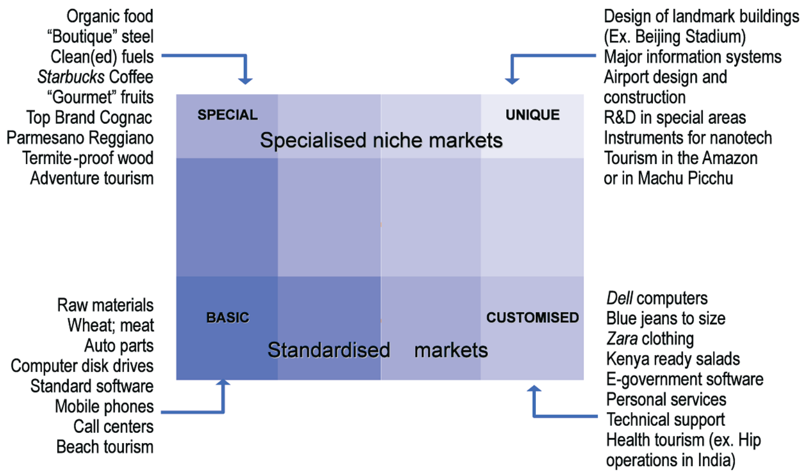


Figure 2B: Some examples of positioning - materials, manufactures and services



Source: Perez 2010

The NR markets, although still primarily based on commodities, are thus seeing an increasing proportion of specialized materials and premium produce for the high-end niche markets. From organic to gourmet, through various dietary products, the food market is segmenting into many specialized niches. The same is happening in the materials sector, where customized alloys, green chemistry, nano-materials and other products adapted to demand requirements and specifications are proliferating and reaping high rewards. Meanwhile, the realm of tangible products has also experienced a hyper-segmentation. On the one hand there are the high end niche products (which often require special materials) but on the other, we have witnessed the commoditization of most standard assembled products with very narrow profit margins. This makes it more difficult for Latin America to compete in the fabrication industries given the extremely low cost of labor in Asia and their accumulated experience – at the same time as it opens spaces in natural resource-related production.

Ample pathways to information and global markets through ICT

And innovation is now much more accessible to newcomers. ICT makes information more easily available, facilitates design, and enables entry into the hyper-segmented product and service markets. Hence, technological dynamism in all sectors, including NR, is higher than ever before, spurred by differentiation in demand and increasingly shaped by environmental and health concerns. In the NR sector, the focus used to be on processes to lower the cost of homogenous products and to overcome local limits, whereas today we see innovation to be increasingly geared to special materials and food products.

ICT has also enabled the new transport and distribution systems that make it easier for small and medium companies to access markets independently. This new context has led to the development of a much greater variety of distribution outlets (from the narrowly specialized to the hyper-markets), and the concomitant transport systems, allowing producers of different quantities and qualities to trade globally and on affordable terms. The fact that Kenya can provide packaged, ready-washed salads delivered by air every morning in the United Kingdom to be distributed among the supermarkets across the country according to their orders the previous afternoon (Jaffee and Masakure 2005), is an example of the substantial change that has been occurring in global trade.

A shift in behavior: from the old MNC to the global corporation (GC)

Since the 1980s, the behavior of MNCs has been changing, as they morph from isolated affiliates acting as foreign enclaves in each country into fully globalized, strongly interacting value networks. Such global corporations (GCs) are now concerned with finding competent and reliable suppliers and partners (Urzua 2007). Hence they now have a financial interest in engaging in training and the proper transfer of technology to ensure quality across the whole structure (Ernst and Kim 2002). This presents new problems, of course, especially regarding the uneven distribution of gains among the participants in the value chain (Gereffi, Humphrey and Sturgeon 2005), but the accumulation of knowledge and experience and the expectation of continuous improvement by all opens learning possibilities for later autonomy that were not available with the low productivity ISI model.

Nor are the GCs able to exhibit the cartel-like behavior that was once the common modus operandi of Western MNCs in developing nations. Such market control is being dislodged by East-West competition for access to resources. This creates conditions for stronger negotiating positions for the producer nations, reinforced by the much greater access to information through ICT.

Can Latin America hitch its car to Asian growth?

The conditions of Asia, with its abundance of population and its relative dearth of natural resources, are in contrast with the relatively low population density of most of Latin America and its plentiful endowment in NR. These are the basic facts underlying the potential of a successful complementarity. The possibility of competing with Asia in *fabricated* mass production is unlikely for the foreseeable future, given their much lower labor costs and much greater accumulated experience. By contrast, the experience that Latin American countries have accumulated to a varying degree in NR production (agriculture, mining, energy) and in the *processing* industries (agro-industry, cement, beer, paper, glass, oil refining, chemistry, metallurgy, etc.) gives them a basic platform for building further capabilities to innovate and improve the export profile. Fabrication of innovative equipment for the NR industries has also been developed in the more advanced countries of the region – as will be discussed in the section on the forces driving innovation, below. Additionally, the infrastructures for logistical and institutional support are basically in place: from ports, roads and a construction industry to telecoms and banking.

This complementarity between the two continents has the potential to engender strong trade links for at least a few decades. Engels (1857) 'law' of decreasing consumer expenditure on food as incomes rise, may not kick in for quite a while as the billions of inhabitants of China, India and other emerging countries gradually join the ranks of the middle class. Demand for both food and materials, standard and special, is not likely to decrease for many years.

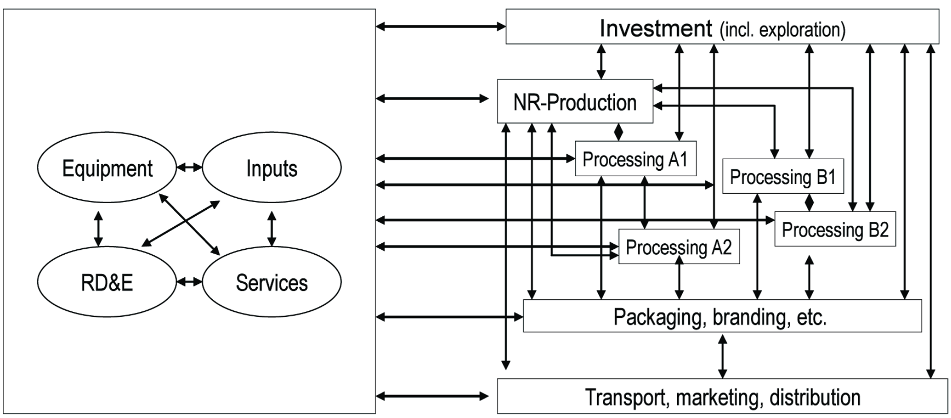
In Latin America, the variety in resource endowment can be seen as an advantage both in confronting global markets and for intra-regional trade. The similarities may contribute to various forms of collaboration in technology and innovation. The primary limitations, both nationally and across the board, are the traditional power structures accompanied by high levels of corruption, entrenched poverty, and, especially, poor education outside middle- and upper-class urban centers. But at the same time, social capabilities across the continent mean that there is the potential for an explosion of development in these areas: the organizational and business skills of the long-standing educated middle class are rapidly being revitalized by the return of a globalized younger generation educated abroad.

Yet the key to success in progressing beyond the mere export of raw materials is innovation capacity – and that depends on education and continuous learning (Bell 2006). This is the Achilles heel of this, and of any other possible strategy in Latin America. As will be seen in the following section, if natural resources are to lead to development they will have to encompass a very wide network of participants and activities, all with an innovative approach. Without a strong shift towards science and engineering in the education system and without intense and persistent learning efforts on the part of companies and the public sector, success is simply not possible, whatever the strategy.

The importance of networks as systems of innovation

Taken in isolation, endowments in resources or capabilities are insufficient. What is crucial to understand in the contemporary context of NR is the importance that networks (and particularly ICT-enabled networks) play in development. It is no longer useful to see natural resources as just the extracting or farming activity on its own, but rather to embrace and promote the complete network, from capital goods and other investment requirements through the production and various processing activities, all the way to packaging, distribution and end use. Such a network of actors and activities is what is now understood as a system of innovation (Lundvall 2007). As shown in Figure 3, such a system includes innovative potential at every step in the NR process, from exploration, research, design and engineering to transportation, marketing and distribution, as well as in the universities, RD&E institutes and knowledge intensive business services – KIBS (Urzúa 2007, Perez 2010b) – supporting each element of the value chain.

Figure 3: Innovative interactions in a natural resource-based network



Source: Perez et al. 2014

Indeed, such is the complex set of interactions among the many activities involved in the exploitation of NRs nowadays – upstream, downstream and laterally – that it is essential for any development strategy to map and identify the technological opportunity space that will allow the flourishing of a dynamic path within any one of these industries. The spectrum of possibilities is very wide: mining, metallurgy, chemicals, petrochemicals, pharmaceuticals, custom materials, livestock, agriculture, agro-industries, aquaculture, forestry, paper, biotech, energy, nanotech, tourism, etc. (each including the range from commodities to specialties).

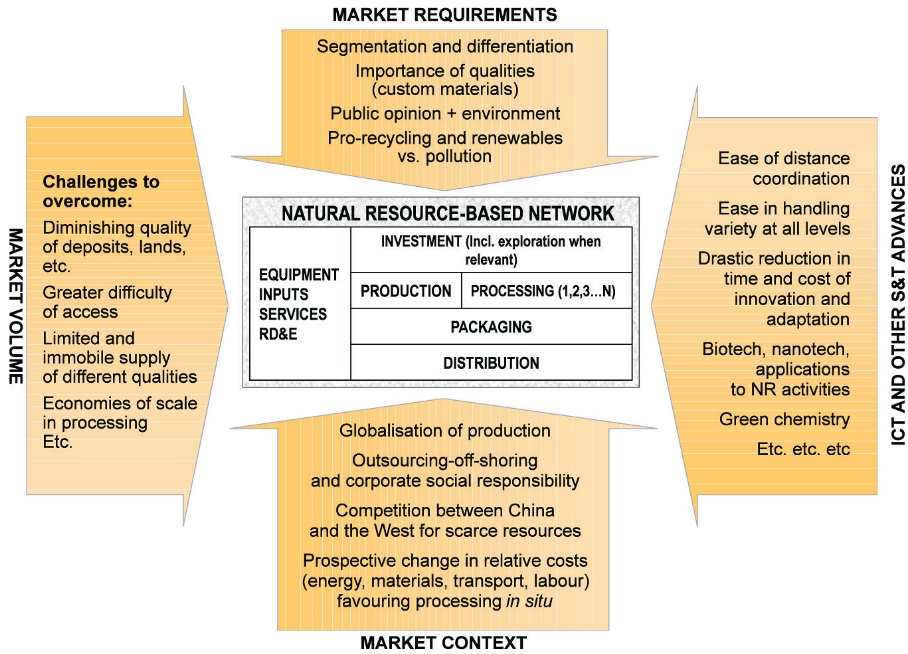
Success in the natural resource industries depends on continuous improvement of technologies, companies, products and human capital, across networks that encompass research, engineering and design; construction, adaptation, installation, compatibility and maintenance; software and systems services; equipment and instruments; laboratory services; quality control, evaluation, measurement, certificates; conservation and packaging; transport, marketing and distribution; technical service to users; market intelligence; improvements and new products; patent lawyers; contract negotiation; training and education of specialized personnel; financial services; and so on: a far cry from raw materials only.

The forces driving innovation in the natural resource networks

Once it is understood that the unit of analysis for a successful NR strategy is the entire *network*, it becomes important to confirm that there are new conditions making it possible and profitable to innovate in such networks in a developing country context. Only then can it be seen as realistic to pursue an innovation-intensive path based on the NR endowment of each country or region.

Currently one can identify several sources of dynamism driving innovation in the natural resource sectors. Some have already come under discussion, as factors in the changing context for development. As shown in figure 4, these drivers emerge from four main factors: the growth in market volume, the changes in the market context, the shifts in market requirements and the advances in ICT and other technologies.

Figure 4: The forces driving innovation in the natural resource networks



Source: Perez 2014

Growth in market volume

Fast growing global demand for materials and food intensifies the traditional innovation challenges for NR producers. Reaching lower quality and less accessible lands or deposits has always required 'remedial' innovation increasing the cost of marginal supplies and benefitting the better located ones. Yet, as demand approaches planetary limits, the required innovation effort becomes more complex and usually more costly, tending to rise the average level around which global prices fluctuate[6] (Farooki and Kaplinsky 2012). This has been the case with deep-sea oil and is likely to increasingly characterize food markets as more millions enter the consumption ladder.

Higher prices due to reliable demand growth will stimulate innovation in new production technologies and higher productivity in existing ones. In Argentina and Brazil, the high demand for soya in Asia has led to innovation in production methods such as zero tillage (Ekboir, 2003; Bisang 2008), and in seed varieties through biotechnology (Marin and Stubrin

[6] This effect has to be disentangled from that provoked by financial speculation

2014). It has also transformed the traditional *chacarero* agriculture of medium-scale farming into a highly technified land rental production system (Bisang 2008). These developments may be as controversial as the 'green revolution' in the 1960s, which extended to developing countries the mass production methods of land management, irrigation, mechanization, hybrid seeds and especially petrochemical fertilizers and pesticides. Social decisions on the balance between the advantages and disadvantages of the new technologies will be on the table, while the new challenges may also lead to environmentally and socially benign alternatives. For instance, Marin et al (2013) discuss the transgenic and cross breeding approaches as alternatives in terms of both their effectiveness and implications. Indeed, deciding on the specific *direction* of technical change and economic development will require participation of a wide range of social actors (Stirling 2008, 2009).

Once the innovation system moves away from the established practices or usual conditions, it becomes necessary to develop special equipment and inputs. That is indeed what has occurred both in Brazil and Argentina, where equipment for zero tillage agriculture has encouraged machinery producers to develop specialized seed planters, sprayers and equipment for residue management and led to a significant export drive (Garcia 2008). These developments are similar, though in a smaller scale, to the process whereby Norway became a specialized supplier of equipment and services for deep sea oil production. The Norwegians pioneered such activities after the oil price hike in the 1970s and are now world exporters in the sector.

The context may also be changing in favor of processing locally. Transporting raw materials looks likely to become uneconomical due to rising energy and transport costs, and in any case may become unacceptable due to environmental policies. Particularly in the case of minerals, raw exports contain a high percentage of waste (in the case of copper it is typically 70%). Changes in context and relative costs and prices are bound to facilitate negotiations with foreign producers and buyers, in addition to spurring local investment and innovation in processing, perhaps in the direction of more flexible facilities,

In essence, although the basic resource exports would continue to be the 'bread and butter' income of the country in question, there can be a set of dynamic processes that stimulate innovation, investment and know-how accumulation up and downstream, allowing a greater control of the whole learning network and opening the possibility of lateral innovation, improving other sectors with similar equipment or input requirements (Walker and Jourdan 2003).

Changing market requirements

Yet demand is not growing homogeneously. As has already been discussed, all markets are segmenting into multiple niches, for higher or different qualities as well as in adaptations to specific user requirements. This opens the possibility of innovating to increase the value of the export mix by including a greater proportion of special products. Such premium segments can include special materials and alloys, 'gourmet' fruit, based on the development of preservation techniques to rescue and export the flavors of non-standardized products, in addition to the 'organic' products of traditional agriculture.

Lowering the cost of luxury products or raising the quality of standard ones are two of many alternative directions in market differentiation. One of the countries that has taken this route in several sectors is Brazil. The forestry sector, for instance, has developed varieties and treatment of eucalyptus to make it look and behave like expensive mahogany (Figuereido, 2009), and other varieties that boast such improvements in productivity, quality and environmental protection that the country is now the world quality leader in the production of pulp for paper (Flynn 2003; Figuereido, 2009).

And the opportunities for niche market access enabled by ICT are open to all, large or small, from traditional farmers to the innovative high tech companies. Producers of niche inputs for production processes can aim at disperse global markets enabled by internet communication and flexible transport systems. Consumer niche products benefit additionally from the existence of specialized outlets (health food stores, organic markets, gourmet restaurants, luxury product shops, etc.) and from global buyer chains, Fair Trade networks, and so on. The organizational capacities brought by ICT can result in high-volume end users working with small-volume producers in a way that was previously untenable; for example, the global coffee chain Starbucks, in order to have reliable high-quality supplies of coffee, works with the growers in several countries providing training and guaranteed markets and prices (Duda, S. et al. 2007).

An additional and growing trend that will change the spectrum of market options is the combination of health concerns with social and environmental sustainability. In Brazil, for instance, the organic cosmetics sector is already 10% of the market, it is exporting and growing (Galvao et al. 2011).

Changes in the market context

The other important feature driving innovation in all sectors is globalization, which has not only changed the location of production but also the character of the global corporation and of the opportunities facing potential producers. The process of outsourcing and off-shoring in which most fabricating industries have engaged distinguishes the core competences that must remain with the GC, the non-core specialized processes that should be outsourced to partners with high capabilities, and the less complex processes that can be outsourced to several suppliers under close monitoring – and most likely accompanied by training – in order to guarantee quality and reliable delivery. The GC aims to achieve the maximum quality at the minimum cost, while generating optimum innovation capability and sustained competitiveness across the whole value chain (Prahalad and Hamel 1990). Thus the space and behavior of the global corporations (GCs) are different from the typical enclaves of the old MNCs, providing opportunities for entering and climbing the value ladder, with possibilities of increasing local production and employment up and downstream (Ernst and Kim 2002; Gereffi et al 2005).

It is true that the conversion from the old model has not gone as far in the processing and resource related industries as in assembly-based ones. But it has begun. De Beers, the traditional giant in diamond production, has been outsourcing successive processing stages to Botswana, contributing to one of Africa's current success stories (Warhurst 2008). BHP Billiton in Chile is engaged in the creation and strengthening of a network of local suppliers, from the simplest services to the most high-tech[7] (Comisión Minería y Desarrollo de Chile 2014). And as the trend towards more *in situ* processing becomes a reality through a shift in relative costs of energy and transport, and/or environmental taxes, foreign companies will be stimulated to increase the links of the value chain to be located at source. Furthermore, the transparency provided by Internet makes it increasingly difficult for foreign companies to ignore the context in which they operate. Corporate social responsibility (CSR) can, at a minimum, be a form of contributing to the well-being of the community through donations and welfare projects, but at best CSR can elevate local innovation capacities and help to grow the human capital of its own personnel and of the 'host' country.[8]

At the same time, there are increasing possibilities for local companies to globalize, in doing so creating regional networks of production and global

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7 This practice of multiplying world class mining services has now become national strategy in Chile (Corfo 2014).

8 An example is the Alcatraz Project of the Santa Teresa Rum company in Venezuela, which has rescued hundreds of young people in the area from drugs and violence, training them, teaching them to work in construction or in its own plants, creating a rugby team that competes internationally, engaging the women in the community in production activities and several other forms of social integration that have changed the atmosphere in that relatively poor district of the central valleys in the country. The project has been so successful that it has attracted the support of several international and local organizations and continues to grow and expand its activities. See http://www.fundacionsantateresa.org/inicia_pa.php?lang=esp.

marketing. Again, this has happened already to a varying extent across Latin America. One of many examples is Cemex, the Mexican cement giant, which now produces in 50 countries around the world, of which about 10 are in Latin America; another is the Brazilian steel company Gerdau; still others are evident across the food industry, such as Arcor (Argentinian), Bimbo (Mexican), Polar (Venezuelan), Noel (Colombia), JBS (Brazil) and so on. Such expansion in the NR processing industries is part of the context changes and has required increasing innovative and adaptive capabilities on the part of erstwhile local companies.

Global and regional geopolitics are also changing, opening opportunities for more effective negotiation. As mentioned before, competition for access to resources between East and West enables innovation capabilities and greater processing to become attainable goals in investment and trade agreements. There may also be greater potential for international agreements such as the new global development pact proposed by Cimoli, Dosi and Stiglitz in this volume. Just as the official recognition of labor unions and subsequent collective bargaining in the age of mass consumption resulted in salaries that increased with productivity and guaranteed growing consumer demand, it could be that advanced countries and GCs would see it to their advantage to have growing markets for sophisticated equipment and goods in a dynamic and advancing developing world (Perez 2013). Resistance to the required shift was then as strong as it is now, and yet it happened.

The environmental challenge is the other shift in market context driving innovation in all sectors, changing the context in which both business and society operate and redefining our concept of the 'good life' from one of mass consumption to one that is sustainable. Climate change and other issues of sustainability are resulting in increasing regulation, which is leading to innovation in renewable materials and energy, recyclables, low-energy processing, water-based chemistry, biodegradable materials, and other adaptive capacities. These innovations may also prove an alternative outlet for NR industries facing a backlash against more traditional extractive industries due to the danger of resource exhaustion, the threat of increasing air and water pollution and of global warming, and the fear of unpredictable consequences of technological advances (such as GM crops). Such developments will further stimulate efforts to increase productivity and to overcome the limits in supply through innovation.

Advances in ICT and other technologies

While all the above drivers of innovation can be seen as part of the context of the current techno-economic paradigm, many – notably the rise in market volume and the associated environmental concerns – are a consequence of prior surges. However, the direct impacts of ICT technologies on the NR industries are numerous. It is now infinitely easier to establish interactive networks with intense communication for coordination of production and services, logistics and administration, giving the NR industries the capacity to cooperate in local, regional and global networks. Distance monitoring – of livestock, oil wells, plantations, fishing areas – is becoming increasingly possible, while intelligent control systems are being developed and used for irrigation, processing, sorting and distribution. Thus the varieties and peculiarities, both in source and in demand, that were problematic in the days of mass production are handled easily with ICT.

Great strides in customization have been made in the life and materials sciences as well as in chemistry: particularly with the use of compusynthesis. The time and cost of acquiring and processing the necessary information for research and innovation have been drastically reduced. The same can be said about designing experimental prototypes by the user industries and measuring impacts. Innovation can occur in the product mix from research to design to processing to distribution, at which point innovations in transport, distribution and retail allow for the accommodation of multiple destinies and small quantities.

Biotechnology and nanotechnology are particularly important to the NR industries (which deal after all with biology and materials). Genetically modified crops, tissue culture as means of plant reproduction, vaccines for cattle and fish, and the use of bacteria for mining (leaching) and for the digestion of oil spills and other polluting agents in water already indicate the many directions in which biotech is being applied in NR, while nanotech is contributing to innovations in materials and processing, such as the development of energy-saving and pollution reducing surfaces and of protective coatings for preservation that improve the handling and packaging of natural products.

Currently advances in both bio- and nano-tech are highly dependent on the information processing capabilities and the accuracy of instruments provided by ICT. Yet they have the potential to unleash a technological revolution of their own. The likelihood that the breakthroughs that will lead to the next technological paradigm shift may come from these technologies is quite high. Participating in their development in these early stages could place the Latin American countries in a good position for a major leap forward when these technologies become all-pervasive, low cost and high growth. This is precisely what the Asians were able to do on the basis of their early involvement with the fabrication of electronic components and products, before the advent of the microprocessor, the personal computer, mobile telecommunications and the Internet.

Essentially then, there is no longer reason to reject natural resources as a possible basis – or springboard – for a dynamic, technologically active, strategy based upon them. ICT has allowed the NR-based sector to overcome the conditions which Singer (1950: p. 476) rightly described when saying that natural resources did not "provide the growing points for increased technological knowledge, urban education, the dynamism and resilience that goes with urban civilisation, as well as the direct Marshallian external economies". Yet Singer went on to clarify that "no doubt under different circumstances commerce, farming and plantation agriculture have proved capable of being such 'growing points'." Indeed, the new enabling technologies and the global market context provide a new set of possibilities around natural resources that can be used as a springboard for a different direction in industrialization. This takes on an even stronger meaning when taking into account the difficulty of competing with the Asian nations in the mass fabrication of consumer goods, and the growing import demand for basic and specialized industrial inputs and food in those same countries. Those export markets can be supplied covering the whole range, from the basic commodities to an increasing proportion of higher value-added products with greater differentiation and adaptability.

A dual integrated strategy

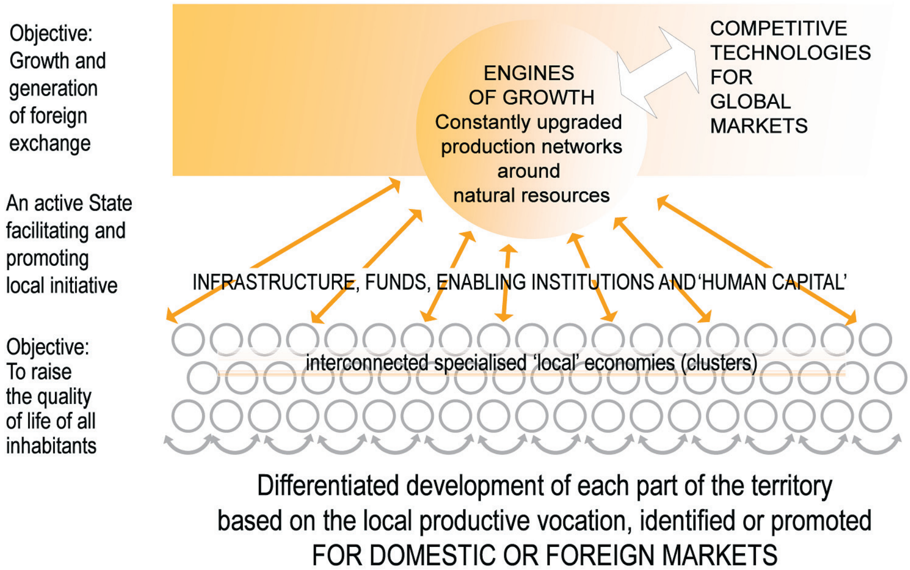
Of immediate concern when considering a natural-resource based strategy for Latin America is its capacity to create sufficient employment and alleviate poverty, given the income polarization that characterizes the region. The processing industries and innovation activities are not as labor intensive as assembly production and require increasingly qualified personnel. Thus, while a strategy based on them promises rising incomes and better quality of life for the participants, it will not be as effective in job creation per unit of investment. Such industries can contribute to economic growth and to the enrichment in human and technical capital – both crucial for catching-up – but they cannot do enough to reduce the gulf between rich and poor, eliminate unemployment and overcome poverty.

Poverty and unemployment worsened in Latin America during the 'lost decade' of the 1980s and have given rise to social discontent, resentment and an ardent desire for change. Since the so-called 'trickle down' effect has not proven its capacity to 'raise all boats', the problem needs to be faced directly. Recent improvements in several countries, more based on income redistribution and service jobs than on new, good quality, high productivity employment, must be enhanced in any strategy for growth. Not doing so would be socially unacceptable and politically unstable.

This suggests the need to set up two complementary and simultaneous policies: one, a top-down approach with the goal of economic growth and global positioning and, the other, a bottom-up strategy to ensure full-employment and well-being for all, as shown in Figure 5.

This two-pronged approach can be called a *dual integrated model* (Perez 2010a) – with both prongs enabled by the new global conditions. The top-down part of the strategy would be oriented towards achieving technological mastery and deep specialization, aiming at global competitiveness. The industries involved – the multi-faceted NR networks – would act as the engines of growth of the economy and the main sources of foreign exchange. The bottom-up part of the strategy would involve the promotion of wealth-generating activities in every corner of the territory and differentiated development aimed at whatever market is most suitable: local or regional, national or global. Here the prime objective is to raise the quality of life of all citizens. Yet, since these bottom-up production activities would tend to be in specialized 'clusters' targeting niche markets based on local advantages, it would, in turn, feed back into the NR networks, encouraging constantly upgraded production around NR. This type of bottom-up innovation is indeed already occurring on an *ad hoc* basis, from Fair Trade cooperatives and other localized but networked civil society initiatives, to regional developments in mobile banking and distributed energy (Murray 2012). In other words, although in the first area competitiveness is the goal, and in the second a means, the dual strategy could tackle social inequality while promoting converging processes of growth and innovation. It is through such a dual strategy that a resource-intensive industrialization process would be able to create not only economic growth but also full employment and rising living standards across society, including the rural population, hopefully stemming the flow towards the city slums.

Figure 5: A dual integrated strategy: Top-down and bottom-up



Such a dual strategy cannot be achieved by the market alone, but neither can it effectively be imposed by government, and much less so in the current paradigm which requires constant innovation and the flexibility to adapt to context changes. The model can only function properly as a socially shared vision, with the various agents of change acting autonomously but following a common strategic direction, integrated by an active government that is able to provide an adequate and effective institutional framework. Implementation would require a process of consensus-building, involving business, government, universities and society, and subsequent policy measures to induce and facilitate market behavior in the agreed direction(s) (Stirling 2008 and 2009).

The dual model would also require institutional innovations, and most likely different agencies providing adequate support for each participant group. The top-down half implies a process of 'embedded autonomy' (Evans 1995, Rodrik 2004), in which the top level public and private actors engage in strategic collaboration to take consensus decisions affecting whole networks that may involve international negotiations, while the bottom-up half would require municipal and local level agencies, strengthened by the direct support of specialized personnel, able to identify, promote and facilitate the adequate production and marketing activities, in addition to engaging in training (coaching) and funding. Thus the dual model implies a dual role for government, providing appropriate support on either end, while also engaging in the customary activities relating to infrastructure and human capital which improve the context for all.

Conditions of viability: the challenges and the obstacles

This chapter has endeavoured to answer three main questions: Have natural resources become capable of sustaining a dynamic innovative strategy? Are there conditions for the developing countries to innovate in order to take advantage of this opportunity and, if they do so, are there export channels and markets for countries to use them as a springboard for growth and social development? The answer we came to, on all three cases, was positive. The opportunity exists and it is technologically and economically viable to consider a natural resource based- industrialization strategy. The next question, however, is much more complex and difficult to answer: Are the Latin American countries ready and able to set up such a strategy and is there a favourable socio-political context for them to succeed.

No strategy for development is simple or easy. The challenges presented by the dual-development model are major: obstacles include competition from other potential adopters; the traditional risks associated with NR in addition to many new risks relating to sustainability; conflicts with established power structures; and the difficulty of building political will and consensus around a 'new' strategic direction. Even prior to implementation, technical and social capabilities and courageous institutional innovations are necessary in order to design and build consensus on a common strategic direction, and to design and then implement adequate stimulating and supporting policies.

But none of this is impossible. Indeed, this is a characteristic of every techno-economic paradigm: making what seemed impossible common-sense practice. Establishing adequate institutions and policies is essential for building political will. When setting up ISI, Raul Prebisch (first in CEPAL and then in UNCTAD) initiated a broad program of international negotiations and advisory support, which included the training of a great number of public servants (Dosman 2008). In this instance, a significant amount of accumulated capabilities already exists, especially in top-down activities related to dealing with companies engaged in NR production and export. However, a regional program for the massive training of consultants to aid in the bottom-up part of the strategy would be warranted.

The need for adequate capabilities and vision to make the double leap

Unlike ISI, which was an adequate response to existing conditions but which in Latin America did not create a platform for future growth, the promise of this strategy at this moment in time is that it endows the continent with the potential to make a leap to development in two stages.

Due to the nature of technological paradigm shifts, the Latin American countries can achieve growth now by taking advantage of the current window of opportunity for NR producers, *and* prepare to make a leap in development with the next technological revolution by developing capabilities, companies and global networks in the sectors of the future (biotechnology, nanotechnology, bioelectronics, new materials, green chemistry, etc.).

For just as the success stories in Asia cannot be repeated because the micro-electronics-related opportunity space came and went, the current window of opportunity with the processing industries in relation to natural resources will also pass and a new one will come along.

This is what happened in Asia: going from ISI and exports in mass production to capitalizing on globalization in the ICT revolution. However, to achieve the equivalent requires intense efforts in training, education, RD&E and innovative cooperation at all levels and in all stages. This chapter has argued that the context conditions are currently in place – but it remains to be seen whether the Latin American nations already have the social capabilities or would be willing to seriously engage in acquiring them in order to implement these complex efforts.

Facing probable competition

The window of opportunity being discussed is open to all resource-rich countries with a certain level of business and technological capabilities. And the dual model strategy is one that could be applied by others. Indeed, it is highly likely that there will be competition on a global scale amongst producers, as well as between the companies and countries that require the resources. In this competitive arena, the advantage will not only go to those possessing the resources with more dynamic demand and higher prices, but, perhaps more crucially, to those who have already acquired basic technological and social capabilities for producing, negotiating, networking and innovating. There is a path-dependent character to the 'hot spots' of growth in the global economy. In these respects, as this paper has argued, Latin America has strong foundations on which to build. At the same time, the diversity of resources will result in a variety of competition conditions, and in all of these cases it is important not to underestimate the advantage that goes to those who make the first move. The countries that first attract the investors and allies who bring the technologies, and those that more intensively engage in learning and innovating, acquire dynamic advantages that put them in a better competitive position.

Traditional obstacles and new uncertainties

There are, of course, numerous risks involved in embarking on such a strategy. Obstacles and uncertainties abound. Price volatility for both raw materials and processed products will warrant not only national policies to minimize the negative impacts but maybe even concerted international action. The 'Dutch disease', affecting the potential for investment and export competitiveness, also remains a problem to confront even in the new market conditions. Addressing it might require a well-devised 'rent management' policy, together with stemming corruption practices through transparency mechanisms (they too, perhaps in coalition with the advanced countries).

New uncertainties appear in relation to climate change, which looks likely to negatively affect agricultural resources, even as it opens up space for innovation. Similarly environmental policies may affect demand in one area while they open up new possibilities. The threat of the over-exploitation of resources is ever-present, while biotechnology and other radical innovations present solutions that could involve new risks. All of these sustainability issues might also lead to a backlash against the use of NR, and any resource-based strategy will have to take these valid concerns into account, together with the public opinion that they generate.

A political and policy challenge

Any new strategy will encounter political resistance from across the political spectrum, both internally and externally. The strategy recommended here has the added difficulty of requiring a conceptual shift, placing innovation at the <u>core</u> of growth and development policy, rather than as a specialized isolated component of industrial policy (Mazzucato and Perez 2014). In practical terms this means moving the science and technology agenda from the fringes of the cabinet in marginal ministries or councils to the very center of the strategy to be pursued. Equally, training and education policy would need to shift from a quantitative effort to a much more complex and 'mission oriented' endeavor (Mazzucato and Penna 2015), with intense collaboration between the public and private sectors and the willingness to take advantage of foreign sources of the required knowledge. If there is a single timeless lesson that can be learned from the success of the Four Asian Tigers, it is their emphasis on learning, both internal – within companies – and external, in public and private education and training systems.

Conflicts of interest will always remain, even without the difficulties presented by the varying levels of corruption across the region – and especially in those countries with a less developed democratic system and a public sector that is more politicized, less stable and less technical. Winning over the traditional groups who control the natural resource sectors may not be easy in some regions, while not all global corporations are likely to be ready to participate in such a strategy. In the face of these constraints, achieving a positive-sum game between business and society will be a major challenge.

In addition, any specialization strategy, particularly when associated with natural resources, confronts market risks in both volume and prices and requires monitoring of future trends and intelligent hedging.

Nevertheless, all successful strategies involve facing challenges and risks while taking advantage of the opportunities that are also present. The object of this chapter has been to argue that the possibility of building a platform for development by innovating across the value network around natural resources exists in the new market conditions and that, while important, the sources of the 'natural resource curse' can be addressed through strategic policies. The networks of NR production and their multiple linkages upstream, downstream and laterally present an innovation space of higher profitability that the probable trends in the global economy will do nothing but expand. The drawbacks and risks involved in any strategy will increase if they are not recognized and if adequate safeguards are not incorporated. But at present, the greatest risk of all is for Latin American countries to miss the boat – to ignore the current window of opportunity and turn their back on the possibility of making a double leap to development.

References

Acemoglu, D., Johnson, S. y J. Robinson (2002). Reversal of Fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly Journal of Economics*, Vol. 117, No. 4, pp. 1231-1294.

Amsden, A.H. (1989) *Asia's next giant: South Korea and Late Industrialization*, New York, Oxford University Press

Anderson, C. (2006) The Long Tail: Why the Future of Business is Selling More of Less. New York: Hyperion.

Auty, R. (1990) Resource-based industrialization: Sowing the oil in eight developing countries. Oxford: Clarendon Press.

Auty, R. (1993) Sustaining Development in Mineral Economies: The Resource Curse Thesis. London: Routledge

Bell, M. and K. Pavitt (1993), 'Technological accumulation and industrial growth: contrasts between developed and developing countries', Industrial and Corporate Change, 2 (2): 157-211.

BELL, M.and Pavitt, K. (1995). The development of technological capabilities. In: Haque, I.U. (Ed.), *Trade, Technology and International Competitiveness*. Economic Development Institute of the World Bank, Washington, 69-100.

Bell, R. Martin (2006) 'How long does it take? How fast is it moving (if at all?) Time and technological learning in industrialising countries', *International Journal of Technology Management*, Vol. 36, No. 1/2/3, pp. 25-39

Bisang, R (2008). "The Argentine Agricultural Scene: Recent Changes, Future Challenges and Latent Conflict (ARI)". November. Real Instituto Elcano. Available at: http://www.realinstitutoelcano.org/wps/portal/rielcano_eng/Content?WCM_GLOBAL_CONTEXT=/Elcano_in/Zonas_in/Latin+America/ARI 111-2008 (Accessed on July 7, 2009)

Cimoli, M., Dosi, G, and Sitglitz, J. (2009) 'The future of industrial policies in the new millenium: toward a Knowledge centred development agenda'. In Cimoli, M., Dosi, G, and Sitglitz, J. *Industrial Policy and Development*. Oxford: OUP. Ch. 20, pp. 541-560.

Comisión Minería y Desarrollo de Chile (Ed) (2014) "Minería, Una Plataforma de Futuro para Chile"; Consejo Nacional de Innovación para el Desarrollo, Gobierno de Chile, Diciembre 2014. Available in (18 feb 2015): http://www.economia.gob.cl/wp-content/uploads/2014/12/Mineri%CC%81a-Una-Plataforma-de-Futuro-para-Chile.pdf

Corfo (2014) "Programa Proveedores de Clase Mundial: Catálogo de Proyectos 2013-2014"; Corfo, Gobierno de Chile. Available in (18 feb 2015): http://catalogo.corfo.cl/cgi-bin/koha/opac-detail.pl?biblionumber=4223&shelfbrowse_itemnumber=4373#shelfbrowser

Dobbs, R., Oppenheim, J., Thompson, F., Brinkman, M. and Zornes, M. (2011) *Resource Revolution: Meeting the world's energy, materials, food and water needs*, London: McKinsey Global Institute, McKinsey and Co.

Dore , R. (1989) 'Latecomers' problems', *The European Journal of Development Research*, 1:1, 100-107.

Dosman, Edgar J. (2008) *The Life and Times of Raúl Prebisch, 1901–1986*, McGill-Queen's University Press, Montreal, Kingston

Duda, S. et al. (2007) 'Starbucks Corporation: building a sustainable supply chain'. *Case study Stanford Graduate School of Business*. HBS Case studies.

Ekboir, J. (2003). 'Research and technology policies in innovation systems: zero tillage in Brazil'. *Research Policy*, Vol. 32, No. 4, pp. 573-586.

Ekboir, J.M. and R. Rajalahti. 2012. Coordination and Collective Action for Agricultural Innovation. In Rajalahti, R. (ed.) *Agricultural Innovation Sourcebook*. Washington, D.C.: The World Bank.

Ernst, D. and Kim, L., (2002) 'Global production networks, knowledge diffusion, and local capability formation', *Research Policy*, 14, pp. 1417 – 1429

Evans, P. (1995) *Embedded Autonomy: States and Industrial Transformation*. Princeton, NJ: Princeton University Press

Farooki, M. Z. and Kaplinsky, R. (2012) The Impact of China on Global Commodity Prices: The Global Reshaping of the Resource Sector, London: Routledge.

Figueiredo, P. (2009). 'Industrial policy, innovation capability accumulation and discontinuities'. Paper presented on Copenhagen Business School Summer Conference 2009, June 17-19.

Flynn, B. (2003). "Eucalyptus: Having an Impact on the Global Solidwood Industry". Wood Resources International. Available at: http://www.wri-ltd.com/marketPDFs/Eucalyptus.pdf (Accessed on July 19, 2009)

Freeman, C. and Louçã, F. (2001) *As time goes by: from the industrial revolutions to the information revolution*. Oxford; New York, Oxford University Press.

Freeman, C. and Perez, C. (1988) 'Structural Crises of Adjustment: Business Cycles and Investment Behaviour' in Dosi et al. (eds.). *Technical Change and Economic Theory*. London, Pinter. pp. 38–66.

Galvão, A., Juruá, M., Esteves, L. and Castanheira, F (2011) 'The Amazon Region and the use of its biodiversity". SECTORIAL REPORT for the IDRC project *Opening up Natural Resource-Based Industries for Innovation: Exploring New Pathways for Development in Latin America*. https://dl.dropboxusercontent.com/u/29408306/NR%20Project_Sectorial%20Report_Brazil.pdf

Garcia, G. (2008) 'The agricultural machinery industry in Argentina: from restructuring to internationalization?'. *CEPAL Review*, No. 96, pp. 223-239.

Gereffi, G., Humphrey, J. and Sturgeon, T. (2005). 'The Governance of Global Value Chains'. *Review of International Political Economy*, Vol 12, No.1, pp. 78–104.

Gerschenkron, A. (1962) 'Economic backwardness in historical perspective'; in Alexander Gerschenkron, *Economic Backwardness in Historical Perspective*, Ch. 1, pp. 5-30. Cambridge, Mass., Belknap Press

Gibson, A. (2005) Bringing Knowledge to Vegetable Farmers: Improving Embedded Information in the Distribution System, Case Study 1, Dhaka: Katalyst Bangladesh, available at: http://www.springfield-centre.com/wp-content/uploads/2012/10/sp0502.pdf

Gylfason, T., Tryggvi, T. and Gylfi, Z. (1999) 'A Mixed Blessing: Natural Resources and Economic Growth', *Macroeconomic Dynamics*, Vol 3, June, pp. 204-225.

Hernandez-Cuevas, C and Pablo Palenzuela (2004) 'Strategies to capture biotechnology opportunities in Chile', Electronic Journal of Biotechnology: 7. 2: 174-190

Jaffee, S and Masakure, O (2005) 'Strategic use of private standards to enhance international Competitiveness: Vegetable exports from Kenya and elsewhere'. http://www.sciencedirect.com/science/article/pii/S0306919205000333 - aff2 *Food Policy*, Vol. 30, No. 3, pp. 316–333

Kaplinsky, R. (2005) Globalisation, Poverty And Inequality: Between A Rock And A Hard Place. Cambridge: Polity.

Lundvall, B.-A. (2007) 'National Innovation Systems—Analytical Concept and Development Tool', *Industry and Innovation*, Vol. 14, No.1, pp. 95-119

Marichal, C. (1988) *A Century of Debt Crises in Latin America*. Princeton: Princeton University Press

Marin, A. (2007) 'Thinking locally: New approaches to foreign direct investment', SCi-DEV, 1 January http://web.scidev.net/en/policy-briefs/thinking-locally-new-approaches-to-foreign-direct-.html

Marin, A. and Stubrin, L. (2015) 'Oportunidades y desafìos para convertirse en un innovador mundial en Recursos Naturales (RN). El caso de las empresas de semillas en Argentina'. WP, CENIT

Marin A., Stubrin, L. and van Zwanenber,g P. (2014) 'Developing capabilities in the seed industry: which direction to follow?'. *SPRU Working Paper series* SWPS 2014-12

Marin, A. Navas-Aleman, L. and Perez C. (2010) 'The possible dynamic role of natural resource-based networks in Latin American development strategies'. *Globelics Working Paper* 43-1, April.

Mazzucato, M. and Penna, C.C.R. (eds.) (2015) *Mission-Oriented Finance for Innovation: New ideas for investment-led growth*. London: Policy Network.

Mazzucato, M. and Perez, C (2014) 'Innovation as Growth Policy: The challenge for Europe' *SPRU Working Paper series*, No. 13, 2014 Link: 2014-13_SWPS_Mazzucato-Perez.pdf (1.2mb)

Morris, M., Kaplinsky, R and Kaplan D. (2012) "'One thing leads to another' —Commodities, linkages and industrial development", *Resources Policy*, Volume 37, Issue 4, Pp. 408–416

Murray, R. (2012) 'Global Civil Society and the Rise of the Civil Economy' in Helmut Anheier, Marlies Glasius, and Mary Kaldor (eds) *Global Civil Society* 2012, London: Palgrave MacMillan

Navas-Aleman, L. (2011) 'The Impact of Operating in Multiple Value Chains for Upgrading: The Case of the Brazilian Furniture and Footwear Industries', *World Development* Vol. 39, No. 8, pp. 1386-1397

Nurkse, R. (1958). *The Quest for a Stabilization Policy in Primary Producing Countries*. Kyklos

Perez, C and Soete, L.(1988) 'Catching Up in Technology: Entry Barriers and Windows of Opportunity.' In G. Dosi et al. (eds). *Technical Change and Economic Theory*. Ch. 21, pp. 458-479. London: Pinter

Perez, C, Marin, A and Navas-Aleman, L (2014) 'The possible dynamic role of natural resource based networks in Latin American development strategies'. In Dutrenit, G. and Sutz, J. eds. (2014) *National Innovation Systems, Social Inclusion and Development*. Cheltenham: Elgar. pp. 380-412

Perez, C. (1985) 'Microelectronics, Long Waves and Structural Change: New Perspectives for Developing Countries', *World Development*, Vol. 13, Nº 3, pp. 441-463

Perez, C. (2001) 'Technological change and opportunities for development as a moving target', *CEPAL Review*, No. 75, December, pp. 109-130.

Perez, C. (2002), *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*, Cheltenham: Elgar

Perez, C. (2008) 'A Vision for Latin America: A resource-based strategy for technological dynamism and social inclusion', *Globelics* Working Paper No. 2008-04.

Perez, C. (2010a) 'Dinamismo tecnológico e inclusión social en América Latina: una estrategia de desarrollo productivo basada en los recursos naturales'. *Revista CEPAL*, No. 100 pp. 123-145

Perez, C. (2010b) 'Hacia la PYME latinoamericana del futuro: Dinamismo Tecnológico e Inclusión Social'. In *SELA: PYMES como factor de integración: 35 años de esfuerzo continuo del SELA*. Barquisimeto, Venezuela: Editorial Horizonte, pp. 111-123.

Perez, C (2013) 'Unleashing a golden age after the financial collapse: Drawing lessons from history'. In *Environmental Innovation and Societal Transitions* No. 6, pp. 9– 23

Prahalad, C.K. and Hamel, G. (1990) 'The Core competence of the corporation'. Harvard Business Review May-June pp. 79-91 https://hbr.org/1990/05/the-core-competence-of-the-corporation

Prebisch, R. (1950). The economic development of Latin America and its principal problems. United Nations Dept. of Economic Affairs.

Prebisch, R. (1951), *Estudio Económico de América Latina 1949*, CEPAL, New York.

Reinert, E. S. (ed) (2004) Globalization, Economic Development and Inequality: An Alternative Perspective. Cheltenham: Elgar.

Rodrik, D. (2004) 'Industrial Policy in the Twenty-First Century'. *KSG Working Paper* No: RWP04-047

Sachs, J. and Warner, A. (1995 revised 1997, 1999) 'Natural resource abundance and economic growth', Working Paper No. 5398, *National Bureau of Economic Research*. Cambridge, MA.

Sachs, J. and Warner, A. (2001) 'The curse of natural resources', *European Economic Review*, Vol 45, Nos. 4/6, pp. 827-838.

Singer, H. (1949) 'Economic Progress in Underdeveloped Countries', *Social Research: An International Quarterly of Political and Social Science*, Vol 16, No. 1 pp. 9-11.

Singer, H. (1950). 'The Distribution of Gains between Investing and Borrowing Countries', *American Economic Review*, No. 44 Vol. 2, pp 473-85.

Singer, H. (1975). *The Strategy of International Development: Essays in the Economics of Backwardness*. – Macmillan.

Stirling, A. (2008) '"Opening up" and "closing down" power, participation, and pluralism in the social appraisal of technology', *Science, Technology & Human Values*, 33(2), pp. 262-294.

Stirling, A. (2009) 'Direction, Distribution and Diversity! Pluralising Progress in Innovation, Sustainability and Development'. *STEPS Working Paper*: Vol. 32.

The Economist (1977) 'The Dutch Disease', November 26, pp. 82-83.

Torvik, R. (2002) 'Natural Resources, Rent Seeking and Welfare', *Journal of Development Economics*, Vol. 67, pp. 455–470.

Urzúa, O. (2011) ' Emergence and Development of Knowledge-Intensive Mining Services (KIMS) *Working Papers in Technology Governance and Economic Dynamics*, No. 41. The Other Canon Foundation and Tallinn University of Technology

Wade, R. H. (1992) 'East Asia's Economic Success: Conflicting perspectives, partial insights, shaky evidence'. *World Politics*, Vol. 44, Issue 2, pp. 270-320

Walker, M. and Jourdan, P. (2003) "Resource-based Sustainable Devel-

opment: An Alternative Approach to Industrialisation in South Africa", Minerals & Energy - Raw Materials Report: 18. 3: 25-43
Warhurst, A. (2008). "How Botswana Leverages Growth". *Business Week*, April 30, Available at: http://www.businessweek.com/globalbiz/content/apr2008/gb20080430_874526.htm (Accessed on July 19, 2009)
Wright, G. (1997). 'Toward a more historical approach to technological change'. *The Economic Journal*, 107: 1560-1566

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