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Economic development revisited: How has innovation contributed towards easing poverty?

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1. INTRODUCTION

The literature on the global distribution of income highlights how poverty worldwide has declined over recent decades. Sala-i-Martin (2006) summarized his findings by stating that poverty rates "in 2000 were between one-third and one-half of what they were in 1970 for all four [poverty] lines. There were between 250 and 500 million fewer poor in 2000 than in 1970". These findings have been confirmed by more recent research. Pinkovskiy and Sala-i-Martin (2009) pointed out that the percentage of the world population living on less than $1 a day (in PPP-adjusted 2000 dollars) declined from 26.8% in 1970 to 5.4% in 2006.

In sum, the message from the literature on the evolution of global poverty shows that, should the observed trends continue, *poverty* will probably be eradicated on planet earth by the middle of the present century. Such a message is of course good news. Particularly if we assume that underdevelopment is a synonym for extreme poverty in the developing world, we can readily accept that the observed decline in global poverty is highly correlated with progress towards economic prosperity.

However, as there are several methodological drawbacks to the way poverty estimates are carried out, one must be careful over their interpretation. The research quoted above refers to a poverty line set at $1 a day in contrast with the World Bank, which has been working with alternative poverty lines. International poverty lines are set close to the mean of the poverty lines identified in the poorest countries. For this reason, it is difficult to argue in favour of just a single poverty line. Over the last few years, the World Bank has mostly been working with a poverty line of $1.25 a day while also having recourse to four other alternative thresholds, $1, $1.45, $2 and $2.5 a day respectively (Chen and Ravallion, 2008). If one takes this last threshold, which is certainly adequate for the many developing countries that are not among the poorest, we quickly find that the 1990 figure of circa 3 billion of world poor did not undergo any decline through 2005. In any case, the available research does seem to confirm that poverty declined worldwide, where not in absolute numbers (even

though much research confirms precisely that) at least in relative terms, as the world population has been continuously growing from about 5 billion in 1990 to almost 7 billion in 2010.

These observations of such a worldwide trend enable us to raise several important questions from an economic development standpoint. The central question relates to the possible causes behind such a positive trend. Certainly many factors are involved in accounting for what has been observed: rising literacy, better health coverage, an expansion in trade, the adoption of innovation and potentially- industrial policies and improvements to institutions being among the most important of such factors. In this chapter we are specifically interested in this wider context and discussion as to the role played by innovation in economic development. We will focus upon possible future roles for innovation in further pushing back global poverty and bringing about development worldwide in the next few decades.

Keeping these questions in mind, the present chapter unfolds into three sections. Section 2 provides an account of how the economic development literature has advanced and dealt with innovation, identifying what lessons one might derive from the many different perspectives that have emerged on the interrelationship between development and innovation. Section 3 then reviews the innovation literature and its approach to economic development from a rather symmetrical standpoint to the previous section. Finally, section 4 summarizes the main topics dealt with throughout the chapter and sets out a forward looking perspective on how innovation and development may be expected to interact over the next few decades.

2. HOW HAS THE ACADEMIC LITERATURE ON ECONOMIC DEVELOPMENT APPROACHED INNOVATION?

The early days

Despite being intimately inter-related in practice, innovation and development have to a large extent been dealt with as two separate academic topics. *Economic Development* emerged and evolved as an autonomous field of study essentially after World War 2, as the implementation of the Marshall plan in Europe and the newly-gained independence of the former European colonies raised the issue as to which were the best developmental policies for the new context. Regarding economic analysis of *Innovation*, many empirical studies on technological change and innovation have been carried out since the 1960s, in the wake of Solow's work, with the introduction of this topic as an autonomous subject in undergraduate or graduate curricula in effect since the 1980s.

For many years, the literature on economic development did not even mention the word innovation. As a matter of fact, the equivalent terms that dominated that literature until a few decades ago were technical progress or technological change. This is ironic as Joseph Schumpeter, best known for being the first academic to systematically conceive of innovation, published a book in 1912 entitled precisely *The Theory of Economic Development* (Schumpeter, 1912). In this work, he began by putting forward a model in which the economy operated in a circular flow. It was the introduction of innovations by pioneering entrepreneurs that enabled the economy to move out of the initial static equilibria of the circular flow. Indeed, it was also within this sequence that *creative destruction,* brought about by the introduction of radical innovations, generated the dynamics of

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the business cycle. However this insight of Schumpeter was not carried over into studies on economic development produced in later decades, possibly as such a view was seen as more applicable to mature capitalist economies than to poorer developing nations.

Balanced versus unbalanced growth: searching for the development engine

Rather than being inspired by Schumpeter, early development theory was influenced by Keynesian growth models. In these earlier approaches, the capacity to raise saving levels so as to finance capital accumulation was seen as a key condition for growth to take place (Domar, 1946, Harrod, 1948). From this perspective, economic modernization and progress depended upon the possibility of raising savings and investment rates, an objective unachievable through policy measures. A similar emphasis on the accumulation of tangible capital was sustained by Marxist authors such as Dobb (1951).

Soon, however, there was a departure from these views, perceived as too simplistic in assuming the economy to be mono-sectorial. The debates rapidly moved on to the problems of balanced versus unbalanced growth and the structural composition of the economy. Lewis (1954) put forward his dualistic model of a two- sector economy, composed of a *traditional* and a *modern sector*. The *traditional sector* coincided with agriculture in rural areas while the *modern sector* essentially coincided with the modern industries concentrated in urban areas. Nowadays, we would state that the modern sector is the carrier of innovations into the economy. Trickle-down effects from the modern to the traditional sector were the expected drivers of modernization and economic development. The views on this sort of inter-sectoral dynamics were researched further by Hirshman (1958). According to this author, the critical aspect of development was not so much the saving and investment rates but the actual ability to mobilize entrepreneurial capabilities. In his view, existing entrepreneurs needed encouragement in order to concentrate their investments on specific sectors whose backward and forward linkages would generate leverage effects throughout the whole economy. This emphasis on the economic structure was later significantly expanded by perspectives focusing on the relevance of the international specialization of the different economies.

At odds with the *dualistic* and *structuralist* views, the proponents of *balanced growth* (Singer, 1952, Nurske, 1953) claimed that development required bringing about a coordinated expansion of several sectors. As markets are limited in developing economies

and as overall output growth depends on existing demand, the balanced growth proponents stated that the existing sectors had to co-evolve to generate mutual demand large enough to provide the necessary leverage for overall economic growth. This was regarded as particularly important as developing countries were seen as having only limited opportunities for exporting to an international market dominated by the OECD economies.

It was this last insight that led to another set of inter-related approaches within the field of economic development. Prebisch (1950), based at the United Nations Economic Commission for Latin America, formulated his thesis that developing countries had to promote import-substitution policies as the world had evolved into a centre-periphery relationship in which developing nations were condemned to export raw materials and primary goods to rich nations, while importing capital goods and other technology-rich imports from the latter. Protectionism was needed to ensure that domestic markets could expand and exploit economies of scale—a critical characteristic of the most advanced technologies of the day. These views crystallized afterwards to form what became *dependency theory,* expounded upon by authors such as Furtado (1973), Frank (1975) and Amin (1973).

Which technologies are best for developing countries?

Since the 1970s there were, however, several signs indicating progressive discontent with the direction of development theory over the decades. Internally, there were those such as Seers (1969) who contested the dominating growth of fetishism, calling for academic analysis of development to turn instead to qualitative aspects more related to human needs. Amartya Sen became the leading exponent of this group of approaches, given his proposition that the critical aspect of development was the freedom of individuals to do or to become something. This right of access could only be achieved when individuals were equipped with capabilities appropriate for implementing their choices (Sen, 1980).

It was within this qualitative set of approaches that an influential book emerged entitled *Small is Beautiful* (Schumacher 1973). The book brought to the debates on development not only the idea that economic growth might not be a central objective, but further suggested that growth might be harmful and, perhaps best avoided by societies. These ideas originated within an intellectual climate rejecting the dominant prevailing materialistic culture of advanced capitalist economies, in conjunction with a growing global perception as to the limits of growth imposed both by environmental degradation and by limited stocks of non-renewable natural resources (Meadows *et al.,* 1972). In his book, Schumacher put forward the idea that many modern technologies were harmful and that societies had to gain by sticking to smaller-scale technologies, which might be either traditional, or possibly *intermediate, technologies*. Such *intermediate technologies* were portrayed as more productive than traditional technologies but with a lower capital intensity and much less damaging to the environment than modern scale-intensive technologies. Schumacher's ideas led to the establishment of the intermediate technology movement that branched out into two streams, one within a developing context, with many locally- based experiments with appropriate technology implemented over the years in poorer countries, and another within the

developed economy context, with the search for environment-friendly technologies. It must be stated that Schumacher's work had very important earlier roots in the thinking of Mohandas Gandhi. India's independence leader had advocated small, local-based technology as a means for Indian labourers to become self-reliant and able to compete with the large-scale technologies deployed by the British. In fact, large scale technologies are typically centralized and, as such, were used by the colonial power as a way of concentrating production and imposing prices on indigenous populations.

This *intermediate* (or *appropriate) technology* perspective is convergent with Amartya Sen's perspectives on individual capabilities and self reliance. *Appropriate technology* is regarded as empowering the poor by allowing greater individual and local community autonomy while simultaneously respecting the environment. It was in keeping with these perspectives that radical views were advanced by thinkers such as Vandana Shiva (1992, 2000). In her 1992 book, she distilled criticisms made in respect of what is termed the *green revolution*. While many have defended the achievements brought about by the green revolution through the application of modern science to genetically recombining the existing varieties of agricultural species, many others have criticized it on social, political, health and environmental grounds. The green revolution represents a fascinating case-study for discussing how innovation impacts on development paths and how technological choice is a current problem that policies and societies should take into consideration.

It is interesting to note that the intermediate technology views have more recently diversified into quite a different perspective. C. K. Prahalad, who was well known for books on strategy and knowledge management, in 2004 published *The Fortune on the Bottom of the Pyramid: Eradicating Poverty through Profits*. The bottom of the pyramid (or simply BoP as it became known) is the 4 billion poor living worldwide on less than $2 a day. Basically, Prahalad's idea was to adapt and integrate the solutions of the past—development aid, subsidies, government support, exclusive reliance on deregulation and the privatization of public assets—within a broader market-based approach. He made a call "to mobilize the investment capacity of large firms with the knowledge and commitment of NGOs and the communities that need help" through the co-creation of unique solutions. Thus, in this view, the poor were not seen as a passive market upon which business firms impose existing products, but rather as an active part of the innovation process itself, which should involve multinational national corporations (MNCs) in the co-creation with them of new products adapted to their needs and wallets. Prahald's approach stimulated an important stream of literature focusing on: 1. how the poor should be involved in the co-creative process for their own benefit (e.g. Ramani *et al.,* 2009; Ghazi and Dusyters, 2009); 2. MNC corporate social responsibility in the Third World (e.g. Rangan *et al.*, 2007); and 3. specific case studies that show how MNCs profit from a global market worth $5 trillion, highlighting evidence on many important pro-poor innovations.[1] In a way, the literature on BoP innovation goes beyond the older literature on technology choice (e.g. Stewart, 1978), which tended to conceive of the option between endogenous (traditional) technology and foreign technology as alternative paths, as the newer approach emphasizes the integration of efforts made by the local poor in developing countries and (mostly foreign) MNCs.

[1] In this regard, the "Special Report on Innovation in Emerging markets" published by *The Economist* in its 17th April 2010 issue, is highly recommended as it provides many interesting examples of pro-poor (or by-the-poor) innovations.

Has development economics developed?

Apart from the recent (qualitative) contributions highlighted in the previous paragraphs, most research on development economics over the last two decades has displayed an analytical character, more concentrated on technical problems than on the actual challenges of development. This happened not only because the *old* development economics was discarded by mainstream economists as methodologically unsatisfactory, but also because the lack of advancement in developing countries helped to make policy makers there grow weary in the face of the excessively normative and impractical nature of the existing theories. As a result, in recent years, a significant percentage of research on development economics has followed a different route, especially under the auspices of the *new growth economics*, as a continuation and refinement of the economic growth models that Robert Solow and colleagues had put forward in the late 1950s and 1960s. Lundvall *et al.* (2009) provide an interesting account of this evolution, concluding that "currently mainstream economics tends to use developing countries' problems as offering interesting opportunities to make use of advanced theoretical models and econometric tools while the interest in understanding the structures that lie behind underdevelopment and the mechanisms that might trigger development tend to end up as being of secondary importance".

However, development economics has not exclusively moved along an analytical path. On the one hand, the perspectives opened up by Amartya Sen led to an important reconsideration of what exactly is meant by *development*, concentrating on the relevance of the freedoms and capabilities of both the individual and the society. On the other hand, much empirical work has been produced about successful instances of development and catch-up in recent decades, providing valuable insights into the strategies advanced for effectively learning and incorporating innovation into the development process. It is precisely to this last stream of literature that we turn in the next section of this chapter.

3. INNOVATION, LEARNING AND CATCHING UP: NEW PERSPECTIVES ON ECONOMIC DEVELOPMENT

This section offers a sort of mirror view of the previous one that reviews the research on *innovation* relating more directly to economic development. It starts by briefly presenting the main concepts of the *innovation literature* before highlighting the approaches to technology transfer and technological learning within a development context. Finally, it provides a summary of the approach to catching up, in which innovation is seen as a central aspect to countries attempting to swiftly move out of underdevelopment.

From innovation as a process to innovation as a system

Innovation has been defined as the first practical application of an invention. Normally, that application takes place in an organized market in which innovating firms introduce new products or supply already existing products through using new processes. As Fagerberg (2005) pointed out, "To be able to turn an invention into an innovation, a firm normally needs to combine several types of knowledge, capabilities, skills and resources. For instance, the firm may require production knowledge, skills and facilities, market knowledge, a well-functioning distribution system, sufficient financial resources and so on." In this view, innovation is essentially a knowledge-intensive process.

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The forces behind innovation have been divided into two main groups of factors associated especially with *market opportunities* and *technological opportunities*. The *market opportunities* argument was formalized into the so-called *demand-pull innovation model*. In this model, innovation is stimulated by needs such as illnesses or the search for more energy-efficient processes for which the market has yet to provide satisfactory solutions. This view was argued in a book, *Invention and Economic Growth* (Schmookler, 1966), based on the study of historical time-series of US patents, investment and production from around the turn of the 19th century through to the 20th century. Such a view came in for criticism from Mowery and Rosenberg (1979), who claimed that not all innovations stem from needs put forward in the marketplace. Specifically, these authors argued that many innovations, in particular in the industrial sectors that emerged in the second half of the 20th century such as electronics, tended to stem from the application of scientific discoveries or from the unexpected results of technological research and development. These innovations, driven by *technological opportunities,* led to the suggestion of a *science and technology-push model of innovation*. These two contrasting views on innovation came to be seen as complementary and later were integrated into the *interactive model of innovation* (Freeman, 1979) and elaborated in the recursive *chain-link innovation model* (Kline and Rosenberg, 1986).

It was in this theoretical sequence that systemic views of innovation emerged, suggesting the concept of an *innovation system*. The *innovation systems* literature (Freeman, 1987 and 1995; Lundvall, 1992; Nelson, 1993; Edquist, 2004; Malerba, 2002) has attempted to integrate the forces of demand with science and technology in a wider, systemic, context, in which different actors and institutions with a role in innovation interact. This view considers the introduction and adoption of innovations to be a complex process stemming from the coordination of efforts between a diversity of stakeholders. Furthermore, this approach has pointed out that the innovation process is strongly affected by historical trajectories and by normative environments -- i.e., it has demonstrated that innovation is an institutionally embedded process. The innovation systems approach builds upon not only the simpler models of the innovation process, which were briefly reviewed above, but also on the S&T system concept developed in the 1960s as well as the old and modern institutionalist schools.

In recent years, this innovation- systems approach has fed through to the analysis of economic development in two streams of analysis. Firstly, by putting forward the *national innovation system* concept,[2] which highlights the need for individual actors (firms, consumers, universities, financial operators, civil servants, intermediate

[2] An internet search carried out in mid-2010 of the "National Innovation System" concept, brought about 742,000 results in Google, while the search for the equivalent "National System of Innovation" expression brought about a further 266,000 results. Together, this represents more than 1 million references to the concept in documents available on-line!

organizations...) coordinating their efforts through collective strategies and forward-looking visions presented at the national level. This concept has been applied to a huge array of economies, initially to mature economies but increasingly to emerging economies and many poorer developing countries (for example, see Arocena and Sutz, 2000; Gu and Lundvall, 2006a and 2006b; Joseph 2006; Lastres and Cassiolato, 2005; Lastres, Cassiolato and Maciel, 2003; Liu and White, 2001; Oyelaran-Oyeyinka, 2006; Viotti, 2002). Secondly, as this approach has evolved into the analysis of *learning systems*, the focus has moved on to the mechanisms behind the production, adoption and diffusion of new productive knowledge, which are of course critical for developing economies. To a certain extent, this second stream of analysis connects both with the older literature on *technology transfer* as it looks into sources of technology within a development context and with the more recent literature on technological learning, both of which are briefly reviewed in the two subsequent points.

Technology Transfer

In the older literature on *technology transfer,* developing countries were portrayed as *followers, to a greater or lesser extent* expected to passively absorb and adopt innovations pioneered by leading economies. To this end, all they had to do was to tap into the sources of foreign technology, of which the most important was the import of capital goods.[3] Other channels consistently analyzed by the *technology transfer* literature included foreign direct investment (FDI), joint-ventures, technology licensing and subcontracting by original equipment manufacturers (OEMs). Concerning FDI, this has generally been seen as having a positive role in the transfer of know-how, though with significant limitations. A common view by the mid-1990s was that FDI was an effective means of transferring innovation but not necessarily the innovative capabilities themselves (Lall, 1996).

These technology transfer sources were extensively discussed in relation to the cases of several successful newly industrializing economies. Analyzing the four East Asian *dragons* (South Korea, Taiwan, Hong Kong and Singapore), Hobday (2000) pointed out how different mechanisms worked effectively in each case. In the case of South Korea, several of the Korean *chaebols* started by subcontracting production capacity as OEMs to large Japanese corporations before next proceeding to produce design and development while still supplying finished goods as subcontractors, before later entering into merchandising and selling their products under their own brands worldwide. This sequential process allowed them to absorb critical know-how from their contractors and acquire innovative capabilities in product and process engineering. In contrast to Korea, in the Taiwanese case the smaller electronics and IT firms of this country focused mostly on importing technology through licensing foreign technology, a path with a certain resemblance to that followed by Japan a few decades earlier (Freeman, 1987).

A relevant recent development in these perspectives on technology transfer has been the analysis of *global value chains* (GVCs) (Ernst, 2001; Kaplinsky, 2005). This analysis provides evidence and insight on how developing countries and their domestic companies are involved in global supply chains. A central topic of this perspective has been the governance mechanisms of the GVCs (Gereffi *et al.,* 2005), assessing with which statute and in which operations

[3] This view brings us back to the problem addressed by earlier development models: the ability of macroeconomic policy to optimize the savings and investment rates.

(assembly, design, marketing...) developing country companies participate in the GVCs.

It should be noted that the focus on the need and interest of absorbing foreign technology contrasts considerably with certain perspectives on economic development that for several decades influenced many countries, namely the *structuralist* and *dependency schools* that advised national governments and developing economy companies to rely as much as possible on their own resources and capabilities rather than on foreign know-how.[4]

Technological Learning

To a certain extent, the literature on technological learning in the developing world context provides an integration of the more interesting aspects of the apparently conflicting approaches that highlight the relevance of external and internal sources of technological development.

Technological learning has been defined as "any process by which the resources for generating and managing technical change (technological capabilities) are increased or strengthened" (Bell and Pavitt, 1993). This view portrays technology as much more than machinery-embodied knowledge and instead has focused on the cognitive aspects of the learning process, stating that "technology is a... bundle of knowledge, with much of it embodied in a wide range of different artefacts, people, procedures and organizational arrangements. These embodiments of knowledge include at least: product specifications and designs, materials and component specifications and properties; machinery and its range of operating characteristics; together with the various kinds of know-how, operating procedure and organizational arrangement needed to integrate these elements in an enormously variable range of different production systems" (Bell and Albu, 1999).

Much of this research on technological learning began by analyzing the mechanisms of technological accumulation at the individual firm level, specifically looking into large-scale companies from countries such as Argentina, Brazil, Mexico, South Korea and India (e.g. Dahlman and Fonseca, 1987; Katz, 1985). The focus was on how individual companies organized their process of capability- building through learning by doing, combined with endogenous R&D. More recently, however, the research on technological learning evolved into analysis of the more complex structures in which developing country companies interact with suppliers, customers and specialized knowledge-generating organizations, such as universities and R&D institutes. Thus, interest moved on from the realm of the individual company to analysis of *networks* or *clusters*. According to Bell and Albu (1999) such combinations of internally organized capabilities with external knowledge resources "have come to be described as *industrial innovations systems*, *technology systems* or *knowledge systems*".

In this systemic context, convergent to that put forward by the *innovation systems* literature, *technological learning* is seen as a dynamic process of capability acquisition and development, with the success of this process depending on both historical trajectories and on the institutional setting in which the process occurs. Furthermore, in contrast to the idea of technology absorption through the importing of capital goods, technological capabilities are not seen as the result of a single occurrence or event but as a time-dependent process associated with a long-term purposeful organization of efforts by

[4] One of the corollaries of these more inward-looking perspectives was that economic development had to be *balanced* with the simultaneous growth of all economic sectors as the developing countries could not overly rely on specialization and the opportunities presented by a trading system largely dominated by OECD countries.

firms and other relevant actors in the national innovation system.

Catching Up

Catching up refers to the ability of a given country to reduce its productivity differential vis-à-vis the leading economies over a given historical period (Fagerberg and Godinho, 2005). The catching-up literature has stressed that endogenous and exogenous factors combine in triggering productivity rises. The historical antecedents to the catching-up literature stretch back to early in the 20th century, with the work of Thorstein Veblen on the German catch up. However, more systematic contributions took place concomitantly with the early literature on development and economic growth, particularly the work of Gerschenkron (1962).

Gerschenkron adopted an essentially optimistic view about the possibilities of countries evolving out of underdevelopment, suggesting that the more backward a country is, the higher its potential for a fast catch-up process. This paradoxical view was seen as possible as underdevelopment originates a tension between the existing backwardness and the promises offered by economic development. Such tension would facilitate a quick rise in the investment rate and a concentration on the rising industries and technologies. This view of Gerschenkron has been extensively tested by many econometric studies, analyzing the negative relationship between initial GDP per capita and its rate of growth for samples with a large number of countries (e.g. Baumol, 1986; Lucas, 1988; Barro, 1991; Barro and Sala-i-Martin, 1992; Quah, 1993).

Despite its essentially optimistic outlook, for many in the developing world, the perspective on catching up has been negatively associated with linear historical views such as those put forward by W. W. Rostow (1960). Rostow stated that all countries have to evolve through pre-determined *stages of growth*, with developing nations expected to mature along similar lines to those of the US or the UK over the 19th and 20th centuries. According to Rostow, the economic development problem basically related to the capacity to mobilize the resources necessary for the *take-off* from backwardness to modernity. The rejection of Rostow's scheme to a certain extent echoes the arguments reviewed earlier about the need for developing countries to encourage and deploy appropriate technology. However, it should be noted that the research on catching up and the work of Gerschenkron himself do not impose any need for countries to evolve through similar stages of development with catching up linked to the conditions necessary for reaching (and eventually surpassing) the productivity levels of the best performing economies in each historical period in a relatively short period of time.

One possible reason for suspicious attitudes towards catching-up theory is the sheer frustration felt by both academics and policy makers in the developing world given the gigantic difficulties and backlashes faced in overcoming underdevelopment. However, it should be pointed out that there are certain variations within this approach ranging from the more positive views that accept the feasibility of *technological leapfrogging,* given certain *windows of opportunity* (e.g. Pérez and Soete, 1988), to other views that have emphasized the many existing barriers and a very diverse set of pre-requisites, especially in relation to the need for prior technological accumulation over lengthy periods of time (Pavitt, 1985).

The mainstream catching-up literature has focused precisely on these latter

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aspects. Following Gerschenkron's insight, most research on catching up soon concentrated on the technological pre-requisites, viewing innovation as a central aspect to efforts by poorer economies to rapidly close the economic gap in relation to mature economies. It was as part of this research that a *technology gap* hypothesis was put forward (Posner, 1961; Fagerberg, 1987; Fagerberg and Verspagen, 2002), suggesting that the greater the technology gap, the greater the potential for catching up. However, while concentrating on the opportunities generated by investing in technology and innovation, the theory underlying this hypothesis has emphasized that technology is not a global, freely available public good. The difficulties faced in absorbing foreign technology gained particular emphasis in conjunction with the need to couple this with the local accumulation of technological know-how through endogenous R&D and other learning activities.

Furthermore, and also in accordance with Gerschenkron's insights and earlier approaches such as Veblen's (1915) analysis of the German catch-up, most research on *technology gaps* has stressed how catching-up candidates have to meet certain institutional pre-requisites. Abramovitz (1994) pointed out that aspiring economies should combine *technological congruence* with an indispensable *social capability*. By *technological congruence,* he meant the degree of coherence between economic aspects such as resource endowment, the degree of specialization in different technologies, the configuration of demand, the prevailing market characteristics and the country's position in terms of physical infrastructures. By *social capability,* he essentially encapsulated cultural and institutional factors, such as the levels of education and technical competence, the political climate, the capacity of business and research organizations to interact and, in more general terms, the economic culture framing entrepreneurship, innovativeness and the risk-propensity of economic actors.

This focus on *institutions* follows in the footsteps of work by economic historians such as Landes (1969, 1998) and North (1981, 1990). Landes argued that the earlier economic advancement of some European countries such as Britain was highly correlated with the presence of a set of efficient institutions, such as the enforcement of contracts and the personal liberties needed to guarantee geographic and social mobility. North adopted a standpoint closer to economics in the sense that he departs from the uncertainty that characterizes economic exchanges, depicting markets as part of the regulating institutions necessary for economic activity to advance. In his later work, he also portrays government as part of

the institutional machinery needed to smooth out economic exchanges.

Some of the most influential empirical research on recent cases of catching up converges around findings within the framework put forward by economic historians working within an institutionalist perspective. Wade (1990) pointed out in his analysis of Taiwan and other East Asian countries that the appropriate combination of free market and government intervention accounts for the rapid industrialization achieved, particularly in terms of coordinated resource-allocation decisions. Rodrick (2007) was clear in stating that "the hallmark of development is structural change—the process of pulling the economy's resources from traditional low-productivity activities to modern high productivity activity", while also feeling the need to stress that "this is far from an automatic process and requires more than well-functioning markets. It is the responsibility of industrial policy to stimulate investments and entrepreneurship in new activities especially those in which the economy may end up having a comparative advantage".

Further to the focus on proper institutions and adequate coordination between markets and government, recent empirical literature has also demonstrated that rapidly catching up in terms of productivity typically results from a combination of selective protectionism along with opening up to foreign sources of knowledge (Chang, 2002; Hobday, 2000).

4. CONCLUDING REMARKS

One important topic present throughout the literature reviewed in the previous sections concerns the possibility of developing nations deciding on which technologies best fit their needs. As seen above, Rostow's linear view of all nations following a similar sequential trajectory imposed the fate of following in the steps of the leading economies on the developing world. In this perspective, the task of developing economies would above all be to concentrate on fine-tuning the absorptive mechanisms and sequentially adopt the technologies invented earlier on by the leading economies. Simplistically expressed, this is the rationale behind the most basic notions of technology transfer. It was in part the rejection of this view that led to the concept of *appropriate* (or *intermediate*) *technology* put forward by Schumacher and others, thereby suggesting there is a *technology space* from which many alternative picks are possible.

Currently, the literature on technological choice extends far beyond the developing countries context to claim that alternative technological routes might be pursued even in a developed economy context. Such a perspective, for example, underpins the longstanding critiques of Fordism and Taylorism that discuss the deskilling effects of modern technology (Braverman, 1974; Noble, 1977, 1984), the works of the Tavistock Institute on socio-technical systems, or the approach that proposes 'anthropocentric production systems' (Lehner, 1992).

The fact that some developing nations have been creating and effectively diffusing some appropriate (process and product) technologies seems to confirm the view that alternative technologies might actually be implemented with success. The recent introduction of the Tata Nano, designed and produced in India, is a very interesting example confirming this assertion. This new car has involved important process and product innovations that have been classified as radical and disruptive at a world level (Lim *et al.,* 2010).

However, despite the idea of a *technology space* -- within which different technological choices can be taken -- now being widely accepted, the consensus is also that such a *technology space* has no infinite possibilities given natural resource shortages and limited design alternatives. This view further implies that as a nation evolves towards higher GDP per capita levels, attempting to catch up with and eventually overcome the leading economies, the choices available within this *technology space* become much narrower. This happens because as a country or a regionally-concentrated cluster of firms begins to approach the state-of-the-art in any given technological field, the main constraint for advancing further becomes the scarcity of knowledge, which on the state-of-the-art frontier is complex and uncertain. The corollary is that when a nation seeks to become competitive at a world level in advanced technology, the practical choices for alternative technologies are significantly reduced. Of course, even in these circumstances, catching-up candidates do not need to invest in *narrow-space* high-technology across all economic activities, particularly in those activities whose outputs might be non-tradable. However, investing in at least a few of the most dynamic technologies of the day makes sense, not only because these typically generate higher earnings in expanding markets, but also because specialization in such technologies might produce the network, trickle-down and dynamic effects mentioned by the earlier development literature (e.g. Rosenstein-Rodan, 1943; Lewis, 1954; Hirshman, 1958, or Kaldor, 1966).

Another important topic dealt with by the literature reviewed in the sections above relates to the question of knowing whether a 'proper' or 'most advisable' sectoral composition of the economy is desirable. We may easily understand that most of the arguments set out in the paragraph above in relation to the choice of technologies and high tech investment can easily be replicated in the context of this discussion on the sectoral composition of the economy. Balanced development might certainly be more desirable in social terms as it would avoid mass migrations or the high unemployment costs stemming from swift changes in the economy's composition. Nevertheless, as economies wish to move on to leading edge technologies, there is hardly any alternative to accepting the roller coaster of creative destruction, at least to the extent that the world continues to be a collection of competitive nations and regions as has happened over the last millennium. Innovation is the epicentre of Schumpeterian dynamics and even though all sectors perform innovative activities, the intensity of such activities is unevenly distributed across sectors.

The catching-up literature has shown that the nations that have been the most successful in advancing rapidly in economic terms are those which have specialized in certain technologies and sectors. As pointed out by Fagerberg and Godinho (2005), the existing empirical evidence confirms that "the countries that have been most successful in catching up, namely South Korea, Taiwan, and Singapore (and Japan before them) have all—after initially having acquired some capabilities through more traditional activities—aggressively targeted the most technologically progressive industries of the day, in which they today play an important role". The higher complexity of the newer technologies in each historical period opens up the possibility for innovative firms and countries to capture niche markets with

potential monopolistic rents. Further to these arguments that focus on supply-side aspects, on demand grounds the analysis has also shown that nations have advantages in specializing in certain sectors rather than in others. Following on from earlier insights into the technology-gap theory (Posner, 1961) and the life cycle approach (Vernon, 1966), Lafay (1982) precisely demonstrated that nations specializing in the products and sectors where international demand grows faster also turn in better economic growth performances.

The advocacy above of the advantages of certain sectoral specializations over others does not mean, however, that an 'optimal' specialization might exist for each given historical period. Specialization should be seen and treated as context-dependent. Resource allocation is a primary determinant of specialization, as pointed out by classical trade theory. For example, economies well endowed with resources such as beaches, sun, forests or valuable monumental heritage have advantages in specializing in tourism-related services. Indeed, the geography and characteristics of each country, in terms of its territory, population and market size, bear important implications in terms of possible sectoral specializations. However, historical evidence has made it clear that (at least for larger-sized) developing nations willing to succeed, there is little alternative but to invest in the most dynamic and innovative technologies and industries.

Another central lesson stemming from the literatures reviewed is that the successful adoption and creation of innovations in the developing world needs a corresponding institutional climate; otherwise investment in technological accumulation risks failing just as investment in capital goods or infrastructures proved a failure in previous development contexts. Taking as a basis their historical reality, countries need to build upon and adapt their institutions to the challenges of dealing with technological knowledge that often has a scientific background. This means a capacity for organizing and strengthening national innovation systems, setting up and improving communication channels between the relevant actors, while simultaneously nurturing the necessary trust so that these interactions also intensify in quantity and quality.

The recent advances of countries like China, India or Brazil stem to a large extent from their ability to put in place the building blocks of their national innovation systems. For smaller countries, however, this task may prove harder as they lack the capacity for similarly establishing critical masses of resources and benefiting from dynamic economies of scale and networking effects to effectively gain a proper return on their investments. Smaller countries might, however, adopt different technological strategies through relying more on natural resources or service-oriented strategies rather than on classical industrialization strategies, while simultaneously integrating further into the global knowledge networks so as to screen the technology sources needed.

One aspect that has changed dramatically over the last two decades in relation to innovation and economic development has been the global geography of business R&D. While twenty years ago the R&D carried out by MNCs was concentrated almost exclusively in their home countries, the situation has now substantially changed with a degree of R&D delocalization to third countries never before experienced. Another aspect that has also changed dramatically has been the international organization of

> "This means a capacity for organizing and strengthening national innovation systems, setting up and improving communication channels between the relevant actors, while simultaneously nurturing the necessary trust so that these interactions also intensify in quantity and quality"

intellectual property right (IPR) systems. The TRIPS agreement was introduced as an Annex to the founding treaty of the WTO, and as such almost all the world has come (or is coming) under a common set of rules for IPR. It is interesting to note in this respect how countries like India and Brazil (and to a lesser extent China as well), which disputed several provisions of that agreement, are now among the countries where domestic IPR usage is rising fastest. As noted by Godinho and Ferreira (2010), "both China and India have been experiencing a historical take-off in the use of intellectual property rights (IPR). As for national IP office applications, the evidence is that by 2009 China became number one worldwide in trademark applications, while India is just behind the US, Japan and the Republic of Korea. Concerning patent filings, China ranks third worldwide and India ranks ninth." Brazil is also more intensely using trademarks and patents and while for this latter IPR type it is not yet in the global top 10, it ranked third worldwide for the former at the end of 2009.

The trends in this sort of indicators point to two different aspects that should be kept in mind for future debate on innovation and development. The first is that innovation is clearly becoming a central part of emerging-economy development processes in the same way as happened before in other cases of successful catch up. The second is that, nowadays, developing economies can hardly look inward if they want to further their economic development prospects. On the contrary, while caring for domestic conditions, they need to search thoroughly for adequate sources of know-how, learn to benefit from participation in knowledge networks, compete for outward FDI in R&D and adapt creatively to the complexities of global institutional frameworks, such as IPR.

Of course, as innovation becomes a central component of economic development, as is happening in China, India and other emerging economies, developing countries will need wise policies to deal with both environmental spillovers and the Schumpeterian waves of *creative destruction*. Research carried out over the past decade shows precisely how the acceleration in innovation has increased income concentration in the developed economies since the 1980s (Levy and Murnane, 2007). Similar effects might be expected in the developing economies as well if appropriate policies are not implemented to combine leading-edge innovation with what has been termed *pro-poor innovation*.

REFERENCES

ABRAMOVITZ, M. (1986), "Catching up, forging ahead, and falling behind", *Journal of Economic History* 46(2), pp. 385-406.

AMIN, S. (1973), *Le Développement inégal: essai sur les formations sociales du capitalisme periphérique,* Paris: Editions de Minuit.

AROCENA, R., and J. SUTZ (2000), "Looking at National Systems of Innovation from the South", *Industry and Innovation*, 7(1), pp. 55-75.

BARRO, R. J. (1991), "Economic Growth in a Cross Section of Countries", *The Quarterly Journal of Economics* 106(2), pp. 407-443.

BARRO, R. J., and X. SALA-I-MARTIN (1992). "Convergence", *Journal of Political Economy* 100(2), pp. 223-251.

BAUMOL, W. J. (1986), "Productivity Growth, Convergence, and Welfare: What the Long-run Data Show, *American Economic Review* 76(5), pp. 1072-1085.

BELL, M., and M. ALBU (1999), "Knowledge Systems and Technological Dynamism in Industrial Clusters in Developing Countries", *World Development* 27(9), pp. 1715-1734.

BELL, M., and K. PAVITT (1993), "Technological Accumulation and Industrial Growth: Contrasts between Developed and Developing Countries", *Industrial and Corporate Change* 2(2), pp.7-209.

BRAVERMAN, H. (1974), *Labor and Monopoly Capital*, New York: Monthly Review Press.

CHANG, H.-J. (2002), *Kicking Away the Ladder: Development Strategy in Historical Perspective*, London: Anthem Press.

CHEN, S., and M. RAVALLION (2008),*The World is Poorer than We Thought, but No Less Successful in the Fight Against Poverty,* World Bank, Policy Research Working Paper 4703.

DAHLMAN, C. J., and F. V. FONSECA (1987), *From Technological Dependence to Technological Development: The case of Usiminas Steel Plant in Brazil,* Economic Commission for Latin America, Buenos Aires.

DOBB, M. (1951), "Some Aspects of Economic Development: Three Lectures", Delhi School of Economics, Ranjit Publishers.

DOMAR, E. (1946), "Capital Expansion, Rate of Growth, and Employment", *Econometrica* 14, pp. 137-47.

EDQUIST, C. (2004), "Systems of Innovation—Perspectives and Challenges", in J. Fagerberg, D. Mowery and R. Nelson (eds.), *The Oxford Handbook of Innovation,* Oxford: Oxford University Press.

ERNST, D. (2001), *Global Production Networks and Industrial Upgrading—A Knowledge-Centered Approach* Economics Study Area Working Papers 25, East-West Center, Economics Study Area.

FAGERBERG, J. (1987), "A Technology Gap Approach to Why Growth Rates Differ", *Research Policy* 16, pp. 87-99.

FAGERBERG, J. (2005), "Innovation: A Guide to the Literature", in J. Fagerberg, D. Mowery and R. Nelson (eds.), *The Oxford Handbook of Innovation,* Oxford: Oxford University Press.

FAGERBERG, J., and M. M. GODINHO (2005), "Innovation and Catching-Up", in J. Fagerberg, D. Mowery and R. Nelson (eds.), *The Oxford Handbook of Innovation,* Oxford: Oxford University Press.

FAGERBERG, J., and B. VERSPAGEN (2002), "Technology-Gaps, Innovation-Diffusion and Transformation: an Evolutionary Interpretation," *Research Policy* 31, 8-9, pp.1291-1304.

FRANK, A. G. (1975), *On Capitalist Underdevelopment,* Oxford: Oxford University Press.

FREEMAN, C. (1979) "The Determinants of Innovation: Market Demand, Technology and the Response to Social Problems", *Futures* 11(3), pp. 206-215.

FREEMAN, C. (1987), *Technology, Policy, and Economic Performance: Lessons from Japan,* London, New York: Pinter Publishers.

FREEMAN, C. (1995), "The 'National System of Innovation' in Historical Perspective", *Cambridge Journal of Economics* 19(1), pp. 5-24.

FURTADO, C. (1973), "The Concept of External Dependence in the Study of Underdevelopment", in Wilber (ed.), *Political Economy of Development and Underdevelopment*.

GEREFFI, G., J. HUMPHREY, and T. STURGEON (2005), "The Governance of Global Value Chains", *Review of International Political Economy* 12(1).

GERSCHENKRON, A. (1962), *Economic Backwardness in Historical Perspective,* Cambridge, MA: The Belknap Press

GHAZI, S. S., and G. DUSYTERS (2009), "Serving Low-Income Markets: Rethinking MNCs Strategies", in G. Duysters, W. Dolfsma and I. Costa (eds.), *Multinationals and Emerging Economies: the Quest for Innovation and Sustainability,* London: Edward Elgar.

GODINHO, M. M., and V. FERREIRA (2010), "Analyzing the Evidence of an IPR Take-off in China and India", paper presented to the *7th Asialics International Conference on Global Recession and Reform of Innovation Systems in Asia*, 15-17 April, Taipei, Taiwan.

GU, S., and B.-Å. LUNDVALL (2006a), "Policy Learning as a Key Process in the Transformation of the Chinese Innovation Systems", in B.-Å. Lundvall, P. Intarakurmend and J. Vang (eds.), *Asian Innovation Systems in Transition,* Edward Elgar.

GU, S., and B.-Å. LUNDVALL (2006b), "China's Innovation System and the Move Toward Harmonious Growth and Endogenous Innovation", *Innovation, Management, Policy and Practice* 8 (1/2), pp. 1-26.

HARROD, R. F. (1948), *Toward a Dynamic Economics: Some Recent Developments of Economic Theory and Their Application to Policy,* London: Macmillan.

HIRSHMAN, A. O. (1958), *The Strategy of Economic Development,* New Haven, CO: Yale University Press.

HOBDAY, M. (2000), "East versus Southeast Asian Innovation Systems: Comparing OEM- and TNC-led Growth in Electronics", in L. Kim and R. Nelson (eds.), *Technology, Learning & Innovation: Experiences of Newly- Industrializing Economies,* Cambridge: Cambridge University Press.

JOSEPH, K. J. (2006), *Information Technology, Innovation System and Trade Regime in Developing Countries: India and the ASEAN*, London and New York: Palgrave Macmillan.

KALDOR, N. (1966), *Causes of the Slow Rate of Economic Growth of the United Kingdom: An Inaugural Lecture,* London: Cambridge University Press.

KAPLINSKY, R. (2005), *Globalization, Poverty and Inequality: Between a Rock and A. Hard Place,* Cambridge: Polity.

KATZ, J. (1985), "Domestic Technology Innovations and Dynamic Comparative Advantages: Further reflections on a Comparative Case-Study Program", in N. Rosenberg and C. Frishtack (eds.), *International Technology Transfer: Concepts, Measures and Comparisons,* New York: Praeger.

KLINE, J., and N. ROSENBERG (1986), "An Overview of Innovation", in R. Landau and N. Rosenberg (eds.), *The Positive Sum Strategies: Harnessing Technology for Economic Growth,* Washington DC: National Academic Press.

LAFAY, G. (1982), "Stratégies de specialisation ou division internationale du travail", in J. Reiffers (ed.), *Économie et finance internationals,* Paris: Dunod.

LALL, S. (1996), *Learning from the Asian Tigers,* Basingstoke: Macmillan.

LANDES, D. (1969), *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present,* Cambridge University Press.

LANDES, D. (1998), "Wealth and Poverty of Nations: Why Some Are So Rich and Some So Poor", W. W. Norton.

LASTRES, H., and J. CASSIOLATO (2005), "Innovation Systems and Local Productive Arrangements: New Strategies to Promote the Generation, Acquisition and Diffusion of Knowledge in Innovation and Economic Development", Special issue of *Innovation: Management, Policy & Practice* 7(2).

LASTRES, H., J. CASSIOLATO, M. MACIEL (2003), "Systems of Innovation for Development in the Knowledge Era", in J. Cassiolato, H. Lastres and M. Maciel (eds.), *Systems of Innovation and Development: Evidence from Brazil,* Cheltenham: Elgar, 2003.

LEHNER, F. (1992), *Anthropocentric Production Systems: The European Response to Advanced Manufacturing and Globalization,* Brussels: CEC, DGXII-Monitor/FAST.

LEVY, F., and R. J. MURNANE (2007), "How Computerised Work and Globalisation Shape Human Skill Demands", in M. M. Suárez-Orozco (ed.), *Learning in the Global Era: International Perspectives on Globalization and Education*, Berkeley, CA: University of California Press.

LEWIS, A. (1954), "Economic Development with Unlimited Supplies of Labour", *Manchester School of Economic and Social Studies* 22, pp. 139-191.

LIM, C., S.-H. HAN and H. ITO (2009), "Disruptive Innovation by a Developing- Country Firm: Product Development Processes without Strong Technological Prowess in Tata Motor's Nano",

paper presented to the *7th Asialics International Conference on Global Recession and Reform of Innovation Systems in Asia*, 15-17 April, Taipei, Taiwan.
Liu, X., and S. White (2001), "Comparing Innovation Systems: a Framework and Application to China's Transitional Context", *Research Policy* 30(7), pp. 1091-1114.
Lucas, R. Jr. (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics* 22(1), pp. 3-42.
Lundvall, B.-Å. (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning,* London: Pinter.
Lundvall, B.-Å., *et al.* (2009), "Bridging Innovation System Research and Development Studies: Challenges and Research Opportunities", paper presented to the *6th Globelics International Conference,* Dakar, Senegal: 6-8 October.
Malerba, F. (2002), "Sectoral Systems of Innovation and Production", *Research Policy* 31(2), pp. 247-264.
Meadows, D. H. *et al*. (1972), *Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind,* Universe Books.
Mowery, D. and N. Rosenberg (1979), "The Influence of Market Demand upon Innovation: a Critical Review of some Empirical Studies", *Research Policy* 8, pp. 102-153.
Nelson, R. R. (1993), *National Systems of Innovation: A Comparative Analysis,* Oxford: Oxford University Press.
Noble, D. (1977), *America by Design,* New York: Knopf.
North, D. (1981), *Structure and Change in Economic History,* Norton.
North, D. (1990), *Institutions, Institutional Change and Economic Performance,* Cambridge University Press.
Nurkse, R. (1953), *Problems of Capital Formation in Underdeveloped Countries,* Oxford: Blackwell.
Oyelaran-Oyeyinka, B. (2006), "Systems of Innovation and Underdevelopment: An Institutional Perspective", *Science, Technology and Society* 11(2), p. 239.
Pavitt, K. (1985), "Technology Transfer among the Industrially-Advanced Countries: An Overview", in N. Rosenberg and C. Fristack (eds.), *International Technology Transfer: Concepts, Measures and Comparisons*. New York: Praeger.
Perez, C., and L. Soete (1988), "Catching up in Technology", in G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.), *Technical Change and Economic Theory,* London. Pinter.
Pinkovskiy, M., and X. Sala-i-Martin (2009), *Parametric Estimations of the World Distribution of Income*, NBER Working Paper 15433.
Posner, M. (1961), "International Trade and Technological Change", *Oxford Economic Papers* 13, pp. 323-341.
Prahalad, C. K. (2004), *The Fortune on the Bottom of the Pyramid: Eradicating Poverty Through Profits*, Upper Saddle River, NJ: Wharton School.
Prebisch, R. (1950). *The Economic Development of Latin America and Some of its Problems,* New York: ECLA/CEPAL.
Ramani, S., S. Sadre Ghazi and G. Duysters (2009), "Taking Innovation to the Poor: Lessons from Sanitation Activists in India", paper presented to the *VIth Globelics International Conference,* Dakar, Senegal: 6-8 October.
Quah, D. (1993), "Empirical Cross-Section Dynamics in Economic Growth", *European Economic Review* 37(2-3), pp. 426-434.
Rangan, V. K. *et al.* (2007), *Business Solutions for the Global Poor: Creating Social and Economic Value,* John Wiley & Sons, Inc.
Rodrick, D. (2007), *One Economics, Many Recipes: Globalization, Institutions, and Economic Growth,* Princeton: Princeton University Press.
Rosenstein-Rodan, P. N. (1943), "The Problems of Industrialisation of Eastern and South-Eastern Europe", *The Economic Journal*.
Rostow, W. W. (1960), *The Stages of Economic Growth,* Cambridge: Cambridge University Press.
Sala-i-Martin, X. (2006), "The World Distribution of Income: Falling Poverty and... Convergence, Period", *Quarterly Journal of Economics* 2, pp. 351-397.
Schmookler, J. (1966), *Invention and Economic Growth,* Harvard University Press.
Schumacher, E. F. (1973), *Small Is Beautiful: A Study of Economics as if People* Mattered, Vintage.
Schumpeter, J. A. (1912), *The Theory of Economic Development.* Leipzig, Duncker and Humblot, translated by R. Opie, Harvard University Press, 1934, Reprint, Oxford University Press, 1961.
Seers, D. (1969), "The Meaning of Development International", *Development Review* 11(4), pp. 3-4.
Sen, A. (1980), "Equality of What?", *The Tanner Lecture on Human Values*, vol. I, Cambridge: Cambridge University Press, pp. 197-220.
Shiva, V. (1992), *The Violence of the Green Revolution: Third World Agriculture, Ecology and Politics,* New Jersey: Zed. Books Ltd.
Shiva, V. (2000), *Stolen Harvest: The Hijacking of the Global Food Supply,* South End Press.
Singer, H. W. (1958 [1952]), "The Mechanics of Economic Development", in A. N. Agarwala and S. P. Singh (eds.), *The Economics of Underdevelopment,* London, New York: Oxford University Press, 1973.
Stewart, F. (1978), *Technology and Underdevelopment,* London: Macmillan,
Veblen, T. (1915), *Imperial Germany and the Industrial Revolution,* New York: Macmillan.
Vernon, R. (1966), "International Investment and International Trade in the Product Cycle", *Quarterly Journal of Economics* 80(2).
Viotti, E. (2002), 'National Learning Systems: A New Approach on Technological Change in Late Industrialising Economies and Evidence from the cases of Brazil and South Korea", *Technological Forecasting & Social Change* 69, pp. 653-680
Wade, R. (1990), *Governing the Market: Economic Theory and the Role of Government in East-Asian Industrialization,* Princeton: Princeton University Press.