The Importance of the Strategic Management of Technology and Innovation to APO Member Countries in the Current Asian Context and the Future

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Introduction

When Thomas Friedman's *The World is Flat* came out in 2005, it captured the minds of policy circles in Washington, D.C. Soon after, it quickly spread around the world because he so eloquently described today's globalized world as being "flat." Since then, one cannot begin the discussion of "innovation in the Asian context" without addressing the paradox of globalization. Innovation is certainly occurring globally. It is occurring in Silicon Valley, Shanghai, Bangalore, and Tel Aviv, and they are all connected. Business process outsourcing has transformed the US economy as well as places like Bangalore, India, or Dalian, China. The paradox of this global economy is that the more we witness the forces of globalization carried along by the constant introduction of new technology, especially in ITC, the more we realize that innovation is being localized in a few areas or "hot spots" around the globe. The development of the globalized "knowledge economy" is supported by local strength that nurtures the capacity for continued innovation and entrepreneurship in regional clusters.

How do the effects of globalization in the world of the knowledge economy enforce the emergence of "growth poles" or the disparities among different regions in their economic growth? Several factors highlight the importance of regional components in understanding the process of innovation such as 1) the importance of sharing tacit knowledge, 2) knowledge-based networks of industry, academia, and government, and 3) interactions between users and producers of technology. Furthermore, some recent studies have focused on the concentration of knowledge to understand why some cities are more actively innovative than others (Florida, 2002). What lies behind all of this is the emergence of global networks of knowledge and the importance of tapping into this globalized knowledge flow.

If one looks around the world today, it is self-evident that the differences in economic performance among different parts of the globe are widening. While the differences in productivity and economic wealth are growing, a few groups of economies, particularly in Asia, have narrowed the gap between the front-runners in both productivity and income. The challenge for Asia is to continue this catch-up process engaged in over the past five decades and spread it to the regions in Asia which were less fortunate than others in facing the new challenges posed by the era of global innovation.

Studies on leading regional clusters or hot spots in global innovation show how the institutions and management of innovation and their knowledge infrastructure are crucial at the initial stage of development. It is here that many Asian economies still need to concentrate their efforts by placing innovation at the heart of their economic development strategy. After the initial stage of development, factors such as global human resources or talent pools, multinational R&D activities, and financial assistance in the form of venture capital begin to play important roles in moving toward self-sustainable growth. Places like Daedeok Valley in the Republic of Korea, Zhongguancun in the People's Republic of China, Hsinchu in the Republic of China, and Bangalore in India are all facing the need to tap into the web of global innovation networks. Thus, learning how to cope with these challenges ranging from managing innovation at the firm level to the creation of local innovation networks at the policy level is an important task for Asian economies to bring their productivity high enough to

sustain their economic growth.

Innovation, Catch-Up, and Economic Growth

The development of the neoclassical growth theory supported by the introduction of new macroeconomic statistics and computing capability in the 1950s marked the beginning of the rise of interest in innovation studies (Fagerberg et al., 2005). However, the many who became interested in understanding the processes of technological progress or innovation gradually created this research area, because they all felt the limitations of the conceptual framework of the neoclassical model in capturing the sophisticated processes of learning and innovating or technological progress (Nelson and Winter, 1982). To distinguish the development of the standard economic growth theory from Solow to Romer, this group of scholars has often been referred to as "the Schumpeterian school" or "evolutionary economists." While the growing interest in innovation is a more recent phenomenon, many scholars took up the issues of productivity and income growth throughout the history of capitalism in the wake of the Industrial Revolution. Adam Smith and Alfred Marshal were among the leading scholars who grappled with questions of productivity and income growth. In particular, the long-term trend in the divergence of productivity and income growth across different economies has been one of the important questions for many social scientists.

As Fagerberg and Godinho acknowledged, there are two main related but distinctive research trends associated with the question of productivity growth. One is the idea of convergence; the other is catch-up. Fagerberg and Godinho made the following distinction: "'Catch-up' relates to the ability of a single country to narrow the gap in productivity and income vis-à-vis a leader country, while 'convergence' refers to a trend towards a reduction of the overall differences in productivity and income in the world as a whole" (Fagerberg, Nelson, and Mowery, 2005). Thus, the question that Asian economies need to address is why only some countries were able to narrow the gap with the front-runners while others fell behind. This is essentially the catch-up problem.

Earlier writers on catch-up tried to show how Germany was successful in catching up with the UK in the period prior to WWI. The works of Thorstein Veblen and Friederich List were among the first to point out the importance of institutions in the process of catch-up. Since then, there have been a number of studies with the central research focus on understanding the processes and institutions involved in technological progress. Consequently, given the present environment of the globalization of innovation, understanding the processes and institutions involved in catch-up should be an important question for the economic studies of development. Furthermore, much of today's policy debates in this area clearly depends on how well we understand the experiences of Germany, the USA, and then Japan, the Republic of Korea, and the Republic of China in successfully catching up with the technological and economic leaders of their time, then carefully reflecting on what is different about the present conditions for the People's Republic of China, India, and others to follow.

Catch-up requires gaining access to and mastering of the technologies and forms of economic and social organization used by the leading economies of that time. Thus, the acutual mechanisms of learning advanced technology need to be explored. However,

one needs to take a broader view of what technologies are, defining the term covering the wide range of techniques that have been developed over the years, from sophisticated product designs, to procedures used in productive agriculture, to effective public health practices, to air traffic control systems, and to alternative energy supply systems. Consequently, in the process of catching up, many different kinds of capabilities must be acquired; hence, their acquisition may take different paths for each case of technological progress.

In many instances, it is not easy to learn what others already have done. Moreover, while the term “catching up” seems to mean more or less exact copying of the practices of the more technologically advanced economies, and efforts to develop often involve attempts in deliberate copying, what is achieved often diverges in a number of ways from those practices in the countries serving as the model. On the one hand, this divergence reflects that imitating the model perfectly is almost impossible, and that attempts to replicate at best barely come close in reality. On the other hand, it shows deliberate and often creative modifications to make those practices more adaptive to the local environment. The organizational, managerial, and institutional aspects of innovative practices often are the most difficult to replicate or reproduce for catching-up economies (Sunami, 2001).

Moses Abramowitz has been one of the key scholars eloquently illustrating how institutions determine successful catch-up level variables that are too aggregated to permit analysis of many of the relevant factors(Abramowitz, 1989). Following his work, there have been a few recent empirical studies showing how countries that are rapidly catching up have focused on the development of their higher education systems for engineering training and have developed indigenous research capabilities through these institutions. Furthermore, several studies examined firms in developing countries which have successfully caught up in specific industries. However, almost all of those studies concentrated on manufacturing, and few were concerned with agriculture or service industries. Successful economic development requires learning from abroad and modifying to adapt what is learned to the distinctively unique environment. Studies on the ways developing countries learn to improve their systems of public health and medical care and on how competence in resource and environmental management is acquired are becoming an important part of innovation research.

Looking Back at History

A careful review of the historical studies on catch-up tell us that, in the past, there were several common elements in all successful examples. First, a considerable international or cross-border flow of human talent, with a combination of not the usual brain drain but “brain circulation” between the country that is catching up and the front-runners and the technical advisors bringing know-how from the advanced economies to the followers in the process of technology diffusion (Saxenian, 2006). Thus, for instance, British textile manufacturing know-how was brought over to the new continent that would become the USA by British technicians. Sidney Pollard illustrated the flow of the British to northern Europe in the early 19th century, who came with the objective of setting up businesses on the new continent (Pollard, 1981). The development of Japanese industry in the late 19th and early 20th centuries, as well as the post-WWII

catch-up period, was helped by technical advisors from abroad, as well as by Japanese returned after studying in the West. The Korean and Taiwanese electronics industries were developed largely by students who had studied and often worked in the USA.

During the 20th century, firms came to play an increasing role in this learning and teaching process. The new Japanese automobile and electrical equipment firms established close interactions with their counterparts in the USA and Europe, which served in essence as their technical advisors. How Korean and Taiwanese firms developed their competence through working for US and Japanese electronics companies as original equipment manufacturers is well documented by a number of studies. Moreover, the different roles of multinational corporations and their overseas factories and R&D centers in the host countries catching up through technology diffusion have been one of the key topics of recent innovation studies.

Over the last quarter-century, an important part of the transnational mobility of human resources in the catch-up process has involved university students studying abroad in the relevant fields of engineering and applied science. University faculty in the successful developing countries have been based to a considerable degree on scholars who received their education abroad. While this development has been quite visible in recent years, one should be reminded that until WWII, a good fraction of the Americans taking advanced training in chemistry and various subfields of physics received their training in Europe. This transnational learning through the system of higher education played a significant role during the 20th century for the countries who were catching up. One can suspect that this university-based transnational learning will also play a major role for developing countries trying to improve their capabilities in resource management, and hence overall innovation management.

The next important aspect of countries that successfully caught up with the leaders during the 19th and 20th centuries was active government support for the catch-up process, involving various forms of protection and direct and indirect subsidies. The argument behind this policy debate has been the need of domestic firms for protection from advanced foreign competitors in the industries considered critical for the development. Alexander Hamilton’s argument for infant industry protection in the early development phase of the USA was very similar to that put forth by Friederich List regarding Germany. The policies and institutions needed in continental Europe to enable catch-up with the UK are documented in Gershenkron’s *Economic Backwardness in Historical Perspective* (1966). The same story also applies well to the case of Japan, and of the Republic of Korea and Republic of China. In many countries, such policies engendered not successful catch-up but a protected inefficient home industry. Furthermore, those policies obviously were problematic for firms and governments in the developed economies, especially when the supported industry began to penetrate the world market. While the case made after WWII for free trade was mostly concerned with eliminating protection and subsidies among the rich economies, increasingly international treaties have been used against import protection and subsidies in countries trying to catch up from far behind.

Finally, during the 19th and early 20th centuries, many developing countries operated

with intellectual property rights regimes that did not seriously limit the ability of their firms to imitate technologies used in advanced countries. Like infant industry protection and subsidies, conflicts emerged when the firm that is catching up began to penetrate into world markets or even the home market of the rival firms holding the original patent rights. This is one of the major factors in bring about the international regime based on the treaty on Trade-Related Intellectual Property Rights. Strict enforcement of intellectual property rights by major advanced economies is affecting agricultural development and the public health systems in developing countries, as well as manufacturing development. Patented seed varieties play an increasingly important role in modern agriculture. Also, patented pharmaceuticals are crucial in the treatment of a number of diseases that devastate poor countries.

From "Japan Inc." to "The Asian Miracle"

Gershenkron (1966) illustrated that the role of the state, and hence both policies and institutions, was a crucial determining factor in Germany's success in catching up with the UK during the mid- and late 19th century. His claim has become the pillar of today's developmental state argument. However, other than those basically inclined to the study of economic history, few development economists have paid attention to the processes of catch-up per se, in large part because prevailing economic growth theory has seen the principal reason for low productivity and incomes as low levels of physical and human capital, as contrasted with inadequate access to or command over technologies and other practices used in high-income countries. Moreover, imitation of technologies and practices that are in use in advanced countries generally has been viewed as relatively easy, if the needed physical and human capital is available and there are no barriers such as intellectual property rights.

Japan has gone through many phases of catch-up. However, it was after the Meiji Restoration of 1868 that real efforts began to catch up with the West. There were two major catch-up periods: pre-WWII and post-WWII. It is the experience of postwar Japan which sparked many scholars of technological progress and catch-up to look into the role of institutions, government policy, and organizational structures, particularly in manufacturing, in Japan's success in taking over the lead in many key industries such as electronics and automobiles from the West. It is no coincidence that in the 1980s the effort to uncover the secret of Japan's success in catching up with the West in technology led to the birth of the study of what is referred to as national innovation systems today (Freeman, 1987). After the success of Japan, the Republic of Korea, and Republic of China, other "Asian Tigers" were considered to follow Japan by many. The notion of the "developmental state" has become the center of the debate in understanding "the Asian Miracle," such as in the study by the World Bank. Now, the newly emerging economies are the People's Republic of China and India.

Toward the Theory of Growth of the Firm

To understand the processes of innovation and catch-up, the capabilities in acquiring technological know-how involve significantly more than what scientists and engineers generally mean when they think about technology. While important aspects of these activities are structured or embodied in machinery or other physical artifacts, they also involve the modes of organizing, coordinating, and managing activities. In many

instances, these latter capabilities are much more difficult to acquire and develop than the formal knowledge of engineering know-how.

Technologies are operated through organizations; thus, learning to master the organizational structures and the modes of management that are necessary for technological advance is an essential part of the catch-up process as well. In turn, firms and other organizations are dependent upon a nation's knowledge infrastructure such as education and training systems, labor and capital markets, competition and regulatory policies, resource and environmental management, and the ability of the government to provide a context for rapid sustainable economic development. Thus, building an institutional structure that is capable of facilitating catch-up may be the most difficult part of economic development. Successfully managing innovation is clearly one of the most important aspects for the countries catching up and firms that are trying to grow in those economies. However, it is only recently that the concept of the management of technology, primarily developed in the USA, has been introduced in Japan and the rest of Asia following the decade-long recession in the 1990s in Japan and the Asian financial crisis. Those who saw the value in the management of technology considered it to be a way to rebuild the Japanese manufacturing industry.

New Conditions for Future Prospects

The new global environment surrounding Asian economies today is very complex. Globalization and the rise of Brazil, Russia, India, and the People's Republic of China are partly based on a system heavily dependent on national systems of innovation based on natural resource endowments. The rising energy costs propelled by increasing demand for economic growth are a source of investment for innovation. Globalized venture capitalists are searching for new investment opportunities all over the world. The source of investment funds is spread over and interconnected throughout the world financial centers. Thus, it is very clear that the current and future development environment for countries trying to catch up is significantly different from what it has been. Various international regimes have changed the environment for catch-up in significant ways. Large corporations in advanced economies will press hard for access to markets and for operations all over the world. Therefore firms and governments in developing countries must develop new strategies to compete and survive in the global economy.

The new regulatory regimes have been put into place in a context in which both business and finance are operating on a more global scale. Foreign direct investment and globalized R&D have played a significant role in the catch-up processes of some successful countries and are likely to play an even greater role in the future. Technological alliances between firms in developing countries and their counterparts in developed countries that possess advanced know-how will also be a factor which cannot be ignored. Once again, managing innovation with a strategy matching the leading multinationals is absolutely crucial for any growing firm in the economies currently catching up.

Arguably, the scientific and technical communities in different economies also are now more connected than they used to be as leading technologies have increasingly become

associated with fields of applied science or engineering from traditional fields of chemical and electrical engineering to modern fields of computer science, and biotechnology. In technologies that require a strong scientific base, advanced training in the field has become a prerequisite for the ability to acquire necessary know-how.

Succeeding in catch-up in the future likely will involve firms and sectors doing their own R&D to build up their capabilities earlier in the catch-up process than was typical in past cases of catch-up. This process in many instances will involve partnerships with foreign firms and foreign direct investment. The building of R&D capabilities in firms will require that the higher education system is capable of providing an adequate number of trained scientists and engineers. Thus, the role of universities and research institutions is a very important starting point for the catch-up story for many firms in developing economies. To be able to tap into and fully utilize the local knowledge infrastructure is certainly the necessary initial step to succeed in managing innovation strategically. Engaging in the strategic management of innovation for growing firms trying to catch up is a very complex but unavoidable path for the development of Asian economies today.

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