Economic Development as a Catch-up Process: What is Different About the Current Environment

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Modern development economics emerged as a field of research, concerned with the questions of why so many countries were desperately poor, and what could be done to lift their levels of productivity and living standards, just after World War II. The center of attention then was on the low levels of physical capital in poor countries. The road to development was seen as involving a combination of foreign aid to provide needed capital, and domestic policies that would get up investment rates. Of course it was recognized that the technologies, the economic practices more generally, in advanced countries were significantly more productive than those employed in the less developed countries. However, this was viewed as largely the consequence of the differences in capital, and the belief was that if the appropriate investments were made, the adoption of more productive ways of doing things would be relatively easy, particularly if there were some technical assistance.

Today, I think many economists studying economic development would say that this mode of analysis put the cart before the horse. Learning to master modern technologies and the organizational and institutional structures that make these productive is the hard part of development. While economic development certainly requires massive investments in new capital, these investments need to be seen as necessary, but not sufficient, to enable this transformation to take place, as a hand maiden as it were to the process of learning and catching up.

The term “catching up” in my view does serve to focus analytic attention where it should be focused. However, the term can be seen as connoting that the catching up country simply copies, and this is misleading. While practice in advanced countries does usually serve as a model, what is achieved inevitably differs in certain ways from the template. In part this reflects that exact copying is almost impossible, and attempts to replicate at best get viably close. In part it reflects deliberate and often creative modifications aimed to tailor practice to national conditions.

The central argument I want to make in this talk is that today, in the twenty first century, in order to catch up a country needs to develop considerable indigenous strength in the relevant fields of science and technology. To make this argument I need to discuss some aspects of the catch-up processes of countries that, in the past, were successful at it, and then some things that are different about the current world environment that increase the need for indigenous technological capabilities.

First of all, successful cases of catch-up have involved considerable cross-border flow of people, with a combination of citizens in the then backward country going to learn abroad and then returning, and people from the advanced country coming as advisors or, in some cases, to establish themselves in the developing country. Thus the core of British textile manufacturing methods was brought over to the new United States by British technicians, who stayed. The development of Japanese industry in the late 19th and early 20th century was helped by technical advisors from abroad, as well as by Japanese returning home after studying Western methods. The Korean and Taiwanese electronics industries were developed largely by men who had studied, and often worked, in the United States.

During the twentieth century companies came to play an increasing role in this cross national learning and teaching process. The new Japanese automobile and electrical equipment companies established close interactions with companies in the United States and Europe that served as their mentors. The development of Singapore was largely driven through the establishment of branch operations by Western multinationals. Korean and Taiwanese companies developed their increasing competence working for American and Japanese electronics companies as Original Equipment Manufacturers.

Over the last quarter century an important part of the transnational flow of people in the catch up process has involved university study abroad in the relevant fields of engineering and applied science. University faculty in the successful developing countries has to a considerable degree been based on nationals who received their training abroad.

A second important characteristic of the nations that have been successful in catching up is that they had or relatively quickly developed educational systems that were capable of teaching the young generation what they needed to know in order to be effective working in the new enterprises, and the young generation eagerly went for that education. In the experiences of successful catch-up during the twentieth century, investments in education in these catching up countries created not only nearly universal primary and secondary education, but also a significant cadre of highly trained scientists and engineers. The argument that I will develop shortly, of course, is that such higher level training is now even more important than used to be the case.

A third important element in countries that successfully caught up with the leaders during the 19th and 20th centuries was active government support of the catch up process, involving various forms of protection and direct and indirect subsidy. The guiding policy argument has been the need of domestic industry for some protection from advanced firms in the leading nations. Alexander Hamilton's argument for infant industry protection in the new United States was virtually identical to that put forth decades later by Friederich List regarding Germany's needs. The same story also fits well with the case of Japan, and of Korea and Taiwan somewhat later. In many countries these policies engendered not successful catch up but a protected inefficient home industry. However, they also were the hallmark during the 20th century of all the countries that have achieved their goals of catching up.

Fourth, during the 19th and early 20th century, many developing countries operated with intellectual property rights regimes which did not restrict seriously the ability of their companies to in effect copy technologies used in the advanced countries. There are many examples where licensing agreements were involved, but for the most part these were vehicles through which

technology transfer was effected for a fee or other considerations, rather than instances of aggressive protection of intellectual property by the company in the advanced country.

It is obvious that, both with respect to admissible national policies of infant industry protection, and regarding ability of firms in developing countries to ignore intellectual property rights. As a result, the current and future development environment for countries trying to catch up is different from what it has been, in a number of respects. International treaties, particularly the WTO and TRIPS, have changed the environment for catch up in important ways. Firms in the advanced countries are likely to press hard for access to markets and in many cases the rights to establish branches abroad. Protection and subsidy of domestic industry is likely to be met by legal and other punitive action on the part of the advanced countries, and hence will have to be more subtle, involving support of sectoral infrastructure, training, and research. Firms in advanced countries also are likely to be far more aggressive in protecting their intellectual property rights, and hence firms and governments in developing countries will have to develop new strategies for access on reasonable terms.

The new legal environment has come into place in a context where both business and finance are operating on a more global frame.

Less well noticed, scientific and technical communities in different countries also are now more connected than they used to be. This has come about at the same time that there have been major increases in the power of many fields of applications oriented science, dedicated to achieving understanding of the principles that are operative in an area of practice, so as to provide a base for rigorous training of new professionals who will work in that field, and a scientific basis for efforts to move the technology forward. Included here are such older fields as chemical and electrical engineering, and modern fields such as computer science and biotechnology. In recent years these fields of science have become increasingly open to those who have the training and connections to get into the relevant networks.

The implications for catch up can be profound. On the one hand, in technologies with strong scientific underpinnings, advanced training in the field has become a prerequisite for ability to

understand and control; simple working experience no longer will suffice. This fact clearly challenges the capabilities for education and technical training in countries seeking to catch up, even if studying abroad can provide at least a temporary solution to the need for acquiring advanced knowledge in relevant fields. On the other hand, a strong science base significantly reduces the importance of operating apprenticeship abroad, or tutelage by foreign industrial experts. This is not to argue that advanced formal training in a field suffices for mastery. However, in many fields it provides a substantial basis for learning by doing. Moreover, having a domestic base of good scientists provides the basis for breaking into the international networks where new technologies are being hatched.

I obviously have begun to develop my central message, which is that, as a result of these changes, the development of indigenous capabilities in advanced training and research now are likely to be much more important in enabling catch-up than used to be the case, and their importance will grow.

I personally am very interested in the roles of research at universities and public laboratories in the catch-up process. However, the roles of such research needs to be understood in terms of their operation within a broader National Innovation System. While, the modern conception of a National Innovation System was developed to be useful in thinking about the key institutions involved in technological advance in countries at or close to the frontier, I propose that a suitably reoriented concept of a National Innovation System can be a useful tool for considering policies and institutions needed for effective catch-up in the new context.

In the first place, it calls attention to the fact that the process of catch up involves innovation in an essential way. The innovating that drives the process of course differs from the innovating that has been the central focus of research on technological advance in advanced economies. The new technologies, practices more generally, that are being taken on board, while new to the country catching up, generally are well established in countries at the frontier. And much of the innovation that is required is organizational and institutional. But what is going on in catch up most certainly is innovation in the sense that there is a break from past familiar practice, considerable uncertainty about how to make the new practice work effectively, a need for

sophisticated learning by doing and using, and a high risk of failure, as well as a major potential payoff from success. These aspects of catch up tend to be denied or repressed in the standard economic development literature.

Second, the Innovation System concept focuses attention on the range of institutions that are involved in the process of innovation. In most industries the roles of business firms is central. However, there has been a tendency of many economists writing about innovation to write as if firms are the full story, neglecting other kinds of institutions that are involved in the processes that support and mold innovation. This is a mistake in advanced countries. It is equally a mistake in thinking about the role of research organizations in countries catching up to those at the frontier, where public research can play a critical role.

In the first place, indigenous universities and public laboratories will play an increasingly important role as vehicles through which the technologies and organizational forms of the advanced countries come to be mastered in the developing ones. They will do so partially as an organizing structure for and partially a substitute for international people flows. Indigenous universities will play a key role as the source of students who take advanced training abroad, and as the home of faculty who have been trained abroad. And it is clear that domestic universities must do the bulk of the training of people who will go to industry and other economic activities needing well trained technical people.

While often overlooked, indigenous research at universities and other public institutions long has been an important element of catch-up in certain important fields for which knowledge originating from abroad was ill suited to national needs. This is especially so in agriculture and medicine. An important part of the reason is that in these areas developing countries often could not simply copy technology and practice in countries at the frontier, but needed to develop technologies suited to their own conditions. Soil and climate conditions tended to be different. The prevalent diseases were different. There is every reason to believe that the importance of having the capability to do effective research and development in these fields will be even greater in the future.

In contrast, while in manufacturing the technologies used in advanced countries may not have been optimal, at least they worked in the new setting with often modest modification, and they generally were available at no great expense. The experience of countries that have successfully caught up in manufacturing over the past half century testifies to the importance of a nation's education system in providing a supply of trained engineers and applied scientists to manufacturing firms catching up. And an important part of the catch up process has involved firms learning to do R and D on their own. However, while there are exceptions (electronics in Taiwan and Korea and aircraft in Brazil are examples), for the most part research per se in universities and national labs has not in the past played an important role in catch up in manufacturing, beyond its role in the training function.

But circumstances have changed. In the new regime of stronger protection of intellectual property, it is going to be increasingly important that countries trying to catch up develop their capabilities to revise and tailor manufacturing technologies relatively early in the game. First of all, this can help companies to develop and employ technologies that avoid direct infringement of intellectual property that is likely to be enforced aggressively. Second, tailoring the technology tofit local conditions can be economically very productive. But more generally, achieving competence in many areas of manufacturing requires staying up with a moving target. Further, as the frontier is approached, the lines between sophisticated imitation and creative design of new products and processes becomes blurry. A strong R and D capability becomes essential. To a considerable extent the R and D needs to go on in firms. However research in universities and public laboratories can play a strong supporting role.

While there has been extensive study of the roles played by indigenous public agricultural research in economic development, there has been little systematic study of the roles played by public research and universities and public laboratories in catch-up in industry. I have been beginning to study a number of interesting cases, working with Roberto Mazzoleni of Hofstra University. We have studied the roles of public research in industrial development in Japan in the late 19th and early 20th century, its roles in the development later in the 20th century of strong industrial capabilities in electronics in Korea and Taiwan, the very interesting case of the development of an aircraft industry in Brazil, and a few other instances. We think we have

learned something from these cases about the kinds of roles public research can play in industrial development, and the nature of programs and organizations that are effective in those roles.

Most of the effective programs that we have looked at were oriented to an actual or potential user community. They were designed to solve problems, and to advanced technology relevant to a particular economic sector. They most emphatically did not operate as "ivory towers" but rather had strong linkages with the user community. Those working in the programs were well informed about prevailing practice in the fields with which they were concerned, and the problems and constraints of practitioners. The programs were responsive to those problems. And there were a variety of mechanisms through which what was learned and developed in research was effectively disseminated to the user community.

I would like to propose that a program of public research can only be effective in a context where the user community has strong incentives to improve their practices, and the capability to evaluate and use what is coming out of the research program. It is interesting and relevant, I think, that in the successful cases we have studied, public research was part of a broader set of programs aimed to improve performance in the sector that included, as well, education and training for people going out to become members or the user community. In any case, even the best designed program of public research is not going to be effective unless it feeds into a user community that is strongly inclined to be innovative, and has the capabilities to be so.

I want to close by briefly summarizing the key points I want to leave you with. The process of economic development is basically one of catching up. That process involves innovation, doing things that are new in the context and highly risky. To be successful in the process today requires a considerable degree of technical sophistication. Universities and public laboratories are playing an increasing role in helping to create that sophistication. But that role needs to be understood as a support and complement to the firms and entrepreneurs that will (or won't) be doing the actual innovating.

These points are much less well recognized in traditional development economics than they should be.