# APPENDIX F
## Technology Transfer

The inclusion of knowledge in the economic growth literature was articulated by Kenneth Arrow, as a "good that once created, can spill over to others at zero marginal cost". The process of spillover is the source of increasing returns that in turn, generates economic growth (Arrow 1962). Arrow's zero-cost spillover effects of knowledge has been contested by the fact that technological knowledge cannot be transmitted easily to others. In fact, some of the costs include the quantification of the learning process carried out through imitation and apprenticeship.

Development literature has recognized that in addition to benefiting from the technology created by technological leaders, technological followers also suffer the consequences of being forced to play "catch up" (Radosevic 1999). This is specially true in the era of the information revolution which creates new questions on the capacity of developing countries for assimilating new information and communication technologies (Antonelli 1991). Since these technologies are decreasing in cost, and are increasingly easy to master, they can be a powerful tools for solving development problems. Some countries have already seized the opportunity to leapfrog IT stages by going straight from underdeveloped networks to fully digitized networks, bypassing traditional analog technology. Others have used new broadband wireless technologies which can be implemented and maintained more easily than traditional infrastructures at a fraction of the cost. New communications and wireless technologies are being applied to pressing development issues like using real-time telemedicine applications over live Internet videoconferencing channels (Aspen Institute 1999). This line of reasoning suggests that it is possible to leapfrog investment in information technology infrastructure in a way that was not possible with other industrial technologies (Kelly and Petrazzinni 1997). This view is supported by the advantages created by mobiles phones, which are gaining rapid penetration in developing countries that in turn, may produce a leap ahead of developed countries into an advanced wireless environment, where the majority of calls and transactions will be made on mobiles (Kibati and Krairit 1999) For example, over a third of all telephone subscribers in countries such as Cote d'Ivoire, Cambodia and Paraguay are now connected via mobiles, a far higher proportion than in the United States (ITU 1999).

The mechanism which underlies this process can be described as *technology transfer*. Technology transfer enables the recipient country to produce something that it could not produce earlier, or to produce something in a novel way, or more cheaply (Arora 1991). Technology is transferred from countries that are technological leaders to countries that are technological followers in two ways: 1) through the acquisition of imported technology, and 2) through the transfer of knowledge for the local generation of new technology. A follower's technological capabilities are critical for both types of transfer, but in different ways. Successful technology transfer requires that the recipient country learn about the leaders' technology, choose the best practices for its own

particular purposes, and institute appropriate policies for their implementation. The policies required for technology transfer are not different from those required for achieving economic efficiency. They usually involve investments in education, infrastructure, and organizational capacity. Technology transfer also offers the possibility of reducing dependence by allowing the technology recipient to increase its technological capability. However, technology is not simply a set of discrete techniques described by a "blueprint"; technology is most fundamentally, *knowledge about how to do* things. It is a social process socially and institutionally embedded, created and adopted (or not) by human agency: individuals, organizations and societies (Dicken 1998).

Acquisition of imported technology for technology transfer among countries also includes considerations of patent and copyrights, i.e. considerations of Intellectual Property Rights (IPR). We understand intellectual property as a creation of human intellectual activity with a recognized legal right to protection. The number of patents applications filed within a country is the number of documents issued by a government office that describe an invention and create a legal situation by which the patent invention can normally be exploited (made, used, sold, imported) only by, or with the authorization of the patentee. Launched by the World Trade Organization (WTO) in 1986 and concluded in 1994, the Uruguay Round of Multilateral Trade Negotiations dealt with the areas of investment, intellectual property rights, and services for its member countries. The technology transfer and development issues for developing countries arising from the round included a "profound impact on the acquisition of foreign technology and development of indigenous technological capabilities by developing countries" (UNIDO 1996). The Uruguay Round produced a more stringent standard of protection of patents designed to strengthen the patent protection systems uniformly around the world. As stated by UNIDO "a strong patent protection seems to exist in those countries which are technologically the most advanced" (UNIDO 1996). The underlying assumption is that the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation, and to the transfer and dissemination of technology, that in turn will be conducive to economic and social welfare, in other words, development. However, many of today's developed countries had loose rules when they were setting up their national industries, becoming stronger advocates of tighter intellectual property rights after they became technology exporters. At an empirical level there seems to be no conclusive results regarding these arguments. It is not clear whether the absence in a country of an internationally accepted intellectual property rights (IPR) system increases its access to existing technology (Radosevic 1999). Regardless of the discussion on the IPR protection system, there is evidence that cumulative patent stocks are appropriate proxy measures for innovation (Andersen 1999). This is consistent with the notion of technological accumulation. Technological change is a cumulative, incremental, and path-dependent process (Rosenberg 1982). Post-Schumpeterian studies extend this concept even further, by suggesting that patent data are proxies for technological opportunity and socio-economic capability (Andersen 1999; Andersen 1994).

Software copyright issues were also covered by the Uruguay round provisions requiring computer programs and databases to be protected as literary works. Since

patent protection under the agreement extends to all fields of technology, it is also open to any member country to grant patents as well as copyright to computer programs.

Finally, completing the virtuous cycle, higher levels of intellectual capital should produce increases in the percentage of a country's high technology exports, or products with high R&D intensity. According to OECD methodology, high technology exports are exports with high technical coefficients for input-output matrices (OECD 1993). High technology industries are those engaged in the production of products in: aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. All these high technology industry exports rely heavily on IT. Higher percentages of high technology exports would in theory, generate economic growth thus allowing faster progress in development.

However, relations of dependency between countries in the core and the periphery are explained by intellectual property dependency. (Antonelli 1991; Antonelli 1999; Aréchiga 1988; Arora 1991; Baranson 1981; David 1993; Jackson 1989; Jackson 1990; Meissner 1988; Miller 1986; Morita-Lou 1984; Poats 1972; Radosevic 1999; UNIDO 1996) Intellectual property dependency states that even if countries were to carry out technology transfer processes to access, adapt and create new knowledge, patent protection of knowledge generated in core countries will perpetuate dependency levels in periphery countries. Higher dependency intellectual property rates would explain why there has not been the expected increase in development in spite of all the other social, economic and political factors designed foster increases in development. This would be another aspect of the unequal relations among countries in the core and the periphery. Indeed, the protection of patents is a phenomenon exclusive of the developed world. In 1995 more than 96% of the patents registered in the EU and the US were registered to residents of developed countries.

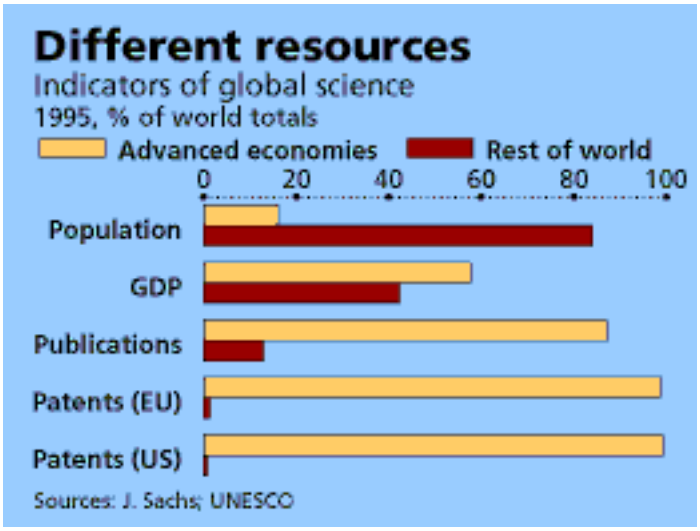


Figure F.1. Different resources (population, GDP, publications, patenst) in 1995. Source: (Sachs 2000)

Despite these trends, technology transfer processes relevant to the use and adoption of information technologies in the developing world have traditionally included the acquisition of imported information technologies and protection to intellectual property rights (Stewart 1985). In sum, the transfer of knowledge for the local generation of new technologies to bridge the global digital divide are issues to consider for the design of development policies that use information and communication technologies in the developing world.