

An approach to the question of technological transfer from developed economies to emerging economies

The clear need for emerging economies to obtain new technologies enabling them to increase the yield obtained from their resources is an essential part of the search for an adequate development strategy. Nevertheless, to ensure that this development can be sustained over time, other factors need to be present in addition to the simple transfer of a technology from one place on the planet to another.

Numerous Latin American researchers in the social sciences (Caponi and Díaz, 1999; Busso, 1997) have maintained that the path emerging economies should follow in the quest for development is not necessarily the same one as that which was followed by today's advanced economies as they developed. It does not seem to be essential to take a mimetic approach in the field of technology and production in order to achieve a more prosperous economy.

However, it seems to be clear that there are a number of key factors in these models of development that should be reproduced, among which is knowing how to exploit the opportunities that arise and above all, recognizing a country's limitations. The level of research and development (R&D) expenditure that developed countries can afford gives them a clear advantage in the technology field. It therefore seems sensible for emerging countries, which have a more limited investment capacity, to exploit these advances with the least possible expenditure.

The technological innovation system in Latin America underwent a profound change in the nineties. Greater openness, deregulation, privatization of certain productive activities, led many state-owned companies that had set up major R&D and engineering departments during the preceding import-substitution phase in the fifties and sixties to reduce the scale of these operations after privatization (Katz, 1999). This process has led Latin American economies towards a development model that is less intensive in national R&D and is more dependent on technology "packages" from abroad.

Nevertheless, in the case of public and private companies, this technology transfer from abroad often comes up against a somewhat unfavourable environment. Among the key factors identified in various studies (Steenhuis and Bruijn, 2001; Guerin, 2001) as being able to facilitate or hinder the appropriate adoption of technologies by emerging economies, the following stand out: the availability of domestic financial resources; the degree of skills and training of the workforce; import regulations; the quality and quantity of local supplies of inputs; the delivery times of the inputs; basic infrastructure; working conditions; cultural attitudes, etc. Unfortunately, in many emerging economies the behaviour of these factors tends to limit rather than promote technological innovation.

The inefficiency of the technology transfer process is also often driven by the system of property rights over technologies, which are frequently in the hands of private companies, beyond the control of governmental or international bodies. It is difficult for such companies to share their technology unless they receive adequate financial compensation, and this price is often high for the recipient.

For this reason, in order to accelerate the process of technology transfer from its owners –mainly companies in advanced countries– to those requiring it –companies in emerging countries– the need arises to improve the current mechanisms of international trade in order to provide incentives to the private sector to take part in this transfer process. It is therefore essential to find new and flexible mechanisms of trade which make it possible to improve this flow, in which technology transfer should be seen as an important mechanism for economic globalization and international investment, and not simply from the static viewpoint of official aid to poor countries from rich ones (Forsyth, 1997)¹.

However, this defence of technological globalization should not be understood as a proposal to abolish national policies on technology, nor should it seek – in the words of Howells and Michie, 1997– to erect protectionist barriers around the base technology in each country. Instead, it demonstrates the need for sensitive policies which seek a compromise between national technological capabilities and those from abroad. The transfer of a new technology to a developing economy must therefore include an element of capacity to create technology in the recipient country, if it is to be successful (Platt and Wilson, 1999, page 396).

Moreover, the urgent need for new technologies felt by emerging economies should not lead one to think that the only valid technology is that being sold by developed countries. It is necessary to maintain and develop local technological innovation as far as possible, as it can often respond better to the reality of emerging economies. According to Da Silveira (2001, page 771), R&D in developing economies should not necessarily be based on the experience of advanced economies, rather it should be formulated taking their own contexts and specific needs into account.

Nor does it seem correct to think that the only relevant technology is that which forms part of those technologies considered to be in the vanguard or latest generation, as many such technologies are simply out of reach and cannot be implemented on an efficient scale in emerging economies. For instance, the unsuccessful attempt to transfer fermentation technologies used in the agrifoods industry to emerging economies offers a clear example of how transferring technologies for small scale installations can be much more successful than larger-scale initiatives, which are not suited to the reality, scale and needs of markets and producers in developing economies (Rolle and Satin, 2001).

Technology transfer from the environmental perspective

Technology transfer in the environmental field has sparked off one of the most intense debates between developed and less developed countries in recent years. We can find examples of the disagreements that have arisen in the negotiations that have taken place on climate change. Despite the commitment and conviction regarding the need to

transfer environmentally-friendly technology from developed countries to less developed ones, the view of many observers is that the negotiations taking place at the United Nations Climate Change Convention and Agenda 21 have not lived up to expectations (WWF, 1997; CEPAL, 2001).

The transfer of clean technologies to emerging economies can provide vital support to the overall goals of reducing greenhouse gases (Ramanathan, 2002; Forsyth, 1997). Indeed, this issue occupies a prominent place in the United Nations Framework Convention on Climate Change (UNFCCC, 1998). However, past experience indicates that, in order to be successful, the transferred technologies must consider a series of factors (Parikh and Kathuria, 1997; Sathaye and Ravindranatah, 1998; UNESCAP, 1997; TERI, 1997), namely: (i) the type of needs of a developing economy and the degree to which the process of technology transfer is in harmony with the country's other development goals; (ii) the requirement for appropriate technologies able to meet these needs; (iii) the availability of the expertise necessary to ensure the transfer is effective; (iv) the factors related to the adoption, assimilation and adaptation of the imported technology.

The United States, one of the largest exporters of technology, maintains that technology transfer to less-developed countries is a lengthy process which cannot be expected to give short-term results. For this purpose, the US Agency for International Development, in collaboration with the United Nations Development Programme and the US Department of Commerce, have set up an *Environmental Technologies Network for the Americas* (ETNA2), the mission of which is to promote trade in environmentally sustainable technologies and to publicize investment opportunities in Latin America both among US and Latin American companies (Williams, 1996). To date, however, its success in protecting the environment has been limited and often debatable.

Experience has shown that often the technology transferred and used by transnational companies in emerging economies has caused significant negative externalities for the environment in the host countries. Impacts of this kind have occurred in a diverse range of areas of production, ranging from agriculture –pest control, cattle feed, weedkillers, etc.– to the high profile disasters caused by oil companies in the seventies in Latin American oil-producing countries such as Ecuador, Colombia, and Venezuela². Obviously, this is not to say that all technology transferred or used by companies from advanced countries in emerging economies has had negative consequences for the environment in the latter.

On this point, authors such as Kiuchi and Shireman (2002), Lovins et al. (1999) or Starik (1995), postulate that it is precisely the transnational companies that are best suited to the role of pioneers in defence of the environment, given the pressure upon them to safeguard their “reputation” in a globalized world. Although it may be debatable whether this factor is given more weight in the decisions of private companies than the undiluted quest for profit, it is nonetheless the case that the need to conduct their business in a sustainable way is increasingly apparent to such companies. This is not only because they want to maintain their image or reputation in society, but also for economic reasons –reduced waste and costs– and the existence of ever stricter environmental legislation. Thus, the need to think in terms of sustainability, beyond being a fad or a publicity stunt to obtain new market segments, is becoming an imperative for transnational companies (Allen et al., 2002).

However, the focus of this paper is not on whether the current path taken by technology transfer is the most appropriate one or the one best suited to the interests of Latin American countries. Nor do we seek to analyse in depth the implications of technological globalization on these countries, a subject which has been addressed by authors such as Howells and Michie (1997), and Dunning (1998).

This paper aims to draw attention to an aspect of technology transfer that can shape its potential benefits in terms of the sustainable development of the economies receiving it. It is necessary to bear in mind that some technologies with a consolidated role in the production systems of developed countries are not necessarily optimal in environmental terms. The phenomenon of technology lock-in can make it difficult to give up a dominant technology, despite its demonstrated inferiority compared with other available alternative technologies.

Problems in the diffusion of environmentally sustainable technologies

It would seem to be clear that in order to achieve greater environmental quality without limiting productive activity, an effort needs to be made to promote innovation in sustainable technologies. There are numerous economic models which try to evaluate the impact that different environmental policies have on promoting *innovation* aimed at pollution control. Chapter 2 of Kemp (1997), contains an extensive review of these models.

However, there is a growing consensus on the potential for environmental improvement that may be achieved by the *diffusion* of existing sustainable technologies, in particular in terms of greater energy efficiency and the associated reduction in the emissions generated by the use of fossil fuels. Some of the conclusive empirical studies conducted in this field are included in the papers by DeCanio (1998), Krause (1996), and Lovins (1991); or the reports of the *Union of Concerned Scientists and Tellus Institute* (1998), *Interlaboratory Working Group* (1997), *Alliance to Save Energy et al.* (1997), and Sant (1979).

If we accept the validity of these studies, it could be asked what factors limit or hinder the rate of diffusion of these technologies. A second question is to what extent these factors are related to failures of the energy and associated equipment market (Jaffe and Stavins, 1994). To the extent that market failures are responsible, the effectiveness of traditional policies intended to promote the adoption of such technologies by means of economic incentives is placed in doubt. Instead, measures aimed at correcting market failures would appear to be more appropriate.

According to Jaffe *et al.* (2000), the main market failures that can affect the rate and direction of technological diffusion include, in particular: i) *problems of information* – information being a public good which is not always supplied by the markets. This is an important factor, in that the adoption of a technology by a number of users constitutes of itself an important source for the transfer of information to other participants, in the form of a positive externality; ii) *agency problems*, which are also related to imperfect information, may be internal or external to organizations; iii) *Other market imperfections*, such as the difficulty small businesses may experience in accessing the