

Technology transfer in the TRIPS age

The need for new types of partnerships between the least developed and most advanced economies

A report prepared by

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The broad and rapid diffusion of new and superior knowledge is good for social well-being. Efficiency and growth are promoted by the rapidity with which new knowledge and new technologies are disseminated: the greater the proportion of individuals, firms or countries making use of superior products and processes and the sooner they do so, rather than being restricted to inferior substitutes, the more widespread and substantial the growth benefits should be. If only one firm (one country) uses a new technology that increases productivity, while other firms (countries) are obliged to retain the old, less efficient technique, it is obviously a less beneficial situation than if all firms were able to adopt the new technology. This rapid dissemination is no minor matter for the efficiency of the economic growth process.

One of the main forms of knowledge dissemination (and probably the most valuable from the point of view of developing productive and innovative capabilities) is technology transfer (TT). Krugman (1979) for instance considers the pattern of trade and economic growth to be governed primarily by two activities: innovation and TT.

Early literature based on the standard model of economic growth predicted convergence across countries and considered TT as an “easy” mechanism to achieve this process. Technology once produced can be widely applied. The implicit assumption is that the cost of technology diffusion is lower than that of its production.

However, in the real world things did not happen like that and the difficulties and complexity of TT operations, particularly when they involve two countries of different development levels, was rapidly recognised in specialised literature on international TTs. Some of the landmarks in this intellectual advancement include:

- i) a more adequate conceptualisation of technology (stressing its tacit dimension);
- ii) a careful appreciation of the transactional difficulties particularly related to the problems of contracting for tacit knowledge and pricing technologies on markets which remain relatively inefficient in this respect;
- iii) a better understanding of the importance (and non-trivial nature) of diffusion within the country once a technology has been transferred there; a process involving particular barriers and incentives;
- iv) the growing consideration of the fact that innovation and technological progress in LDCs cannot be a mere reproduction of what is happening in rich countries. Innovations have to be tailored according to local opportunities, capabilities and needs. Their consequences for economic development are strongly dependent on how such “particularisation” materialises in products, processes and services;
- v) the recognition that the most important innovations for LDCs are probably not “technical” but reside in the process of discovering what a country is good at;
- vi) and finally an accumulation of evidence concerning the relative advantages and shortcomings of the different channels through which TT occurs.

However, these various milestones along the intellectual path towards a better understanding of what TTs are about, what the conditions for success are and how to minimise the risks of failure have not given rise to new policy opportunities and the implementation of new programmes.

In parallel, the knowledge economy has been established slowly in the rich countries, affecting the relative importance of the various TT channels quite strongly – the market for technologies becoming a prominent mechanism over the last two decades, possibly at the expense of non-market-based mechanisms such as imitation.

This report draws on the abundant empirical literature produced over recent decades to develop the following set of arguments:

1 – The economic fundamentals of technology transfers towards LDCs

1- A technology transfer basically consists of a transfer of technological knowledge, that is to say a transfer of the capacity to assimilate, operationalize and develop a technology. The acquisition of information concerning the technology is thus only a part - although admittedly an important one - of the transfer. The process of learning how to use and maintain the technology is at least as important as its frequently required adaptation to local conditions. This adaptation may ultimately lead to the development of new applications based on the transferred technology. Furthermore, a technology is itself progressive; therefore the challenge of a TT is to master a progressive state of the art. Finally, the perimeter of potential adopters of the transferred technology is never predetermined and the transfer's social returns depend essentially on the extension of this perimeter beyond the initial target (for example a specific industrial installation). In other words, the transfer process does not stop at the first installation but should end with the generalisation of the technology in the geographical space considered.

2 - Thus a successful technology transfer goes through the perilous phases of the assimilation and **absorption** of technological knowledge, its **adaptation** to local conditions, **the absorption of subsequent improvements** and the **generalisation** of the transferred knowledge. I would describe these phases as the *consolidation* of the transfer. This complex cognitive dimension of technology transfer imposes an at least equivalent level of complexity of organisational forms. The latter must guarantee not only the acquisition of information but also the learning of the technology, its adaptation and its progression. Favourable organisational conditions can also promote its generalisation. It is in accordance with this logic that the efficiency and effectiveness of the various transfer modes can be evaluated.

3 - The technology transfer context between systems with very different development levels makes the problems of TT consolidation (absorption and learning process, adaptation, assimilation of subsequent improvements, generalisation) even more difficult to solve. Such heterogeneities create “capabilities’ issues”. Weak capabilities on the LDC side impose strong forms of *internal and external* organization in the LDC to maximize the probability of succeeding in the various phases of TT. Weak capabilities also imply

that the various modes of TT are not “equivalent” in term of their potential to impact the productivity of a wide range of sectors in the local economy.

4- As far as LDCs are concerned, this report emphasizes the centrality of a particular model of innovation for growth and development. R&D and other more informal learning activities undertaken to produce locally oriented innovations allow the country to develop absorptive capacity, while at the same time the locally generated spillovers from this same R&D may end up diffusing away from the local economy. There are vast areas of economic activity where innovation is needed to *serve local needs, local demand*, whereby “local” may mean a large fraction of the world population.

5 - Economically speaking, it makes sense to know whether **the TT constitutes an economic operation in itself or is it dependent on an economic operation that exceeds it?** In this respect, a distinction will be made between:

- transfers that are dependent on more general economic operations (such as foreign direct investments, the construction and supply of infrastructure, or the integration of companies from developing countries as exporters in international trade). In any event, the TT is a *joint product or by-product*²; the importance and quality of TTs are therefore contingent (dependent on a large number of factors resulting from the primary economic operation) and it is thus the incentives to make a success of the primary economic operation that determine the motivation to make a success of the TT and consolidate it (or not);
- transfers that in themselves constitute the *main product* and as such is the primary economic operation; either through the medium of the market (licence, joint ventures), or via non-market channels. In these cases, the prime motivation for the operation is the success of the TT and it is definitely the incentives directly linked to the TT (cost and profit) that control the operation.

6 - It is therefore apparent that the technology holder’s commitment may vary considerably depending on the TT’s status as economic operation and the importance attributed to it in the success of the primary operation (if it does itself not constitute the primary operation). When the TT is a *joint product* (occurring as a consequence of a direct investment), and if the things are going well, the phases of absorption, adaptation and assimilation of subsequent improvements are in a sense “embedded” in the investment’s plan. However, since the TT is a joint product, there is the problem of « balancing incentives » between the need to make the direct investment operational and profitable in the short term and the need to transfer technologies and capabilities. Indeed, the risk of a strong imbalance arising between these two incentives is considerable in LDCs since the cost of transferring technologies and building capabilities is very high. As a result the foreign firm is tempted to limit the scope and depth of the transfer of

² - We refer to the definition of these concepts in accounting: *joint products* are two products that are simultaneously yielded from one shared cost and they have comparably high (sales) value. *Byproducts* for their part are produced along with a main product. The latter constitutes the major portion of the total (sales) value. Byproducts have a considerably lower (sales) value than these main products. We can apply these concepts to TTs, substituting “perceived value to technology holders” for “sales value”.

technologies and capabilities in order to increase the short-term profitability of the investment. In such a case, the TT is no longer a *joint product* but becomes a *by-product*, that is to say a negligible objective.

When TT is the *main product*, the problem is that incentives cannot be allowed to depend on another economic operation. The TT must be sufficiently attractive in itself for the technology holder to enter into the transaction. In that case, the main operational phases can be contractually established and their achievement is part of the binding contract. However, complex technologies increase the cost of writing and negotiating such obligations for example in the set up of a licensing arrangement.

In both cases (joint product and main product) the broad dissemination of the technology and the spillovers stemming from a given TT locus are not guaranteed. The successful achievement of this final phase of the TT requires particular organizational forms and incentives.

7 - The locus of decision-making with regard to undertaking the TT in a certain field and under certain conditions is an important variable *when* TT is the *main product*. When TT is a joint product of FDI, the locus of decision-making lies in foreign firms:

- Foreign firms decide about the modes of learning, the amount of resources devoted to the TT operation, the potential scope of further dissemination, the objectives of assimilating subsequent improvements.
- The choice of the domain where the TT will operate is pre-defined when the TT is a *joint* or a *byproduct*. The report will draw on Enos et al. (1998) to show that when the locus of decision-making regarding areas for TTs lies in the foreign firms, there is a risk of a sub-optimal decision process.

When the TT is the main product, there is more flexibility about who will make the main decisions - domestic bodies (entrepreneurs, governmental agencies), foreign donors or foreign firms. The argument is that in the circumstances of TT as main product, the locus of decision-making should not be kept in foreign assistance bodies but transferred to local government initiatives, entrepreneurs. For instance, when the TT is the main product, the question of the choice of domains (who makes the choice, based on which criteria, how to go about discovering the « best » domains) **becomes an integral part of the economic issue of TT**. Enos et al. (1998) expressed this argument very well : “*We argued that the main task in advancing science and technology in the developing countries is to identify the most attractive direction in which to proceed. This proper direction is that which best represents the interests of the developing countries and this interest is not congruent with the interests of banks or foreign donors*”. This aspect is crucial since the choice of areas where TTs will operate matters a great deal. TTs operate in specialised domains that they will logically strengthen in order to transform them into a growth engine for the country concerned. As a main product, TTs provide opportunities to respond to the local demand for technologies.

The table below summarizes the economic characteristics of TTs as main, joint- and byproduct.

<i>TT as economic operation</i>	<i>Main product</i>	<i>Joint product</i>	<i>By-product</i>
<i>Transactional forms</i>	Licensing Joint ventures	FDI, infrastructure Trade: Import of high tech products and capital goods; export by firms from LDCs; subcontracting	FDI Trade Large scale infrastructure projects
<i>Incentives</i>	Directly associated to the TT for both technology supplier and technology demand	Need to balance incentives between the FDI operation and the TT	The TT is contingent (submitted to the main objective)
<i>Choice of the domain</i>	Part of the TT process	Neutralized This is the domain of the FDI	Neutralized

Table 1 – A typology of TT as economic operations

8 - Which economic forms are best suited to LDCs ? Firstly, they are all important. This is the application of the so-called Tinbergen assignment which tells us that as there are a number of generic goals and often an array of specific sectoral and regional economic concerns that TTs are intended to serve, there will be a need for as many separate instruments as there are targets. All the forms are important, provided that there are sufficient incentives to consolidate the TT, even when the TT results from a joint product logic.

9 - Intellectual property offers in the first instance a relatively extensive range of solutions to all the problems identified above. It creates a particular institutional framework within which certain transactional forms can be developed, the purchase of licences for example. This transactional form offers a specific answer to the difficult questions concerning the cognitive complexity of the transfer : intellectual property does in fact allow the structuring of complex transactions including unpatented knowledge (technical assistance for instance). Finally it offers a suitable incentive structure to encourage a technology holder to transfer his technology (he can fix a price that makes it worthwhile for him to transfer his technology). In short, it is rare to see a mechanism offering such a « range of services ». However, the efficiency of intellectual property as facilitating mechanism for technology transfer is by no means always guaranteed; particularly when the TT involves entities of very different development levels. While a

market for licences is considered relatively inefficient when it involves firms with the same level of capabilities, it is likely to be super-inefficient when an LDC is concerned. The technology market will not necessarily always constitute the most appropriate institutional form to ensure a TT. It is quite reasonable to think that too many transactions, although essential for the innovation projects of potential purchasers, will in fact never be realised.

2 – Current situation and main message of this Report

10 - Most recent evidence on LDCs tend to show that relying on the joint product and by-product logics *only* to ensure a satisfactory flow of consolidated technologies towards these countries does not suffice. Above all a principal TT activity must be developed. The 2008 World Bank report addresses precisely this question: while middle-income countries are increasingly relying on FDI and trade to access to foreign technologies and those TTs are likely to spill-over into the domestic economy thanks to the progress made in terms of absorptive capacities; this is not what's happening in the case of LDCs. These countries are still locked in to a low equilibrium between a low exposure to foreign technologies and a weak absorptive capacity. Therefore the main message of this report is the following:

In the case of LDCs, the number, scale and domains of TTs cannot be allowed to depend on general economic operations such as foreign direct investments or infrastructure construction ; neither can they take the form of market transactions alone (licences). In all these cases, the particular circumstances and conditions prevailing in LDCs imply a suboptimal level of TT in relation to the these countries'needs.

11 - There is therefore an obvious economic rationality for specific projects in which the TT is the primary product (an economic project in itself, not linked with another economic operation) but entails a very low expected private profitability for the technology-owning firm. Such a prospect would involve acknowledging the existence of TT operations with far smaller commercial returns or no commercial return at all and finding operational mechanism to incentivise these firms to sink costs in these operations. Such a strategy obviously requires the provision of additional incentives from the governments of developed countries.

12 - Incentivising foreign firms to enter such transactions is a clear opportunity for governments of developed countries to properly fulfil their obligations as expressed in Article 66-2 of the TRIPS.

3 – Towards new types of partnerships

13 – The complexity and difficulties of TT operations as supported and incentivized by governments of rich countries make it necessary to use “specialized agents” which have accumulated experiences in TT’s operations. The essence of a public-private partnership – to put this institutional mechanism in contrast with the more usual “public funding of private initiative” kind of arrangement – resides in **the involvement of a third party, which is specialized** in linking public donors, private firms and local entrepreneurial activities to ensure the effectiveness and efficiency of the operation.

The third party is a non for profit organization whose objective is to manage efficiently the public or philanthropic funding. As a general statement the PPPs will build the link and make it operational and effective between the public donor, a private company that hold the technology and the local demand:

- it will make sure that the whole process is “demand pull” (i.e. an area or field of TT that clearly matches a local entrepreneurial need) and create the proper incentive structure ofr the local entrepreneurs to engage resources in the project;
- it will target the appropriate partner (technology holder) and will generate the incentive to involve it into the transaction;
- it will create the proper conditions to contain costs;
- it will supervise the whole process so that the various phases of the TT (absorption, adaptation, assimilation of subsequent improvements, generalisation) are successfully managed (internal and external organizations);
- it will create mutual contractual obligations so that no party can leave the project before its completion;
- last but not least, it will manage the IPR side.

The argument n°7 stated that in the circumstances of TT as main product, the locus of decision-making should not be kept in foreign assistance bodies but transferred to local government initiatives, entrepreneurs. Shifting the locus of decision making to local actors and authorities is part of PPPs’ menu of tasks.

14 - Cost containment is a crucial condition for increasing the anticipated private profitability of TTs within a PPP framework. Intellectual property can, paradoxically, play a certain role in this direction, by supplying structured technological information for the benefit of countries to which the IP protection related to that information has not been extended.

15 - The PPP has to work both on the supply and demand side. In both cases, the incentive issue (i.e. to motivate both local entrepreneurs and technology holders) have to be addressed.:

- On the demand side, the centrality of innovations targeting local needs and having the potential to generate spillovers that can be captured by the local economy has been emphasized (argument n°4). The areas in which TTs must be primarily carried out are those of goods and services addressing domestic needs through local entrepreneurial activity; projects in these areas are socially beneficial; extraordinary advances must be achieved in these areas of entrepreneurial

activities developed mainly in traditional sectors and generating local spillovers. So the PPP has to target the local demand for technologies.

- On the supply side, the PPPs has to take into account the existence of a certain profile of technology holders in developed countries that can be motivated and proceed efficiently as entering a TT transaction toward LDCs. As a consequence of a certain stage of vertical disintegration in industries, the emergence of specialized segments focusing on the invention and development of technologies while not competing on the downstream market is a good news for TT towards LDCs. This is a favorable context to find capable and motivated suppliers that are likely to undertake TT in an efficient way.

16 - The role and functions of the governments of developed countries must finally be examined and evaluated with regard to the different arguments previously developed. In short, TRIPS Article 66-2, which in very vague terms merely calls for the provision of additional incentives to the firms and other organisations of developed countries to undertake TTs to LDCs, should be made more explicit. We would make the following practical recommendations :

- i) The TT should form the subject of a principal economic operation (and not be a joint product or byproduct; i.e. contingent on other operations); the locus of decision making regarding modes of learning and areas for focus must shift away from foreign bodies to local agents and authorities;
- ii) in providing additional incentives to the technology-owning firms, governments are seeking for effectiveness and efficiency:
 - they should provide incentives in an effective way by offering no assistance to projects that would be carried out in any case since there are sufficient market incentives and assisting projects that are socially beneficial but not very profitable for the firms that own and could transfer the technology.
 - conditions for the efficiency of the TT operations involve the choice of relevant partners both on supply and demand sides, selection of the right area for focus (related to a clearly expressed local demand for technology) and the creation of organisational forms that will favour the consolidation of the transfer (absorption, adaptation and subsequent spillovers) as well as the related entrepreneurial dynamic.
- iii) governments should make use as much as possible of PPPs as a mechanism ensuring both the effectiveness of the intervention and the efficiency of the TT operation.

17 - TTs have of course to be operated in many domains (including export-oriented industry). But they must be particularly supported in those domains corresponding to the model of innovation which is central to economic growth in LDCs (argument n°4) : entrepreneurial activities meeting needs on local markets that are likely to generate domestic spillovers. In other words, TTs must offer a positive supply response to a demand for technology stemming from local entrepreneurs. Two reasons have been given:

- first, these domains are potentially very important for growth because the spillovers generated in the course of such projects are likely to be captured by the *local* economy;

- second, these domains *need* additional incentives – so the donor’s intervention will be effective and will respond fully to the TRIPS provision – which is not necessarily the case of export-oriented sectors in which the market incentives alone are sufficiently strong to motivate firms in rich countries to operate TTs.

The other areas – for instance the export goods-oriented manufacturing and processing sectors - are also important but they will in any case be served through TTs operating as joint products of FDI. As such they should not be listed as part of the efforts made by the developed countries to comply with the 66-2 provision.