

North-South Technology Transfer: Two Neglected Problems*

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I. Introduction

The Group of 77 representing the developing nations (the South) in the North-South dialogue has voiced several complaints with the practices of multinational corporations (MNCs) and of their developed parent-countries (the North). Two of the more important issues concern the cost and availability of technology to southern nations, and the degree of appropriateness of technology actually transferred to the ambient host-economy. Sections I and II seek to shed some new light on the two problems in the hope that the level of the dialogue can be raised at the same time that its stridency is reduced. Section III examines the broader implications of constraints upon the range of input mixes in some products for economic development.

II. Cost and Availability of Technology

The existence and exploitation of market imperfections is the essence of the Hymer explanation of multinational enterprise. A monopoly position in technological inputs was the most common and extreme type of imperfection. The automatic abhorrence of monopoly colored the perception of MNCs particularly in the

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the feasibility curve will shift inwards and the MNC is counter-productive. But when an MNC creates a new piece of technology by expenditure of private funds on R & D and the degree of competition in all markets (except for the new monopoly in the proprietary knowledge) remains the same, both the production curve and the feasibility curve will shift outward. It is true that the retention of the know-how in the hands of the MNC allows the feasibility curve to shift outward by a smaller amount than the possibility curve but the feasibility curve does move outward and the world benefits. As the proprietary knowledge slowly seeps into the public domain, the feasibility curve approaches the possibility curve. Dunning identifies this Jekyll and Hyde aspect of multinationals. The simple identification of monopoly does not distinguish sufficiently between the two phenomena. The two phenomena would be equivalent if MNCs used their profits to buy up and preclude the utilization of a piece of proprietary knowledge generated by another entity since that would amount to technological destruction.

The problem with Johnson's analysis (1970) and with the normative prescription of zero price deduced from it, is that the analysis is essentially static. No additional social resources are used up if proprietary knowledge is transformed into a public good commanding a zero price if (and only if) future R & D expenditures are not influenced by the private return on past expenditures. Any such relationship could be overcome by having the government intervene to buy the technology and to make it freely available but this is economic legerdemain implying the ability of economists accurately to value a piece of technology and to effect a transfer at zero cost. In the absence of exact government intervention, the transformation of private technology into a public good (or input) would have a social cost. To the extent that a firm experiences a reduction in its rate of return on technological innovation, it will reduce its R & D expenditures. Indeed if a zero rate of return is assured, a profit-seeking firm will reduce its R & D expenditures to zero. The social cost of making technology freely available to all is the difference between the social rate of return on private R & D (now eliminated) and the social rate of return on the alternative uses of the resources.

The essentially-private aspects of technology are developed by Johnson in a later paper (1975):

technological know-how is a proprietary good so that transfers take place between enterprises or economic units.

It is the public good/private asset distinction, which is the key to the North-South disagreement. Costs incurred in the production of existing technological know-how are sunk. It is possible to regard the *stock* of technology as a collection of potential inputs which will enhance global output with small or zero marginal costs. Developing nations may be expected to reap large gains. This may be the concept of the Group of 77 preoccupied with the difference between the *stock* of technology employed and available in the developed world and the *stocks* in their own home countries. The developed world, on the other hand, is mainly concerned with the continued *flow* of technology and with the need for returns on the fruits of R & D being sufficient to ensure further R & D expenditures.⁴

The private aspects of technological know-how are necessary for continued technological advance unless governments can be relied upon for all research and development initiatives. Without denying the supportive role of government in many endeavors, the private aspects of technological know-how are likely to continue to dominate commercial innovation in a world in which the leading industrial nations rely on private enterprise. It is no accident that the larger part of what may be broadly termed "commercial technology" (as distinct from "weapons technology") has originated in the so-called western world. The freedoms of thought and individual action that characterize democratic, market-oriented economies constitute the most favorable climate for the advancement of knowledge (including economic innovation). This equation of the kind of intellectual and commercial climate which most encourages technological progress is important. If private ownership of technology and the probability of technological innovation are positively correlated, then the future flow of innovation would be drastically reduced if the public goods prescription were to dominate returns to technological innovation.

Bronowski attributed the movement of the intellectual leadership from Italy and the Mediterranean to northern Europe as a

⁴ Despite economists' concern with static analysis, it is doubtful if a free-enterprise system could function satisfactorily in the absence of invention and innovation.

resolved by allotting to central governments the responsibility for R & D expenditures. Under existing conditions, the innovating MNC is the medium through which existing technology can be transferred.⁷ The inherent cost to the recipient country is likely to be small in comparison with the cost of indigenous generation of comparable technology. The stock flow or short-run/long-run distinction demonstrates the problems of Johnson's normative prescription (1970) and Hymer's failure to distinguish between kinds of monopoly. None of this suggests that MNCs do not fully exploit their advantages in product markets whenever possible nor that they release their proprietary know-how into the public domain quickly enough to meet a set of objectively-determined social criteria (if such a set could be constructed). The argument does suggest that the Group of 77 might use its leverage more profitably by devising ways in which the life of patent protection can be shortened and proprietary technology which has greater value in the South than to its owner, can be acquired by southern countries.

III. The Constraints on the Transfer of the Appropriate Technology⁸

There exist several possible reasons for the alleged failure of MNC subsidiaries to utilize in developing host countries, the technology which the host sees as appropriate. Many developing countries see the failure of MNCs to adopt a labor-intensive, low-technology production process as deriving from MNCs' overriding concerns with short-run profit maximization, and as evidence of MNCs' complete lack of empathy with southern economic developmental goals and aspirations.

MNCs' costs in the transfer of technology are reduced when previously-used (and presumably high-technology) processes are incorporated in the subsidiary plant (Teece). This precludes adaptation of the production process to meet local characteristics or serve social goals. MNCs also tend to develop more

⁷ On the effectiveness of actual transfer, see Cipolla, pp. 174-181.

⁸ The author is deeply indebted to Robert G. Hawkins who supplied the seminal idea of a given technology being dictated by conditions in the industry and not by the status of the producing country. Decanal duties precluded Hawkins' further involvement in the paper.

corporations or by MNCs.¹⁰ These industries may be described as 'inflexible'. Some of them are: basic steel; shipbuilding; office-equipment; computers; aircraft; chemicals; pharmaceuticals; oil-refining; synthetic textiles and non-ferrous metals smelting. Some consumer goods can also fall with general category of inflexible industries.

The concept of a production process which is insensitive to relative factor prices and the conditions of the ambient economy can best be portrayed by a production function with fixed coefficients. The mix of inputs to be used in the production of a final or intermediate product, X , is predetermined and places heavy emphasis on the use of technologically-advanced inputs. The latter comprise heavy use of physical capital with embodied technology and a matching emphasis on highly skilled labor. The role of unskilled labor is likely to be quite small. The advanced technology embodied in the physical capital requires even more technologically-advanced physical capital for its production so that the capital equipment to produce X has to be imported from a developed nation. In terms of a traditional diagram of a two-input production function with technologically-advanced inputs on the vertical axis and low-technology inputs on the horizontal axis, the output expansion path will be very steeply sloped through a series of right-angled isoquants.¹¹

In contradistinction, most manufactured goods will be perceived by host governments as having production functions with smooth, continuously-differentiable isoquants with fairly large elasticities of substitution. It is the gap between actual inflexibility and perceived flexibility that is likely to cause strained relations. There are two possible explanations of the fixed-coefficients production function: (i) the speeds of product and production development are so fast as to preclude any thought being given to alternative, less-technologically-intensive means of

¹⁰ As will be discussed below, it will be possible to adapt the means of production to suit the host economy if the host nation is prepared fully to shelter the domestic market for the product from world competition and fully to renounce any expectation that the industry itself (or downstream industries in some cases) will be able to export its product.

¹¹ Reference in the text to right-angled isoquants and perfectly fixed coefficients is made solely for purposes of exposition. Some minimal substitutability may exist. For ancilliary production activities such as materials handling in warehouses, security, cleaning, etc., substantial substitutability between high- and low-technology inputs may be possible.

of production might be very high in terms of the need for their services in seizing an advantage from competitors in advanced countries.

This aspect of the problem can be expressed in terms of a dynamic product-cycle model. It is not clear in Vernon's original essay, how many innovations are to be incorporated within a single product cycle. Tsurumi leaves the problem undefined but implies an ongoing *series* of innovations so that the product family can evolve to new and higher stages of development even as the original concept of the product is capable of being standardized. It is certainly possible for a product to evolve through different generations so that the original version would have reached stage two or stage three of Vernon's product cycle while the next generation is barely entering the first stage. If the product family is capable of several generations of design and evolution, then the product-cycle can continue for many years and the thrust toward adaptable production (high-technology) techniques viable in the long run will also continue on for many years. Within the small range permitted by both the basic and the derivative proprietary knowledge, the technology employed in such an industry is worldwide. If competitors are also emphasizing product development, considerations of cost reductions in consequence of changes in the input-mix are ignored.¹⁴ Any lower-cost production process which relies less on technologically-advanced inputs will be less flexible and adaptable as new features of the product come "on stream". The transfer of production to a developing country at an early stage of the product's development seems unlikely and the resistance to reductions in the level of reliance on technological inputs will continue even when the production of the current generation of the product has begun to standardize.

The argument of this subsection is that there exist families of technologically-advanced products which, because of their *rate* of development, command highly technological input-mixes. Production of these products in developing countries is not possible unless the host nations are prepared to tolerate the introduction of high-technology production subsidiaries in what may amount to

¹⁴ Differences in absolute factor costs will lead to production abroad: particularly when capital is mobile and can be transferred at its opportunity cost in developed countries and combined with low-cost labor in the developing country, see Gray (1982).

separate production function for each quality of the product.)

Define quality in terms of reliability of product. This definition can, in turn, be translated into smaller variability of product. For machine-made parts, smaller variability implies closer engineering tolerances and a smaller variation of tolerances within the range allowed. For non-metallic products, smaller variability implies consistency in the features that affect the input's ability to combine with co-operating factors of production. A very precise capital good will require a material input which is consistent if it is to produce goods with small tolerances. The quality of a product will vary directly with the technological intensity of the factors of production, and the quality of the material inputs.

It is useful in the development of this concept of the relationship of the quality of the end-product and the technological intensity of the production process to borrow from Lancaster's theory of consumer demand (Lancaster).¹⁵ Lancaster distinguishes among products according to their characteristics — the features of the individual products. Products with identical characteristics are the same 'good' and groups of products with similar but not identical characteristics that fulfill the same end use constitute a Lancastrian 'commodity'. Within a commodity group, goods are highly substitutable and, *ceteris paribus*, the demand for a good is very sensitive to its price relative to the price of competing goods. Lancaster's emphasis is on final goods and he has provided a more precise description of the phenomenon of product differentiation than Chamberlin although it is still not possible to delimit membership in a commodity group except by some arbitrary demarcation. When the concepts of Lancastrian goods and commodities are applied to intermediate goods serving the same end-use and with differing degrees of variability the potential interdependence of the characteristics of the inputs and outputs become clear. Define an 'intermediate commodity' as a group of substitute 'intermediate goods.' The quality of the intermediate good to be used in the (next) stage of production derives directly from the quality required in the finished product as well as upon the quality required by its co-operating inputs (including the

¹⁵ This application of Lancaster's model to inputs was first made by Laura Tandy in a study of the decline of the jute industry in Bangladesh. Her study was directly concerned with the quality differences between jute and its synthetic substitutes.

conditions of preparation as well as to the prohibition of certain ingredients in food products.

If the developing country is willing completely to shield its home market from foreign competition — including competition from other developing nations that adopt the technology-intensive techniques — it may be possible for the country to use a low-technology mix. Under these circumstances the developing nations can forego playing host to MNC subsidiaries with possible ideological benefits and obvious technological costs. It is not clear that the renounced technology may be available through licensing arrangements. The short-run gains of sheltering a labor-intensive industry are that additional employment in the industrial sector can be 'manufactured'. The costs are that having the low-quality product prevade the economy will generate negative spread effects. The negative spread effects will be particularly apparent when the sheltered industry produces intermediate goods which will retard the technological development of downstream industries. However, a developing nation may rationally be more willing to renounce ultra-strict quality control on food and drug products. Finally, the renunciation of modern technology denies the possibility of allowing a home industry to use the export market as a vent for surplus.

IV. Implications of the Constraints on Low-Technology Production

The possibility that a substantial number of basic industries does not allow developing nations to utilize low-technology (labor-intensive) production techniques, will have important implications for development strategies. Four aspects of this possibility can be considered briefly here.

The inability to absorb excess population in some industries makes the burden of excess population more intractable and rapid population growth becomes a matter of even greater concern than many currently believe it to be. The comfortable idea that a nation can create useful employment for (virtually) all of its population of working age by expanding its secondary (and tertiary) sector(s) is seriously damaged. What is likely to happen is that the growth of those industries which do lend themselves to

irrespective of size, is again vulnerable to shifts in international conditions and to the whims and caprices of the MNC. The specialization of an MNC subsidiary in the production of an intermediate good or in a single process in a complex production chain, makes the host country vulnerable to international conditions in the sense that its productive equipment cannot produce a complete good which could be adapted for the home market in the event of a major disruption in the international economy. The fear of capricious behavior on the part of the MNC is less of a problem since the MNC will be unwilling, except in the most unusual circumstances, unnecessarily to alienate a host government and to waste valuable capacity. When the product produced by the MNC subsidiary is a differentiated consumer good, the production in the developing country is directly dependent upon the parent corporation's marketing plans and effectiveness even when the complete product is produced within the host's boundaries. It is arguable that if developing nations are to continue to expand their manufacturing sectors, they will need to produce manufactures for export. These additional exports are likely to comprise differentiated consumer durables to an increasing degree as the market in developed nations for standardized products becomes satiated. Under these circumstances the host does not have the option of developing an export market without the aid of an MNC because this type of product requires a sophisticated marketing organization in the country of sale. Developing nations have a comparative disadvantage in such endeavors and would be likely to be frustrated by MNCs which control the established marketing organizations.

V. Conclusion

Strains in the North-South dialogue on the matter of technology transfer to the South through MNCs can be reduced by explicit recognition of (i) the concerns of northern economies for the continued flow of R & D expenditures and (ii) of the operational constraints limiting the use of low-technology production. Recognition of these factors suggests that the Group of 77 might usefully take aim at less ambitious targets than those to which they originally aspired. Unfortunately, the implications of the constraints on the behavior of the North and the MNCs both

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