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The Transfer of Technology to Developing Countries

Analytical Concepts and Economic Policy Aspects

by Lutz Hoffmann, Regensburg*

Although both the industrialised countries and the developing countries have an interest in the transfer of technology, there is a considerable amount of disagreement as to how the gains from the transfer should be apportioned. Professor Hoffmann offers a theoretical analysis of the mechanisms involved in technology transfer and in the determination of the transfer's price, and makes some suggestions as to the policies to be followed by the countries involved.

The transfer of technology from industrialised to developing countries has long been the subject of international discussions and declarations, unanimously advocating that the transfer should be stepped up. The developing countries are convinced that unless there is a rapid technology transfer under favourable conditions, it will be impossible to narrow the development gap vis-à-vis the industrialised nations within the foreseeable future. The industrial countries themselves are conscious of the developing countries' ever-growing significance as markets for their exports and of the fact that they must therefore have the technology to be able to produce competitive exports of their own in order to finance their imports from the industrialised countries.

Superimposed upon this mutual interest is a conflict as to how the benefits should be shared out. Just as the gains from trade and their apportionment are important concerns in trade between countries, similarly the question of how the gains from technology transfer should be apportioned has been, and continues to be, the object of ever new controversies. In one direction, these usually take the form of accusations by the developing countries that the technologies being transferred are inappropriate, that the price they command is too high, or that the transfer agreements are too restrictive. Conversely, the industrialised countries protest that insufficient protection is provided for rights of ownership, that conditions under which profits may be transferred are unfavourable, and that costs generated by government intervention in the host country concerned are too high.

It is possible to approach technology transfer to the developing countries as a general problem of the international trade in technologies, and indeed a number of attempts have been made to treat it within the framework of neo-classical trade theory. In conformity with the nature of this theory, these treatments involve general equilibrium models, stressing the analysis of welfare effects. In addition, questions such as real factor rewards, using the Stolper-Samuelson theorem relating to the theory of international trade, structural change between labour-intensive and capital-intensive industries (Rybczynski theorem), and national factor intensities are dealt with.

How appropriate these theoretical concepts are for analysing the transfer of technology is very much open to question because, among other things, they neglect the typically monopolistic nature of technology markets and usually bring technology progress into the model as an exogenous quantity. As far as technology transfer to developing countries is concerned, the static welfare concept used in these theoretical approaches is of little relevance, as the main concern here is not so much to maximise the production of goods in the present as to bring a qualitative improvement by way of learning processes of the production factor labour; this is essentially a dynamic process. In any discussion of technology transfer from industrialised to developing countries, then, it is appropriate to take account of this overall economic goal.

The neo-classical model defines technology in terms of particular combinations of factors of production, predominantly labour and capital. The spread of possible combinations available to any particular

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society depends upon its supply of technical knowledge. This knowledge determines what is described as a country's technological capacity, which is expressed in the available range of factor combinations. It is not the factor combinations themselves which can be transferred to another economy, but the technical knowledge which underlies them. Technology transfer is therefore appropriately defined as a transfer of knowledge which improves a country's technological capacity. Technical knowledge is usually given a broad definition so that it takes in knowledge related to the organisation of production processes and to product marketing.

Technology transfer, then, is part of a learning process. If learning could take place without loss of time and learning capacity were unlimited, it would be possible to demand that the flow of technical knowledge to the developing countries should be as large as possible. All the receiving countries would need to do would be to make their choice from the supply available and make use of whatever seemed most appropriate to their level of development.

In reality, though, not only are learning processes very time-consuming, with only a limited amount able to be absorbed within a given period of time, but also only a fraction of the technical knowledge available in industrialised countries does actually flow to the developing countries. Because learning capacity is limited it becomes essential that the right things should be learned at the right time. Thus the question arises as to whether such technical knowledge as is made available to the developing countries by the industrialised nations in fact corresponds to what the different countries in their various stages of development really need. This is the problem discussed in the literature under the heading of "appropriate technology".

Anatomy of the Learning Process

The learning process related to technology transfer can be divided into three stages. During the first of these there emerges the ability to independently seek suitable technologies and make the choice between alternative technologies. During the second stage, the technology importer learns to adapt the technology acquired to local conditions and his own needs. At a more advanced point in the same stage foreign technologies may already be imitated. At the third stage, the country is able to make its own independent technological developments.

Whether or not stage one of the learning process takes place depends upon the way in which the

technology transfer is effected. The forms of transfer are distinguished in this instance according to the amount of packaging involved. Packaging is the term used when the transfer of technology occurs together with other economic transactions. Direct foreign investment represents the highest degree of packaging. Until the early 1970s, this was the predominant form of technology transfer. In the case of direct investment, the decision as to which technology should be transferred lies exclusively with the foreign investor. Citizens of the developing country thus have no opportunity to seek out technologies appropriate to their needs and select accordingly. As a result, stage one of the learning process is not realised.

The problem also exists with some other forms of transfer with a lower degree of packaging. For example, in a joint venture it is generally the foreign partner who decides which technology should be used. Even in the case of licensing arrangements the licensor frequently stipulates which equipment the licensee should use. Evidently, then, the first stage of the learning process does not take place as readily as it may appear at first sight.

Stage two depends rather less on the form of technology transfer involved, and generally takes place either under competitive pressure or because of requirements set by the state. This second stage is the learning phase proper as regards the handling of technologies. Empirical studies have shown that technological adjustment and indeed imitation are carried out to a substantial extent in semi-industrialised countries.

If a country has gone through the first two stages, stage three follows virtually automatically. If, on the other hand, stage one does not properly get under way and stage two does not really have a chance because uncontrolled technology imports flood the domestic market, then stage three cannot be expected to happen at all. The situation is similar to that of an infant industry in a developing country which cannot gain a hold against competition from abroad unless its initial competitive disadvantage is compensated for by an interim protective tariff.

Technological Competitiveness

When a developing country makes technological developments of its own, it faces the following competitive disadvantages:

- Foreign technologies, because of long experience in the development and application of technologies, are more reliable and hence involve less risk than domestic

technologies. At the time of transfer, their development costs have frequently been largely written off, with the result that they can be transferred at relatively low marginal cost. The marginal cost consists mainly of the cost of transfer itself.

□ The risk in developing a technology domestically is not only that it may technically fail to fulfil its function, but also that the products the technology produces may not be marketable. Competing foreign technologies often carry a trademark which gives their products a competitive advantage.

□ Technology transfer agreements often include restrictive provisions on the development and use of competing domestic technologies. This leaves limited competitive scope for domestic technological developments.

□ Most domestic subsidiaries of foreign corporations prefer to have their research and development work done in the parent company's laboratories. This may be a question of company strategy, but may also be due to cost considerations. Industrial research calls for expensive laboratory facilities which in many cases can only be used cost-effectively if all R & D activities are centralised there. Furthermore, central laboratories make it easier for a company to keep its new developments secret.

These competitive disadvantages of the developing countries, taken together with the industrial nations' technological dominance, impede any autonomous development of technology. At the same time, though, the developing countries need to import a certain amount of technology before they can even begin with developments of their own. A further consideration is that the domestic development of technology should not be totally shielded from foreign competition, for fear of losing touch with continuing international advances in technology, which again would detrimentally affect the country's competitiveness with regard to the goods produced. Technology policy, then, has to strike a difficult balance between providing a certain amount of protection to allow the country's own technological developments to come to light on the one hand, and making sure there are enough competitive impulses to prevent losing track of international developments on the other.

Formal and Informal Transfer

It was already mentioned above that there is a correlation between the learning process – the development-policy goal it is hoped technology transfer will achieve – and the way in which the transfer actually

takes place. However, it is not simply a case of the learning process being a function of the form of transfer, for this in itself is essentially determined by the current level of knowledge, or in other words by the learning processes completed in the past.

An initial distinction can be drawn between formal and informal transfer mechanisms. A mechanism is informal when the transfer occurs by way of personal contacts, conferences, specialist literature, straightforward observation, the migration of qualified personnel or through similar means, without any formal transfer agreement being signed between the supplier and the recipient of the technology. Such informal transfers are not actually free of cost, because visits to exhibitions, the studying of literature, etc., generate costs of their own, but there is no direct payment associated with the transfer as such. Contrastingly, a formal transfer is generally based upon a contract in writing defining precisely what technology will be transferred and what will be paid for it.

There is little exact knowledge of the relative significance of informal and formal transfer, though one thing that is clear is that it varies greatly from one country to another. A study enquiring into the situation in South Korea concluded that formal transfer comprised only a relatively small proportion of the total. One may assume that this has a connection with the technological capacity South Korea already possesses, allowing trained technicians to establish new production processes with the aid of information which is readily available. Undoubtedly this applies to a much lesser extent in developing countries where technological capacity, including the abilities of management, is still relatively underdeveloped.

Because the informal type of transfer, by its definition, does not represent a market transaction, it is relatively difficult to research into. As yet, there are hardly any studies available which offer an insight into how this mechanism works.

Direct and Indirect Transfer

Within the category of formal transfer – to which the following discussion will be confined – one can distinguish between direct and indirect transfer mechanisms, a distinction which ties in with the concept of packaging referred to earlier. Indirect transfer mechanisms involve a package of different elements of technology, the most "packaged" example being the establishment of a wholly-owned subsidiary by a foreign company. Other indirect forms of transfer are as follows: joint ventures, delivery of turnkey plants, international

subcontracting, sale of patent rights, licences under patent protection, other licences, management and service contracts, franchising, product-in-hand agreements, and production sharing agreements.

Direct transfer means that the technology importing firm only buys individual elements, such as the services of foreign engineers in an advisory capacity. The boundary between indirect and direct transfer mechanisms cannot always be clearly defined. To illustrate, if a licence is acquired for a particular part of a process which in all other respects is independently constructed and operated, this too would be described as a direct rather than an indirect transfer of technology. It would also be possible within the definition of direct transfer for the importer of a particular technology to have members of his own workforce trained by foreign experts, whether in his own plant or in the foreign plant. The importing firm would also purchase the necessary capital equipment direct from the manufacturer, and not from a foreign producer of the product manufactured with the aid of the technology concerned. Clearly, the direct form of transfer is only workable if the importer

already has substantial technical and management capacity of his own.

Accordingly, indirect forms of transfer are most strongly in evidence where technological capacity is too limited to allow direct transfer. However, another source of indirect transfers is the unwillingness of some providers of technology to be drawn into a direct arrangement. Almost any country, for example, could produce Coca-Cola if it could buy the recipe, with no need for any other elements of technology. The Coca-Cola Company, however, categorically refuses to part with that recipe, leaving the technology importer no other choice but to acquire an import licence which is also bound up with various other technological elements.

Elements Transferred

Within the categories of transfer mechanism delineated above, a further breakdown can be made of the various elements of technology forming the object of the transfer agreement.

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Rolf Jungnickel/Ulrike Maenner

EIGENIMPORTE DER DEUTSCHEN INDUSTRIE (OWN IMPORTS BY GERMAN INDUSTRIAL ENTERPRISES)

Own imports by German industrial enterprises from subsidiaries and associated companies, from partners in cooperation agreements and from unrelated foreign producers, have until now been more or less ignored by empirical economic research. In deliberations on production and sales strategy own imports are becoming increasingly important for enterprise policy not least with regard to the providing of security for the enterprise and its employees in the face of growing competitive pressure. Both from a general economic perspective and from the point of view of economic policy, the question is therefore raised whether own imports, for example because of their sectoral effects on employment and income, should be judged differently than "traditional" import forms. This empirical analysis sheds light on some fundamental aspects of the problem.

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V E R L A G W E L T A R C H I V G M B H - H A M B U R G

Typical examples of these elements are:

- ☐ provision of blueprints, technical formulae, specifications etc.,
- ☐ provision of plant and equipment,
- ☐ provision of materials and components necessary for a process's operation,
- ☐ initial instruction at the time the technology is acquired,
- ☐ on-going provision of instruction and training throughout the period of the contract,
- ☐ continued provision of information on technological improvements and further developments made by the suppliers,
- ☐ information and training on marketing, company organisation etc.

Clearly, the more elements an agreement includes, the more valuable it is to the technology importer. However, the supply price will also be proportionately greater, since the costs of transfer faced by the provider of the technology are higher and his exclusive rights to the production and management know-how are reduced.

Terms of Transfer

Establishing the terms of transfer presents two sets of problems. The first set involves the positive question of what price is agreed upon for a given technology package, and the second the normative question of whether that price is appropriate, too high, or too low.

In general terms technology is traded along similar lines to goods, with a transaction taking place if there is a purchaser willing to pay the seller's asking price. Nevertheless, the market in technology does have some special features which do not normally apply to the goods market. On the latter, the effect of an increase in price is to raise the quantity supplied and lower the quantity demanded, the reverse being true for a decrease in price. Such quantitative movements in supply and demand are less significant on the technology market. The sale of any given technology is usually a one-off transaction. Once it has been transferred to a given country, it cannot normally be transferred to any other purchaser in the same country, even if there are several potential purchasers at the outset. Under these circumstances the seller and the purchaser will negotiate bilaterally, trying to establish, respectively, the highest or lowest possible price. It is quite possible for negotiations to be conducted

simultaneously with a number of potential purchasers, but ultimately only one of these will be able to conclude the deal.

Scope for Negotiation Regarding the Price

Negotiations between the purchaser and the seller are conducted within a range which allows both the price and the technological content of the transfer package to be varied. The lower limit for price movement is set by the technology seller's opportunity cost, and the upper limit by the purchaser's.

The opportunity cost to the seller comprises the present value of the profits he could make by using the technology himself to supply goods to the potential purchaser's markets. This could mean the purchaser's home market or third country markets or part of the seller's home market if the purchaser intends to export there. As far as the purchaser's home market and third country markets are concerned, the seller's alternative would be either to export into those markets or to set up his own production facilities there. In the latter case, although technology is actually transferred in the geographical sense, its ownership does not change hands, so there is frequently no need for a formal technology transfer agreement.

The seller, then, will take the potential profits foregone as a yardstick when taking a view on the minimum profit he would like to obtain from the technology transfer. This profit is made up of the price paid for the various technology elements minus transfer and negotiation costs. The extent of the profit foregone as a result of the transfer essentially depends upon:

- ☐ the markets actually sold into by the technology purchaser, which may be determined by way of the transfer agreement,
- ☐ the purchaser's competitiveness, which will be considerably influenced by the transfer's technological content,
- ☐ the degree of competition in the technology purchaser's intended markets, and
- ☐ the degree of competition from other technology suppliers.

If the seller manages to enforce a provision in the transfer agreement banning exports by the purchaser, the profit foregone will be confined to the purchaser's home market and the opportunity cost will be accordingly lower.

If, by transferring a package with an extensive amount of technology, the seller helps the purchaser into a

position where he can become a serious competitor, perhaps by using the acquired technology as a base for his own independent further developments, there is a danger that the seller's foregone profits may turn out to be relatively high, and hence the opportunity cost is high.

If the markets in which the purchaser intends to operate are intensely competitive, the purchaser will have a relatively limited chance of building up a particularly large market share. Hence the seller's foregone profit and opportunity cost will be correspondingly low.

If there are several suppliers of the technology concerned, then there is a strong probability of a purchaser being able to strike a deal elsewhere if any particular seller is not prepared to release the technology at the price offered. At the same time the chance of profiting from using the technology oneself cannot be rated very high in view of the potential competition, so the seller's opportunity cost is low. Conversely, if the seller has a monopoly over the technology, effecting the transfer will mean depriving himself of the ability to reap monopoly profits by making use of the technology himself. Given that such profits, depending on the preferences of the purchasers of the product involved, can be high, the seller's opportunity cost in this case is also accordingly high.

The purchaser's opportunity cost, which sets the upper limit of the negotiating range, is equal to whichever of the following three alternatives is the lowest:

- ☐ the price the purchaser would have to pay if he were to obtain the technology from another supplier,
- ☐ the costs involved for the purchaser if he developed the technology himself, or
- ☐ the profit which would be foregone if the purchaser decided to do without the technology altogether.

Any purchaser who is able to obtain the technology from various suppliers will hardly be prepared to pay more than the asking price of the cheapest of these.

If the purchaser is in a position to himself develop a technology suitable for producing the required product, he will certainly not wish to pay more for imported technology than his estimate of his own development costs. In making this comparison he may of course include a risk premium in his own development costs. However, it is always possible that the imported technology would generate extra revenues if, say, it allows a well-known trademark to be used. Account

must be taken of this additional profit in the comparative cost analysis.

If the would-be purchaser calculates that the revenues derived from deploying the technology are less than the price payable for importing it, he will not be prepared to make the purchase. It is then economically preferable for him to go without the expected revenues which the use of the technology would bring.

As in the seller's case, the purchaser's opportunity cost will depend on the size of the market he operates in, his competitive strength and the intensity of competition in both the respective goods and technology markets: if the purchaser is prohibited from selling the product outside his home market by the technology supplier, the profit foregone by not acquiring the technology is small. If the technology transfer brings with it a great deal of competitive strength, the profit foregone is relatively high. If the market on which the technology purchaser sells his product is intensely competitive, the earning prospects, and therefore the profit foregone if the transfer does not occur, are low. Finally, if the technology market is keenly competitive, the purchaser will have a good chance of finding a supplier at a reasonable price. The reason for the close correspondence between the factors determining both seller's and purchaser's opportunity costs is that the profit made by one of them represents profit foregone by the other.

Limits on Technological Content

The above discussion concentrated on the price limits for a given level of technological content in the transfer package. If, however, that content varies, the price limits too will be different. In many cases both the price and the technological content will be subject to negotiation.

The technological content comprises a number of components which can be divided into three categories:

☐ The number of elements transferred of a given technology may be relatively high or low, and the transfer costs vary accordingly. If the transfer package is so comprehensive as to bring a lasting improvement in the purchaser's technological capacity, thus making him a potential competitor to the seller, both the purchaser's and seller's opportunity costs are proportionately high.

☐ Technologies for manufacturing different types of product (product technologies) vary in their complexity and sophistication. Manufacturing precision machinery calls for a higher level of technology than food or textile processing. There are many suppliers of the simpler

technologies, whereas the supply of complex technologies is more limited and often monopolised. As a result, the seller's opportunity cost tends to be lower for the simpler technologies than for the complex ones.

□ Different technologies for manufacturing a given product (process technologies) can also vary in their sophistication. As a rule, these differences are associated with variations in cost and quality: a high-value technology will have economic advantages over a lower-value one. The seller's and purchaser's opportunity costs vary accordingly.

If there is to be any leeway for negotiation, the purchaser's opportunity cost must be higher than the seller's. The purchaser's opportunity cost, like the seller's, increases if more elements of technology are supplied. It also rises if a complex product technology allows the purchaser to attain a dominant position in his home market or in third markets or if sophisticated process technology provides him with a competitive edge in terms of costs and/or quality.

The purchaser's opportunity cost asymptotically approaches an upper limit set by the (restricted) purchasing power in the markets available to him, which generally means the home market. In that market he will either have a natural advantage over the seller, by being more familiar with domestic participants and conditions, or an administrative advantage by virtue of state protection against foreign competition. Initially, therefore, his opportunity cost is higher than the seller's.

If the number of technological elements supplied by the seller is too low, hardly giving the purchaser the chance to get into efficient production, the latter's opportunity cost is very low, and may indeed be well under the seller's opportunity cost. If, on the other hand, the seller provides very many elements of technology, it is quite possible for his transfer costs to exceed the purchaser's opportunity cost. This is all the more true if, as a result of receiving the technology, the purchaser becomes a serious competitor on third country markets, or if the seller has to concede his monopoly position as a result of the transfer of a very complex technology. In the latter case the resultant reduction in the seller's profits is not matched by an equivalent gain for the purchaser, as the loss of the monopoly position will lead to falling prices. Consequently, the seller's opportunity cost is higher than the purchaser's.

Negotiating Strategies

The seller follows a negotiating strategy aimed at achieving the highest possible price for a given technological content in the transfer package, at

keeping his own transfer and opportunity costs as low as possible and/or at minimising the technological content without yielding on price.

The purchaser's negotiating strategy is the reverse of the above on all points. Where the agreed price actually settles in the range between the two parties' flexible opportunity cost curves is determined by their relative bargaining strength and negotiating skills. Each of these can vary a great deal in differing situations, and it is thus impossible to make any generalised prediction of the result.

The measurable price of a technology transfer is expressed as a combination of a number of quantities, namely a lump-sum payment, an annual royalty rate – normally a percentage of turnover – payable once production has begun, the annual turnover, and the period of the transfer agreement which governs the duration of royalty payments. As an underlying principle, these four quantities can be freely substituted one for another. The higher the lump-sum payment, the lower the royalty rate and the contract duration need to be. Similarly, a high annual volume of production will enable the other three price determinants to have lower values, or if the contract is particularly long, the royalty rate does not need to be so high, and so on and so forth.

Be this as it may, due to risk and liquidity considerations both seller and purchaser generally voice preferences for particular components of the price. The seller, for instance, normally prefers lump-sum payments because of the risks involved in royalties should production or product marketing run into difficulties. Conversely, the purchaser prefers royalties because he does not need to pay for the transfer until production is successfully under way and, furthermore, can motivate the seller to remain on hand with technical and organisational advice, hence helping to ensure trouble-free production. It is also possible that the seller may have an interest in a long contract duration which secures him a longer period in which he can exercise control over the way the technology is used. In contrast, the purchaser cannot have any interest in being subjected to long-term control by the seller.

Which of these preferences win through again depends on the two parties' relative bargaining strength, but the nature of the preferences also plays a part. One party may well be more interested in pushing through its preference than in obtaining the highest possible price, calculated, for instance, as the present value of all the price components involved. If the seller has a strong bargaining position, for instance, he could insist on the price being set entirely as a lump sum, but in

return be prepared to make concessions on the price level itself. If one of the parties has greatly superior bargaining power, then, this does not necessarily mean that the price agreed upon will be almost at the level of the opposite party's opportunity cost.

Is the Price Reasonable?

In discussing whether or not the price for the transfer of a particular technology is reasonable one must ask, on the one hand, what price maximises welfare and distributes the gains equitably between parties, and on the other, how the price should be set to allow a continuous flow of new technologies. The first approach is essentially static, while the second considers dynamic arguments first and foremost.

There is an essential difference between the production of a good and the development of a technology. A good, once produced, disappears when it is consumed, whereas a technology brings a permanent rise in the level of technological knowledge. Thus the marginal cost of utilising an existing technology is close to zero. The demand could then be made – as indeed it often has been in political discussions – that the transfer of technology to the developing countries should take place free of charge. The one item conceded by this point of view is that the cost of actually making the transfer should be credited to the technology seller.

The counter-argument is that any technological development generates costs and, in addition, involves considerable risk. If earnings from transferring technology were limited to the pure costs of transfer, the incentive to develop new technologies would be markedly reduced, as the technology developer would have to renounce at the outset any potential earnings from passing on the technology to other operators. Given that technical progress forms the backbone of economic growth, this too, it is argued, would suffer lasting damage. Thus it would be wrong to eliminate the elements of monopolistic profit which are typical of technology markets. Indeed this was the basic idea underlying the patent system introduced in Europe in the 19th century.

Harry Johnson has put forward the argument that the above reasoning may be correct in principle but that it need not be applied to the developing countries. The opportunity cost of transferring technology to them, the argument runs, is negligible because the markets involved are small. Thus if the price were simply equivalent to the transfer costs there would be no appreciable threat to the profitability of new technological developments. However, the assumption

that the earnings made in the developing country technology market are insignificant is not correct. In the mid-1970s income from technology transfer to developing countries contributed 18 % to total technology transfer income in the USA, 19 % in West Germany, 23 % in France, 28 % in the United Kingdom and 51 % in Japan. The premise on which Johnson's argument is based, then, is not empirically tenable.

In an effort to show that the price paid by developing countries for imported technology is too high, various representations have been made that the price has risen sharply in the past. However, these obviously took no account of structural changes in the transfer of technology. As the development process progresses, the structure of production typically shifts away from standardised consumer articles towards intermediate products, consumer durables and capital goods. At the same time, the ratio of factor rewards tends to rise in favour of wages and against interest on capital. Both effects lead to higher-value technologies being used, as a result of which prices rise. In this situation, the only way of reducing the cost of technology imports without retarding the process of structural change is to confine formal imports to particular elements of technology and to import a greater quantity informally for adaptation and further development at home.

Economic Policy Involvement

The industrialised nations do not exert any significant influence over technology transfer to developing countries via their economic policies, whereas the developing countries themselves have taken measures which on occasion have been very wide-ranging to exercise some control over the technological content, the scope of the transfer involved and the terms under which it is made. The general assumption made here is that the purchaser in the developing country is in the weaker negotiating position. Though this may well be true in the case of the traditional suppliers of technology, namely multinational corporations, the assumption is a dubious one as far as the many small and medium-sized companies from industrialised countries are concerned which increasingly joined in the technology transfer process during the 1970s. This assumption has in the past led numerous developing country governments to pursue a technology transfer policy which aimed at, or in any case resulted in, strengthening the technology purchaser's negotiating position. The policy essentially consisted in a restriction of the scope for negotiation.

It can only be appropriate to limit the negotiating range in order to strengthen the purchaser's bargaining

position if the parties to the transfer agreement are independent of one another. If the purchaser is a subsidiary company of the supplier, the only justification for state intervention on the purchaser's behalf can be to keep the price low so as to minimise the drain on foreign exchange reserves.

In cases where the two parties are indeed independent, such intervention sets an upper limit to the negotiating range. The consequences of this are, on the one hand, that the agreed price is kept down as intended but, on the other, that the range of technologies available for transfer is restricted. Thus it is quite possible that, by pursuing a restrictive technology policy, a country will not manage to obtain the technologies it regards as desirable. Most of the newly industrialising countries, for example, are now interested in importing technologies with a high degree of sophistication. At the same time, however, some of these countries are pursuing a policy of trying to keep down the price of imported technology as far as possible. Since these two policy aims are in conflict with one another it comes as no surprise that a number of countries complain they are unable to acquire an adequate amount of high-value technology.

At least to some extent, the effects of state technology policy can be compensated for by way of particular terms agreed between the contracting parties. Such arrangements have to reduce the seller's opportunity cost since any changes in the purchaser's opportunity cost would not have any influence on the upper range of the technology spectrum. Examples of measures to reduce the seller's opportunity cost are export restrictions imposed upon the purchaser, a prohibition against passing on the technology elsewhere (technology diffusion), and reductions in the transfer package's technological content.

Such a reduction of the seller's opportunity cost lowers at the same time the technology's value to the purchaser, and for this reason such clauses in transfer agreements are frequently not allowed. This may result in the seller, either unilaterally or with the purchaser's consent, pushing through measures which undermine the price limitations set by state authorities. Prime examples of this are excessive prices charged for items of equipment delivered as part of the transfer agreement or for other materials supplied in connection with day-to-day production – these have been thoroughly discussed in the literature under the heading of "transfer prices" – and overcharging for supplementary services such as training, management advice, etc. If such supplies and services on the part of the seller are not provided for in the transfer agreement and the opportunity to increase

the seller's return is closed off, the policy will necessarily mean that the "top slice" of the range of transferable technology is cut away.

There are a number of countries where the responsible state agencies are well aware of the problem. To some extent this has led to a gap opening up between the legal code and administrative practice (the operational code), the latter showing more flexibility towards the demands generated in concrete bargaining situations. The tendency has been for the operational code to permit a higher price limit on high-value technology than is theoretically possible under the legal code.

Although one can presume that this flexibility in the operational code will have saved a number of transfer negotiations involving high-value technologies from collapse, there are undoubtedly also various potential suppliers of technology, especially among small and medium-sized companies, who were deterred from even entering into negotiations by the restrictive legislation.

In many countries the legal code also contains regulations applying to mature technologies which have already had a long period of use and only permitting very low prices or indeed blocking any transfer whatsoever. This means an additional limit is placed on the spread of importable technologies at the lower end, particularly in cases where the permissible price does not even cover the costs of transfer. The idea of this type of policy is that domestic enterprises will be forced to improve their own efforts to apply, adapt and possibly further develop relatively straightforward technologies. The price limit is intended to make sure that the foreign technology supplier only provides individual elements of technology which are relatively cheap, and that the domestic company or enterprise has to produce the remainder itself. This frequently means that, at least for some length of time, the domestic firm's products are inferior in quality to equivalent products on the world market. If the domestic product market is largely fenced off from the world market by protectionist measures, the domestic firm can survive despite the lower quality produced. However, if it is subject to powerful foreign competition, the domestic firm will either be driven out of the market or will feel compelled to match the quality of its products to those of its foreign competitors as rapidly as possible. Whether this is possible, given that the firm is technologically weaker, is a question which has not as yet been objectively resolved. This fact is not changed by the claim made by protagonists of free trade that it is possible for firms in such a position to adapt, nor by the denial of the very same by protectionists.