TECHNOLOGY TRANSFER, WTO AND EMERGING ISSUES

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I. INTRODUCTION

The impact of liberalisation and of the WTO regime on the innovative activities of the less developed countries' (LDCs) enterprises, and in particular, on the Indian enterprises is difficult to predict. Till recently, most LDCs enterprises had been functioning under restrictive regimes, restrictive in terms of foreign transactions, import of technology and goods. Under the liberalised WTO regime, the LDCs will have to liberalise their external transactions, that is, remove import restrictions and import quotas, reduce import tariffs, offer national treatment to all multinational enterprises (MNEs) and grant most favoured nation status to all WTO member countries. Moreover, they will have to provide intellectual property protection in terms of longer product and process patents.

This paper analyses issues relating to the possible impact of the WTO regime on the nature and character of FDI inflows, the complexion of R&D and other innovative activities under the WTO regime, the role of technology acquisition in promoting exports and the globalisation of small and medium enterprises (SMEs). In analysing the impact of the WTO regime, a literature survey is undertaken for evidence and this will be used for projecting the possible trends. The paper, consequently, synthesises the findings of research already completed and reviews the state of the art and the gaps that need to be filled in.

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The paper is organised as follows: Section II presents and discusses the main provisions of the WTO regime that are relevant for technology transfer and FDI. Section III presents evidence from literature on the changing nature of FDI, in particular, the transformation from a market seeking to efficiency seeking one. Section IV analyses the recent phenomenon of FDI in R&D units in third countries. The relation between technology imports and in-house R&D efforts are examined in Section V. The impact of technology acquisition on exports is discussed in Section VI, while Section VII examines the role of technology acquisition in promoting growth of firms. Section VIII is devoted to the changing role of the SMEs under globalisation. Section IX discusses the policy imperatives for successfully facing the WTO regime.

II. WTO: MAIN PROVISIONS

The main provisions of the WTO that influence technology transfer and the global competitiveness of firms come under the following sections: Trade Related Aspects of Intellectual Property Rights (TRIPs), Trade Related Investment Measures (TRIMs), Subsidies and Countervailing Measures (SCMs), and Information Technology Agreement. Two basic principles govern all WTO sections. They are, national treatment and the most favoured nation status. National treatment to all firms prohibits the local host government from granting to the local firms, favours, privileges and advantages that are not available to the foreign firms. Thus in matters relating to government purchases, licensing etc. local firms and foreign firms have to be treated on par. Likewise, the most favoured nation status prevents the host government from favouring firms from one WTO member country over firms from other WTO member countries.

Most less developed countries (LDCs) and India in particular, consider TRIPs to be the most controversial of all the WTO provisions. Nearly all debates in political and scientific circles centre on the TRIPs provisions. This is mainly because most LDCs give relatively weak protection to intellectual property and in particular to drugs and pharmaceuticals. For example, in the case of pharmaceuticals, India does not grant product patents and grants process patents for only seven years. The WTO provisions require granting of patents for both products and processes for 20 years from the date of filing. Furthermore, copyrights are protected for 50 years, and they cover several items like software, databases, recordings, performances and broadcasts (20 years). Trademarks and service marks are protected for 7 years and are renewable indefinitely. Moreover, compulsory licensing and linking of foreign and domestic trademarks are prohibited. These are enforceable through courts. The enforcement mechanism should be efficient and transparent. Developing countries are required to implement these measures by January 2000 and the least developed countries by January 2006.

TRIMs will also require several changes in the rules and procedures that are followed with regard to foreign affiliates in India and other South Asian countries. So far, India and other South Asian countries have been insisting on local content requirements from foreign firms. In this regard, in several cases, physical targets have been fixed to promote domestic procurement and increase the local content. To prevent the outflow of foreign exchange trade balancing requirements are also imposed. These limit the imports of foreign firms to their earnings of foreign exchange through exports. In some cases, less stringent requirements like foreign exchange neutrality, namely, some balance between foreign exchange inflows (through exports and investments and other transfers) and

outflows are enforced. TRIMs provisions prohibit all these measures. Developing countries are expected to give-up measures like local content, trade balancing and foreign exchange neutrality by January 2000.

In addition, developing countries have to stop export subsidies by January 2003. By January 2000 all developing countries should end domestic subsidies that encourage the use of domestic over imported goods. For compliance the least developed countries are given more time, namely, till the year 2003. In addition to these provisions, an Information Technology Agreement was signed in Singapore in December 1996. This agreement calls for the elimination of all tariffs on information technology (telecommunications and computer equipment) products by the year 2000. The list of products listed is exhaustive and covers most of the products and their components.

The impact of these provisions on technology transfer and acquisition of designing and manufacturing capabilities of Indian and South Asian firms is not unambiguous. For instance, strengthening of intellectual property protection could lead to an increase in the market transactions of technology or arm's length purchase of technology against royalty, lump-sum and licensing fee payments rather than intra-firm transfer through foreign direct investments (FDI). Better patent and copyrights protection will reduce transaction costs in transferring technology through the market. On the other hand, reduction in tariffs and abolition of quotas could encourage exports to these countries rather than transfer of technology to local firms. Likewise, national treatment to foreign firms could make (FDI) more attractive as it could internalise the transactions in technology and goods and increase the profits. Removal of import restrictions could promote intra-firm trade in goods and technology. Therefore on balance it is difficult to

predict in advance whether licensing (arm's length purchase) of technology will increase or decrease as a result of the WTO regime.

In the pre-WTO regime, the foreign firms were required to source components and materials from the host country. This resulted in the parallel transfer of technology to the component manufacturers and improved the designing capabilities of the small and medium firms. The WTO regime could reduce parallel transfers and increase imports of components. It need not necessarily result in an increase in overall imports, as MNEs will continue to source components from the host country if they are competitive in terms of price and quality. MNEs could also source components from India to their other production locations. Here again, it is difficult to predict the impact of the new regime in advance on the manufacturing and designing capabilities of local (host country) firms. Nevertheless, the WTO regime will have implications for technology transfer, exports, the role of small and medium firms, technological and designing capabilities, and the global competitiveness of Indian and South Asian firms.

The WTO regime has raised several new issues for the LDCs. This paper focuses on some of the questions that are relevant to the theme of technology transfer, in particular: What kind of FDI is India likely to attract? Will this be market seeking or efficiency seeking? Is India likely to attract FDI in R&D? If so, in what sectors and with what consequences for India's technological capabilities? What is the relationship between technology imports (both FDI and arm's length) and in-house R&D activities? Do technology imports stand in the way of in-house research activities or do they promote them? What are the relationships between technology acquisition and exports? Do MNEs export more? Are the determinants of MNE exports to the home country different from

exports to third countries? What kind of exports is the new WTO regime likely to encourage? What is the relationship between technology acquisition, liberalisation and the growth of firms? What role do the new technologies like information technology play in improving the competitiveness of small and medium enterprises?

In answering these questions, the paper will examine evidence from the literature and in particular draw upon research studies conducted for less developed countries. However, as these studies report the results of the pre-WTO regime and they cannot be mechanically projected to draw lessons for the WTO regime. This aspect will be kept in mind in drawing inferences for the new regime based on the past studies.

III. EFFICIENCY SEEKING FDI

The current technological revolution (information technology and biotechnology revolution) has certain characteristics that are different from those of the earlier revolutions. The current revolution is knowledge and information intensive and not natural resources or materials intensive. Natural resource rich countries may not enjoy any advantage in exploiting this revolution. Furthermore, the product life cycles are very short, in some cases as short as a year. Additionally, for several products, size advantages in manufacturing do not exist. This feature has enabled small and medium firms to enter and become important players in manufacturing and technology generation. Besides, the impact of information technology is not confined to a particular sector or product. It is more like a technological fusion, which cuts across industries and sectors. These characteristics have important implications for technology creation and transfer. Due to short product life cycles, technology transfers have to be continuous and not a once-for-

all phenomenon. Since the small and medium firms are also significant players in technology creation, networking involving exchange of technology has become important.

The role and nature of FDI is also likely to change drastically in response to the needs of the new technology and the WTO regime. During the 1970s and 1980s most FDI was targeted towards host country markets and for using the host country as an export platform to export to the home country. These were mainly in response to trade barriers, effective rates of protection and preferential tariffs. For example, Lall and Siddharthan (1982) found effective rates of protection the most important variable in explaining foreign investments in the US. Kumar (1998a,b) found US tax laws significant in explaining US FDI being used as an export platform to the US (the home country). However, under the WTO regime, the roles of tariff and non-tariff protection, and tax laws will diminish drastically. Still, efficiency-seeking FDI, establishing manufacturing units overseas with a view to export to third countries (Kumar 1998a) will expand fast. The variables that determine efficiency-seeking FDI are different from those that attract the other two types of FDI (Kumar, 1998b).

Efficiency-seeking FDI can also result in efficiency-seeking FDI in R&D. MNEs undertaking R&D in the host countries (in foreign locations) is a recent phenomenon. If the FDI was mainly undertaken to manufacture and sell in the host country, then the nature of R&D would be mainly to adapt the technology developed in the home country to host country conditions. However, if the FDI is efficiency-seeking, then the nature and determinants of R&D undertaken in the host country will be different.

Kumar (1998) has argued that export-platform production by MNE affiliates which is geared to their home markets is different in nature from that which served the third countries. The paper examined the determinants of export-oriented production by the US and Japanese MNEs abroad. The data set consisted of pooled observations of 74 host countries, seven broad branches of manufacturing, and over three points of time for the period 1982-1994. His results showed that the home-market oriented production in the host countries was essentially cost saving in nature and was motivated to benefit from international differences in factor prices and raw material costs. Further, the US MNEs were encouraged by the provisions in the US Tariff Code which allowed duty free re-imports of components exported by US enterprises for offshore assembly. These have been found concentrated in countries that afford a low cost but educated work-force, good infrastructure, and trading facilities. The results also showed that countries situated geographically closer to the home country (in this case the US) have an edge over the others.

The third-country-oriented production abroad, on the other hand, resulted from the strategic decision of the MNEs to restructure in pursuit of enhancing their efficiency. This requires a more liberal trading regime than the home-market-oriented production. Hence, the WTO regime might attract more of efficiency-seeking FDI. Such FDI is likely to be directed towards countries that have good infrastructure facilities, a science and technology base and a skilled work-force; in other words, towards countries relatively more advanced among the LDCs. The importance of expenditures on infrastructure, skill formation and R&D in attracting FDI has been emphasised by several other studies. Wheeler and Modi (1992), based on a cross sectional study of 42 countries, have emphasised the role of these

variables in attracting FDI. Loree and Guisinger (1995) have concluded that expenditures on infrastructure are much more useful than just incentives for attracting FDI. Kumar (1998b) also concluded that local technological and absorptive capacities mainly determine technology transfer. In this connection, literature stresses the cumulative nature of technological learning and hence the increasing returns to scale on technological activity. The importance of developing leading or flag-ship corporations to attract technology transfer and networking is also emphasised in the literature (see Kumar and Siddharthan, 1997, for reviews). Thus countries like India cannot attract FDI and technology transfer unless they increase their skill and technological competence. They also need to encourage flag-ship firms to evolve into global players. The presence of these firms in-turn will attract FDI and technology of current vintage.

In efficiency-seeking investments by MNEs, low wages do not play an important role. On the other hand productivity, skill intensity and other variables play a dominant role. For example, Willmore (1992), for a sample of 17,053 firms from the Brazilian manufacturing sector found variables representing MNE affiliation, productivity, and product differentiation important in determining the decision of the firms to export (logit model). However, wage rate was not important in influencing the decision to export. Industries that enjoyed low protection levels exported more. Material intensive industries also did not have high export intensities. This is mainly because, in high tech and high value added industries, the wage component is not high. Even in automobiles the wage component is small. Thus the LDCs cannot exploit their low wages for exports. In many instances low wages are accompanied by low levels of productivity. It is the skill levels and technological capabilities that influence the competitiveness of firms and nations.

IV. EFFICIENCY SEEKING AND FDI IN R&D (FDIRD)

Another important development in recent times has been the setting up of R&D units by MNEs in the host countries. Till recently MNEs mainly conducted their R&D in their centralised home country laboratories. Initially, the European MNEs started operating R&D units in the US and the American MNEs in Europe. Later, some of the First world MNEs initiated R&D in the LDCs. Reddy (1997) examined FDI in R&D in India and came to several interesting conclusions. It was generally assumed that MNEs would set-up R&D units in countries like India mainly to make modifications in their proprietary technologies to suit Indian materials and consumer tastes and preferences. They may not undertake higher order innovative activities. Contrary to this general understanding, Reddy's study showed that the primary driving force for locating R&D units in India was technology-related. The availability of R&D personnel is the chief reason for the location of R&D units in India. His survey of 32 MNE R&D units in India showed that about 44 per cent of them were involved in higher-order R&D activities. These units mainly deal with new technologies, microelectronics and biotechnology. MNEs have also been collaborating with the Indian national research institutes, like the Indian Institute of Science and the National Laboratories under the Council of Scientific and Industrial Research (CSIR). Following Perez and Soete (1988), Reddy (1997) concluded that countries that have an adequate supply of science and technology personnel, even though they lacked actual manufacturing experience in conventional technologies, can become locations for innovation activities in new technologies. Success in attaining international competitiveness in manufacturing, however, will depend on government polices aimed at

encouraging entrepreneurial development and global competition (Nelson and Pack, 1999).

There are some important studies on FDI in R&D for the developed countries. These studies reveal several interesting features and they may be of relevance to India. Florida (1997) examined the scope, activities, performance and organisation of 200 foreign-affiliated R&D labs in the US. His study covered the stand-alone units and did not include R&D undertaken in manufacturing plants. While discussing the motivation of these units, the study distinguished between market-and-technology-oriented R&D. The paper argued that technology-oriented factors are important in motivating FDIRD. The results showed that gaining access to science and technology and developing links with the scientific and technological community were the only two significant determinants. Furthermore gaining access to human capital was also an important motive.

Kuemmerle (1999) examined the forces influencing MNEs in locating their R&D units overseas. While making a distinction between Home-base-exploiting and Home-base-augmenting FDIRD, this paper examines whether the two types of laboratories are subject to different locational pulls. The former will support the transfer of knowledge and prototypes from the firm's home location to actual manufacturing to adapt existing products better to local needs. In contrast to the capability-exploiting motive for FDI in R&D, the Home-base augmenting motive for FDIRD might be to augment the firm's knowledge base, and exploit the potential spill overs from R&D organisations such as, universities, publicly-funded research institutes, and innovative competitors.

The sample for the study consisted of wholly-owned or partially-owned labs of 32 top MNEs. These had 156 sites abroad. In the logistic regression equations, the dependent

variable was a dummy variable taking the value 1 for Home-base augmenting and 0 for Home-base exploiting. The results showed that the differences in the R&D intensities between the host and home countries and differences in the revealed comparative advantages of the host and home countries were significant with a positive sign. In a like manner differences in the number of relevant Nobel prizes and differences in percentage of population with tertiary education also had positive and significant values.

These studies show the importance of enhancing the R&D base and skill intensity of the population for attracting FDIRD. Incidentally, these variables also emerge as important factors in attracting FDI. In other words, the issue is not one of domestic R&D versus import of technology. Rather, the two go together and complement each other. R&D rich countries import a lot of technology and also export technology. The next section will discuss the evidence from the LDCs regarding the relationship between technology imports and domestic R&D.

V. IN-HOUSE R&D AND TECHNOLOGY IMPORTS

The relationship between in-house R&D and technology imports is a complex one. Some studies have argued in favour of a substitution relationship between them. In other words, they are of the view that the technology imports stood in the way of in-house R&D efforts. The other view is that most firms are simultaneous buyers and sellers of technology and there are very few firms that rely solely on their own R&D. Even in the developed countries, firms network with other R&D units, exchange technology, and use technology imports as main inputs for further R&D. In the LDCs very few firms do innovative research that result in technological paradigm shifts. On the other hand, their

R&D is mainly targeted towards adapting the imported technologies to suit local market and resource conditions. For these units technology imports are complementary to their in-house R&D efforts.

Odagiri (1983) for a sample of 370 Japanese manufacturing firms for the period 1969-81 found the relationship between in-house R&D and technology imports as complementary for a large number of products. Nevertheless, the relationship between these two variables was not significant for some industries such as, drugs, precision equipment, chemicals, and electrical equipment. He considered royalty payments as an indicator of technology imports. He found very few firms spending on technology imports. Blumenthal (1979) argued that the technological level of a country is a function of indigenous R&D, technology imports, and the relation between the two. She found the relationship to be a complex one and her empirical exercise did not yield unambiguous results.

Desai (1980, 1985) found many Indian firms stepping up their R&D outlays after technology import agreements. He attributed this to the difficulties in obtaining government approval for their extension and their dissatisfaction with the technology suppliers. Subrahmanian (1991) found a difference in the R&D behaviour of Indian firms between the pre and post-liberalisation periods. For the pre-1985 regime his study confirmed the results of Desai, but for the post-1985 regime he found a continued reliance on technology imports and less evidence in favour of a complementary one.

Lall (1983) for a sample of top 100 Indian engineering manufacturing firms (for the year 1978) found size of the firm, royalty payments, skill intensity of work-force and import of capital goods important in determining their in-house R&D expenditures. They all influenced R&D intensity (R&D by sales ratio), positively. However, exports influenced it

negatively, and the share of foreign equity (an indicator of MNE investment) was significant at only the 10 per cent level. Based on these results Lall concluded that for his Indian sample the two variables are complementary and influenced each other positively.

Braga and Willmore (1991) based on a Brazilian survey data for 1981 consisting of 4,342 establishments analysed the determinants of import of foreign designs and production engineering. In addition, they also analysed the determinants of R&D, programmes for new product development. In their sample there were 3903 private firms, 48 state enterprises and 391 MNEs. All their dependent variables were dummy variables taking the value 1 for foreign source and 0 otherwise. The following variables turned out to be important determinants: foreign equity participation, size of the enterprise and exports. Concentration represented by the Herfindahl index had a significant and positive impact on technology imports. Profit variable had a negative sign. Most of these variables (except concentration) determined the R&D also. Thus, in their study, more or less the same variables influenced technology imports and in-house R&D activities indicating a strong complementarity.

Katrak (1985) considers the strategy of importing a technology and then adapting it to suit local conditions as "import and adapt" technology (IAT) strategy. His paper examines the following two questions namely, first, does the IAT strategy stimulate local R&D? And second, do the expenditures on adaptive R&D differ between large and small, indigenous and foreign-owned, private and public sector enterprises? He considered import of capital goods and royalty payments as variables representing technology imports. In his study he used two data sets, one, the department of science and technology data set and two, the Reserve Bank of India data set. His main conclusions were, first, import of technology did stimulate in-house R&D but its magnitude was limited, and the effect was weaker for

the more complex technologies. Second, larger enterprises undertook proportionately less R&D than the smaller ones. In another study Katrak (1997) for a sample of 82 Indian enterprises in electrical and electronic industries, (of which 53 have import agreements), regressed the logarithm of R&D expenditures and the logarithm of R&D manpower on technology imports and other variables like size. For the R&D expenditures equation, the coefficient of technology imports was significant and positive but for the R&D manpower equation, it was negative and significant. Katrak concluded that technology imports had a significant negative impact on technological intensities measured in terms of R&D manpower but not when the intensities were measured in terms of R&D expenditures. He attributed the difference in the results to the inclusion of the purchase of machinery in R&D expenditures.

Siddharthan (1988) examined the R&D activity of firms in the Indian chemical, electronic, industrial machinery and textile industries. Within each industry, he separated firms on the basis of ownership - private or public. The proportion in sales of lump-sum payments for technology as provided in foreign collaboration approvals for the years 1982-5 denoted technology imports and the proportion of R&D expenditures in sales revenue was the dependent variable. The relationship between import of technology and in-house R&D varied across industries as well as across ownership groups, thus casting a doubt on the robustness of the cross-section industry results. The coefficient of import of technology variable had a positive sign for the private sector firms for all the industries, though it was not significantly different from zero for heavy machinery and the chemical industry firms. However, for the full sample, the technology import coefficient was not significant. For the private sector firms the evidence showed a mild complementary

relationship between in-house R&D and technology imports. The public sector firms seemed to have a negative relationship between the import of technology and in-house R&D efforts.

Deolalikar and Evenson (1989), for an Indian sample based on inter-industry cross-sectional data for the period 1960-70, estimated a generalised quadratic cost function. In their study, R&D (measured in terms of patent taken by the Indian industry) and technology purchase were considered as jointly determined by the characteristics of Indian industries, the prices and supply of purchasable foreign technology. Their study showed evidence of a complementary relationship between technology imports and inventive activities. Foreign and state ownership did not have a significant relationship with domestic patenting, except for the chemical industry, in which case the domestic patenting was positively related with state ownership and negatively with foreign ownership.

Earlier studies had shown that technology imports and firm size influence the in-house R&D expenditures. But do these variables also influence the output of the R&D-based products? Katrak's study (1994) concentrated in finding answers to this important question. For this it used the Department of Scientific and Industrial Research data set relating to chemical and allied industries that reports the value of products that are produced partly or mainly, on the basis of the enterprises' R&D efforts. The study covers 91 units and contains two dependent variables, a logarithm of R&D to sales ratio and a logarithm of the value of R&D-based production to R&D expenditures. The study showed that technology imports while influencing R&D intensity did not influence R&D based production. Furthermore, firm size also did not influence R&D-based production. Thus

R&D-based production depended on the nature of R&D done rather than on technology imports or firm size.

Kumar (1987) argued that the nature of the relationship between imported technology and local R&D is also influenced by the mode of technology import, in addition to other factors. Consequently, he estimated an R&D function for a cross section of 43 Indian industries for the years 1978-81 using arm's length purchase of technology and intra-firm technology transfer through FDI as arguments. Both these variables were significant in explaining the variation in R&D intensity - foreign share with a negative sign and royalty payment with a positive one. He argued that MNEs tend to centralise their R&D activity near their headquarters and may discourage their affiliates in LDCs from undertaking in-house R&D activities. Hence, the complementary relationship is valid only for the licensees.

Siddharthan (1992) used firm-level data for a sample of 69 Indian private sector firms reporting R&D expenditure for the period 1985-7, and used foreign equity participation and lump-sum payments as a percentage of sales turnover as technology import variables to explain R&D intensity. The coefficients of both the variables were positive and significant, implying a complementary relationship between technology imports and in-house R&D. On the other hand, a study by Kumar and Saqib (1996) for a sample of 291 Indian firms did not find any significant relationship between technology imports (both intra-firm and licensing) and R&D. Evidence for the 1990s shows an increase in R&D activities by the MNEs in the host countries. With liberalisation, mere import of technology might not give an advantage to the technology-importing firm, as most firms are allowed to import technology. Furthermore, barriers to entry are also removed. Under these

conditions, firms that are able to modify the imported technology to suit Indian conditions will do better.

VI. TECHNOLOGY AND EXPORTS

Current literature on international trade has been emphasising the role of technology and skills variables in influencing the relative competitiveness of countries and enterprises (Wakelin, 1997, Kumar and Siddharthan, 1997). The common feature of all the technology models of trade is their assumption that technology is not a freely, instantaneously and universally available good (Dosi, Pavitt and Soete, 1990), and that there are several advantages in being the first to introduce a product or a process. Several studies on the developed countries have found the "technology factor" important in explaining international trade. In the case of less developed countries, however, the technology models have had limited success in explaining export performance. In as much as the new technology is primarily created in the developed countries one does not expect technology factors to dominate in explaining the export patterns of LDCs. Nevertheless over time new technologies gets diffused to the LDCs. Moreover, LDCs differ greatly in terms of their technological capabilities for imitation, adaptation or absorption. More importantly, within a less developed country, enterprises differ vastly in terms of their technological acquisition, absorption and capability.

The export share of high-tech goods in the overall Indian exports is small. This is also true for many LDCs. There are several reasons for the insignificant share of high-tech exports by the LDCs. Exporters of high-tech products need to provide product-specific services such as instructions, installation, repairs, maintenance, etc. in the potential markets

abroad. This cannot be done through unaffiliated licensees due to the high transaction costs. MNEs, therefore, enjoy an inherent competitive advantage in international markets for high technology goods because of their in-house ability to provide associated services at geographically diverse locations. Thus studies have shown (for a survey refer to Kumar and Siddharthan, 1997) that less developed countries enjoyed a competitive edge only in medium- and low-tech industries. However, enterprises in medium-tech industries, having a good R&D base, and networking with overseas firms for technology imports and market information have been successful in their export orientation (Willmore, 1992, Athukorala et al., 1995, Haddad et al., 1996; Lall and Mohammad, 1983). At the same time, it is also possible that the relationship between exports, and technology imports and in-house R&D is a mutually reinforcing one. An enterprise, which enjoys the better endowment of a technology and knowledge base, is more likely to be export oriented in comparison to others. Subsequent to entering the export market, the firm may have to spend more on in-house R&D and technology imports to remain globally competitive.

Strategic affiliation with MNEs can also improve the international competitiveness of enterprises (Willmore, 1992; Athukorala et al., 1995; Haddad et al., 1996; Kumar and Siddharthan, 1997; Lall and Mohammad, 1983). In the case of high-tech industries, in most countries, enterprises function as a part of a global networking system. A single enterprise does not manufacture and export a whole product. Instead, it acts as a link in the global manufacturing system, where an enterprise imports goods, makes its value addition and exports it to the next link in the chain. Here, strategic affiliation with overseas firms can give a boost to exports. Recent studies for India, analysing the determinants of exports of

high-tech goods like pharmaceuticals, electronic items, automobiles, etc. show that the export intensity of MNE affiliates was more than that of the technology licensees. These studies show that to increase the exports of high-tech industries India needs to attract export-oriented FDI. Till recently, India did not succeed in attracting export-oriented FDI. Most MNEs came to India to serve the large domestic market. To attract export-oriented FDI a different set of policies is needed. For example, reform of the banking sector and customs and ports administration, physical infrastructure facilities, and easy access to the information highway.

VII. TECHNOLOGY ACQUISITION AND GROWTH

The Neoclassical economic theory did not have a theory of the growth of firms (Hay and Morris, 1991). It mainly concentrated on the problem of maximising profits given the cost and demand structures faced by the firm. It also considered the cost and the technological environment in which the firm functioned as given. Furthermore, it assumed that the various technological options were known to all firms and there were no search costs involved in locating appropriate technologies (Dosi, 1988, Dosi et al., 1990). Consequently, the neo-classical economists did not tackle the problems involved in technology acquisition and its impact on growth.

Therefore, in analysing inter-firm differences in growth rates, studies used the managerial economics framework. Marris (1964) was the first to develop a rigorous model to explain the growth and profits of firms. In his model, Marris introduced the concept of super environment in which a firm operates. Thus, firms would be able to push their profit-growth frontiers and achieve higher growth and profit rates by changing the

super environment in which they functioned by undertaking expenditures on technology acquisition, product development and product diversification. In the absence of a change in the super environment, firms could achieve higher growth rates only by sacrificing profits. Thus technology acquisition played a vital role in a firm's strategy for growth.

Siddharthan and Lall (1982) used the Marris framework to analyse the determinants of growth in 74 largest US multinationals during 1976-79. Unlike earlier studies, which concentrated on the impact of firm's size on growth, Siddharthan and Lall introduced other variables representing innovative activities (R&D intensity), product differentiation, minimum economies of scale, profits and multinationality. With regard to the influence of size on growth, their study confirmed the results of the earlier studies, namely, size was not an advantage for growth and gave some interesting insights into the managerial model of firm's growth. Expenditures on product diversification, differentiation and innovative activities did seem mainly to promote growth for non-consumer goods firms. For growth though the size of the firm was not an advantage, minimum scale economies played a notable role while multinationality was also not important in inducing growth. On the whole, their study brought into focus the important role of technology acquisition variables in promoting growth.

Siddharthan, Pandit and Agarwal (1994) extended the Marris framework and developed a comprehensive econometric model to analyse the growth, profit margins, investment and financial choice of the top 385 private corporate firms in India during the pre-liberalisation period (1981-84). Their study differed from earlier studies with regard to several aspects. They used a simultaneous equations framework to highlight the inter-relationship and interaction between growth, profits, investments and financial choice

variables. With regard to the introduction of the size variable, they argued that the firm size is a catchall variable that could capture the influence of several factors like vertical integration, capital intensity and capacity to spend on technology and product differentiation activities. All these activities are influenced by firm size. It would be better to introduce these factors directly as determinants of growth and then analyse the importance of the size factor. Furthermore, technology variables should be directly introduced in the growth equation as determinants to examine their relative importance.

In analysing inter-firm differences in growth and profits, they considered both technology input and output variables as determinants. The technology input variables included technology purchases from abroad against royalties, lump-sum payments, technical fee payments, and foreign equity participation representing intra-firm transfer of technology from the home firm to the affiliate. Royalty, lump-sum and technical fee receipts; awards won for their R&D activities, and patents registered were taken as representatives of technology output variables. Most of the technology-input variables, including foreign equity and royalty payments had a significant and a favourable impact on profit margins but not on growth. They attributed the unimportance of the technology variables in their growth equation to the existence of the pre-1985 strict capacity-licensing regime in India. In this regime, expansion of capacity and growth depended on obtaining an industrial license and not on expenditures on innovation and technology. If their explanation is correct, then in the post-deregulation regime, technology acquisition factors should influence growth.

Siddharthan and Pandit (1998) examined the impact of the economic liberalisation policies of the government of India in the mid-1980s on the relative growth performance

of large Indian corporate firms and MNE affiliates in India. The study considered firms from the three oligopoly industries: chemicals, pharmaceuticals and machinery. The study analysed the investment behaviour of the firms belonging to the three industries for the pre- and post-liberalisation periods and compared the results. The study argued that in the pre-liberalisation period for maintaining the market share the Indian firms depended on mainly acquiring an industrial license. In other words, entry deterrence was possible without enhancing expenditures on R&D and technology. However, under the post-1985 liberalised regime to enhance their market shares, firms had no option other than to create additional capacities and to incur expenditures on technology acquisition. The results of the stydt showed that technology variables were a great deal more important in influencing the relative growth of firms in the post-1985 period than in the earlier period. In the pre-1985 period only the initial market share and the capacity to obtain a license for import of capital goods turned out to be the important determinants of growth. In the post-1985 period, however, several technology variables such as, in-house R&D, intra-firm transfer of technology through FDI, arm's length import of technology against royalty and lump-sum payments and import of capital goods emerged as important in explaining growth.

In another study, Pandit and Siddharthan (1998) argued that technology acquisition would decisively influence the investment behaviour, modernisation and expansion plans of firms. Nevertheless, the capabilities of firms to acquire technology would differ considerably. That would depend on entrepreneurial capabilities and the initial knowledge endowment of the entrepreneur. Given the entrepreneurial characteristics, the role of technological opportunities would also play a crucial part. In

this context, the role of an entrepreneur is not to invent or create a new technology but to exploit an invention or a new technology in introducing new processes and products. The policy regime in India prior to 1985 did not permit the firms to take advantage of technological opportunities in introducing new technologies. The reforms introduced since 1985, for the first time, permitted the Indian firms to expand their product range, introduce new technologies and to increase their production capacities without obtaining an industrial license. Their study also showed that how investment in technology helped the Indian firms to lower the costs and expand the market for their products.

Evidence from literature on the growth of Indian firms since the introduction of deregulation and liberalisation measures, suggest that in the future, technology variables will play a greater role in promoting the growth of firms. In the post-WTO regime, the main competition will come from technology and new products. Indian entrepreneurs who are able to exploit technological opportunities and introduce new products will succeed in global competition. Industrialists who are not technology-oriented will fail. In this context, it is vital to study the causes for the differential adoption of technology by different firms. Here the role of the entrepreneur, his/her knowledge base, skill intensity and professional background in introducing technological change at the firm level will need detailed examination through case studies.

VIII. INFORMATION TECHNOLOGY (IT) AND THE GLOBALISATION OF SMEs

While the earlier technologies favoured mass production of a given model of a product, the current microelectronics and information technologies support flexibility in designs and

frequent changes in models and product mix. The contemporary manufacturing methods characterised by computer-aided designs, computer-aided manufacturing and flexible manufacturing systems, encourage repeated changes in product specifications. Under these transformed conditions, the mass production of a specific design does not grant any advantage to the manufacturing firm. Hence the giant corporations that enjoyed enormous advantages in the earlier technological regime may not be ideally suited to successfully exploit the current technology in their manufacturing activities. On the contrary small firms (employing less than 100 workers) and medium firms (employing less than 300 workers) are more flexible and are capable of introducing rapid changes regarding technological choice, products mix, etc. Consequently, they have an advantage over the larger firms in the current technological scene.

The adoption of IT and its consequences have been studied by several scholars (Loveman, 1988; Kraemer and Dedrick, 1994; Brynjolfsson and Hitt, 1996; Lal, 1996 and 1998). Studies on Indian SMEs manufacturing garments, electrical and electronic goods (Lal, 1996, 1998) show that the introduction of information technology results in a paradigm shift in the manufacturing configurations. Evidence for both developed countries and LDCs indicates that IT promotes productivity, profits, and exports, and the advent of higher profits in turn makes it possible for the firm to invest more on information technology. Similarly, the role of IT in improving the quality of the products and in promoting the international orientation of SMEs is now adequately established.

Although it has been argued by Mody and Dahlman (1992) and Rahim and Pennings (1987) that investment in IT can accelerate economic growth by enhancing

workers' productivity, no significant productivity gains were found in empirical studies conducted during the initial period of adoption of IT (Loveman, 1988). These results are referred to as "productivity paradox". However, recent studies (Kraemer and Dedrick, 1994; Brinjolfsson and Hitt, 1996; and many others) have challenged the productivity paradox phenomenon and have found evidence in favour of significant productivity gains across all industries in developing and developed nations. Insignificant productivity gains in the early period of adoption of IT can be attributed to the adoption of inappropriate IT tools for a particular task. Subsequent developments in IT have led to the creation of industry-specific IT tools. Furthermore, the costs of IT tools have also come down sharply and are now within the reach of SMEs. Consequently, the adoption of IT in LDCs by SMEs has been on the increase (Amsden, 1989; Ranis, 1990). However, the absence of infrastructural facilities and easy access to the information highway has stood in the way of Indian SMEs taking full advantage of the IT revolution and playing their rightful role in the global markets.

IX. POLICY IMPERATIVES

The impact of liberalisation and the WTO regime on the innovative activities of the less developed countries' enterprises, and in particular, of the Indian enterprises is difficult to predict. Till recently, most of the less developed countries' enterprises have been functioning under restrictive regimes, restrictive in terms of foreign transactions, import of technology, services and goods. Under the liberalised WTO regime, the less developed countries will have to liberalise their external transactions, that is, remove import restrictions and import quotas, reduce import tariffs, offer national treatment to all MNEs,

grant most favoured nation status to all WTO member countries, and provide intellectual property protection in terms of longer product and process patents by January 2002. The least developed countries will have to adopt these measures by January 2005. The restrictive economic regimes of the pre-1990s did not encourage drastic technological upgradation of their enterprises. Consequently, most of the Third World enterprises functioned under the earlier technological paradigms and did not shift to the new ones. However, they developed sufficient capabilities to make substantial modifications in the imported technology and traversed different trajectories. Nevertheless, their R&D units were not tuned to introduce paradigm shifts.

Liberalisation measures introduced in the 1990s resulted in the introduction of new technologies and products resulting in major paradigm shifts. The experience of the in-house R&D units in altering the earlier technologies based on a different technological paradigm might not be useful in developing new technologies. Thus in the short-run, soon after liberalisation, massive imports of technologies through intra-firm transfer and arms' length purchase of technology against lump-sum and licensing fees could take place and the relative importance of in-house R&D might decline (Narayanan, 1998). However, in the long run, even under the new regime, enterprises with established R&D units might do better. Firms with R&D units will be in a better position to locate technologies that are appropriate and likely to succeed in the domestic environment. Moreover, in a competitive environment mere possession of imported technology might not give an advantage, as, given the liberalised regime, most firms can afford to import. To succeed in the market, the enterprise will have to introduce major modifications in the imported technology to suit the

domestic environment, consumer tastes, and domestic resource endowments. In such a scenario, firms with active in-house R&D units will have an advantage.

The introduction of the WTO regime will have far reaching consequences on knowledge and technology transfer. It will affect the nature, mode and the quantum of technology transfer. However, the nature of the impact is difficult to predict. For example, better protection for intellectual property could prompt foreign enterprises to licence technology rather than transfer it intra-firm through FDI. But the other provisions of the WTO regime like national treatment for all firms, sharp reduction in import duties, and removal of domestic procurement obligations could induce FDI as a preferred mode. A study by Contractor (1990) showed that as a result of economic liberalisation and deregulation, countries attracted more FDI than licensing and technological collaboration. In the pre-WTO regime, due to the high import duties and domestic procurement obligations, MNEs transferred technology to component manufacturers in the host countries and thereby developed the technological capabilities of the smaller enterprises. In the new regime they could find it profitable to import the whole product and sell it in the host country. To that extent knowledge transfer would be reduced.

In particular, market-seeking FDI will decrease while efficiency-seeking FDI will become more prominent. The ability of a less developed country like India to attract efficiency-seeking FDI will depend on the location advantages India is able to provide. This in turn will depend on the government policy, the ownership advantages of intangible assets that the Indian enterprises possess and the infrastructure facilities available for networking. Government policy must concentrate on all three elements to make the enterprises globally

competitive. India is well endowed with science and technology institutions of eminence like the Indian Institute of Science, Indian Institute of Technologies and National Laboratories. The presence of these institutions can attract FDI in R&D. To exploit these fully, India should also encourage some flag-ship companies to emerge. High-tech enterprises depend mainly on venture capital funds. Venture capital facilities in India need drastic improvement if India is to play an important role in technology creation.

The main provisions of the WTO regime will alter the global manufacturing and trading scene. The role of MNEs in transferring technology, investments, and international trade will increase. In particular intra-firm trade is likely to expand. In specific segments SMEs will have a decisive advantage, while in certain other segments large corporations can play a better role. The large corporations should restructure themselves, vacate industries where they are not likely to have an advantage, and consolidate in sectors where they have a future. SMEs can play a useful role only if they are allowed and encouraged to modernise their operations and are provided the necessary facilities to network.

India is not an important player in the global arena. The Indian share in both world exports and FDI inflows is less than 1 per cent. With such an insignificant share India will enjoy very little power in influencing WTO rules and regulations. However, being a member of WTO automatically gives India the most favoured nation status with all the other WTO members. If India leaves WTO it will lose this status immediately. Hence, at the global level, the strategy should be to strengthen the multilateral organisations and co-ordinate Indian activities with other less developed countries. For instance, the developed countries, while, advocating free trade in goods and services, have been introducing

restrictions with regard to trade in technology. As seen in the earlier sections, they are not willing to sell machinery and components embodying new technology to unrelated third parties. Less developed countries need to campaign for opening up of the technology market to make the state of the art technology available to them. Less developed countries should also campaign for the removal of restrictions for import of high-tech goods and the abolition of non-tariff barriers being erected by the developed countries.

Simultaneously, India should introduce several domestic reforms and create domestic institutions to face the global challenge. In this context it is vital to promote venture capital firms to encourage and assist innovations in the SMEs. This might require the introduction of new laws and the deletion of outdated ones. Since modernisation of the SMEs should be a priority, India should relax the restriction imposed on FDI in the small-scale sector. In this context India can learn from the experience of China and other East Asian countries that have been successful in modernising their smaller units and making them global players.

It is vital for India to increase the value addition in Indian exports. In addition to changing the export basket in favour of high-value added goods, India should also urgently improve the infrastructure. Kalam and Rajan (1998) have emphasised the role of infrastructure in augmenting value addition. More importantly, delays caused by bureaucracy, customs, transport bottlenecks and time consuming procedures can significantly contribute to negative value addition. Under the protectionist regime, Indian enterprises enjoyed enormous rents and could tolerate the negative value addition caused by bureaucratic delays and infrastructure deficiencies. The enterprises could also share the

rents arising out of the protectionist regime with the rent-seeking bureaucracy. However, in the post-WTO competitive environment, there will be no rents due to protection and the profit margins will be low. Under the changed environment, negative value addition will inflict serious damage to the enterprises. Many of them will cease to be competitive and might even go out of business. Hence the urgency in improving infrastructure, introducing administrative reforms, in making the decision making transparent and in introducing accountability.

The current era can be characterised as an internet and E-commerce age. The competitiveness of firms and nations will depend on easy and instant access to the internet and E-commerce. Market conditions, consumer tastes and preferences, and fashions change continuously. It is not possible to remain in business and be competitive unless firms are able to monitor constantly the market conditions on the internet. Furthermore, most commodities including automobiles and computers are sold using the internet and E-commerce. In the information age, countries that impose restrictions on free flow of information and do not create conditions for easy access to the international information highway will become victims of the current revolution. The information technology industry in India has experienced notable growth mainly because the government had very little say in this sector. Nevertheless, access to the international information gateway is still being controlled by government agencies and is a monopoly of VSNL. This can result in overcrowding, create bottlenecks and hinder future expansion possibilities. The creation of a new ministry by the current government to administer information technology could be a mixed blessing. If the new ministry concentrates on regulation and exercise of its power,

then it can greatly hinder Indian competitiveness. However, if the ministry confines itself to investments in infrastructure and development of the sector then it can act as a facilitator.

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