Journal of Economic Cooperation **20**, 3 (1999) 21-38

TECHNOLOGY TRANSFER AND PATENTS: THE IMPACT OF TRIPs ON MUSLIM COUNTRIES

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Technology is a crucial input in the industrialisation and development of countries. The dependency on foreign technology in developing countries is indicated by an increasing trend of foreign technology transfer payments and foreign direct investment (FDI) inflows. Most of the technology required for industrial development is patented and the patents are owned by business corporations in developed countries. Furthermore, the innovative activity which is the source of technology generation tends to be highly concentrated in a handful of industrialised countries and dominated by a small number of larger corporations. The question is, will developing countries benefit from Trade-Related Intellectual Property Rights (TRIPs) by adopting and strengthening patent protection? Advocates of TRIPs argue that having a stronger, standardised and effective intellectual property protection could improve technology transfer and FDI inflows into developing countries. However, there are other studies which show that intellectual property protection, particularly patents, have played an insignificant role in determining the effectiveness and enhancing technology transfers in developing countries. This paper attempts to examine this question and analyse the constraints and prospects of Muslim countries gaining from extending patent protection to foreigners in terms of enhancing technology transfer, stimulating R&D activities and consequently increasing local technological capabilities. Discussion will be focused mainly on developing countries as data and literature available on this issue are largely related to developing countries. However, any implications that TRIPs would have on developing countries would certainly have an equivalent effect on Muslim countries.

1. INTRODUCTION

Technology is a crucial input in the industrialisation and development of countries. The importance of technology in economic growth is enhanced further as international competitiveness is now increasingly being determined by advances in technology. In developing countries, technological capability is built mainly by acquiring foreign technology through technology transfers, importation of appropriate technologies and appropriation of disembodied technologies via foreign direct investments (FDIs).

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The dependency on foreign technology in developing countries is indicated by an increasing trend of foreign technology transfer payments and FDI inflows. The annual technology transfer payments rose from $6.6 billion in 1976 to an estimated $64.4 billion in 1995 (Kumar, 1998). Between 20 and 30 per cent of total global technology transfer payments come from developing countries. Similarly, the annual global FDI inflows rose from $22 billion in 1975 to a peak of $315 billion in 1995, of which more than one third is being channelled into developing countries. However, technology transfers to developing countries have grown at a slower rate than overall inflows (see Table 1). In addition, the growth rates of FDI inflows have been more impressive than those of technology transfer payments. In the early years, developing countries' share in technology payments generally exceeded their share in FDI inflows, but an inverse tendency is apparent in more recent years. The increase in the share of developing countries as recipients of FDI and their decreasing share in global technology transfers suggest that a recent surge in FDI inflows may not have been accompanied by disembodied technology transfers in the same proportion (Kumar, 1998:25). One of the reasons for such development is that a considerable proportion of FDI inflows in the recent period has been on account of mergers and acquisitions of existing enterprises (UNCTAD, 1996), which could be restricted to the transfer of some organisational and managerial skills.

Table 1
Average annual growth of global technology flows and foreign direct investments, 1975-95

Year	Technology transfer payments		FDI inflows	
	World	Share of developing countries %	World	Share of developing countries %
Average annual growth rate, 1975-95	13.14	15.33	16.40	16.57
Average annual growth rate, 1975-85	7.44	8.93	9.56	7.59
Average annual growth rate, 1985-95	18.99[2]	17.95[2]	21.19	24.06

Source: Extracted from Kumar (1998), Table 2.7, p.26.
Note: [1] Figures are for 1993-95 (projections).

[2] Figures are for 1985-93.

The patterns of technology generation and its transfer abroad have been greatly affected by various changes such as liberalisation of international trade regimes, creation and development of new core technologies, improvement in telecommunication systems world-wide, the adoption of the Trade Related Intellectual Property Rights (TRIPs) Agreement and regional economic integration. One of the major consequences of these developments is that mastery and control of new technologies is becoming a major determinant of international competitiveness (Mody and Wheeler, 1990), and due to this, technology suppliers are apprehensive about creating their own competitors (Kumar and Siddharthan, 1997:24). Dahlman et al. (1995:176-7) argue that this causes the relative slow-down of technology transfers to developing countries in the 1990s.

However, advocates of TRIPs argue that having a stronger, standardised and effective intellectual property protection could improve technology transfer and FDI inflows into developing countries. Frischtak (1989), for example, suggests that developing countries need to be more aware of the potential role of intellectual property protection in attracting foreign technology through licensing. He claims that in a competitive global trading environment, it is indispensable for a developing country to revise its regulatory environment, including its intellectual property regime, so as to attract foreign expertise of the kind most beneficial to it. Furthermore, it has been suggested that technology owners did not have an incentive to transfer their propriety knowledge to countries with weak intellectual property rights systems for fear of the potential for 'piracy'.

The question is, will developing countries benefit from TRIPs by adopting and strengthening patent protection? This paper attempts to examine this question and analyse the constraints and prospects of Muslim countries gaining from extending patent protection to foreigners in terms of enhancing technology transfer, stimulating R&D activities and consequently increasing local technological capabilities. However, it is important to note here that a stronger IPR protection would have a significant effect on FDI, particularly investment in high-technology based industrial sector. In this case, technology transfer and foreign investment are very much inter-related to each other and are inseparable[1]. Discussion in this paper will be focused mainly on

[1] Nevertheless, a short note distinguishing the difference between technology transfer through patenting and that with FDI would be useful here. If a technology transfer agreement involves patent licensing, this means that legally the licenser is granting the licensee not only the right to use the technology but also release detail technical

developing countries as data and literature available on this issue are largely related to developing countries. However, any implications that TRIPs would have on developing countries would certainly have an equivalent effect on Muslim countries.

2. THE TRIPs AGREEMENT

An Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) was proposed to be included in the World Trade Organisation (WTO) as a result of intense multilateral debate for strengthening intellectual property protection standards and its enforcement world wide. Higher expenditure on research and development, stiffer international competition, and changes in the organisation of research and production spurred efforts to intensify intellectual property protection (Wijk and Junne, 1993). The developed countries insisted that inadequate standards of protection and ineffective enforcement of intellectual property often unfairly deprive [them of] their rights and lead to production of counterfeit and pirated products. Therefore they have to bear heavy losses. For instance, in 1986, 193 US firms estimated their aggregate world-wide losses in this respect at $23.8 billion (US, International Trade Commission, 1986).

The TRIPs Agreement, which came into effect on 1st January 1995, is claimed to be the most comprehensive multilateral agreement on intellectual property. It deals with each of the main categories of intellectual property rights, establishes standards of protection as well as rules on enforcement, and provides for the application of the WTO dispute settlement mechanism to resolve disputes between Member States. The areas of intellectual property that the TRIPs Agreement covers are: copyright and related rights (i.e., the rights of performers, producers of sound recordings and broadcasting organisations), trademarks including service marks, geographical indications including appellations of origins, industrial designs, patents including the protection of new varieties of plants, the lay-out designs of integrated circuits, and undisclosed information including trade secrets (WIPO, 1996).

The TRIPs Agreement has been referred to as a minimum standards agreement, and the WTO has emphasised that it was not intended to be a harmonisation agreement. This means that Members must conform to the

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information related to the technology. The constraint of the effectiveness of such transfer is discussed in the text. On the other hand, technology transfer which comes via FDI is broad in terms of its scope and it may involve transfer of knowledge on know-how, management, technical assistance, turnkey and engineering services, and/or also patent and trademark agreements.

minimum requirements established by the Agreement and they are free to provide more extensive protection of intellectual property within their own legal system and practice. The minimum standards are set at a level broadly comparable with that in the main industrial countries. The Agreement sets the standards by requiring the Members, first, to comply with the obligations (the most recent version) of the main conventions of the WIPO, the Paris Convention and the Bern Convention. Secondly, the TRIPs Agreement adds a substantial number of additional obligations on matters where the pre-existing conventions are silent or were seen as being inadequate. The TRIPs Agreement is thus sometimes referred to as a Bern and Paris-plus agreement.

The Agreement gives all WTO Members transitional periods so that they can meet their obligations under it. However, there are two important substantive obligations that have been effective from the entry into force of the TRIPs Agreement on 1st January 1995. One is the so-called "non-backsliding" clause in Article 65.5 which concerns the changes made during the transitional period. The other is the so-called "mail-box" provision in Article 70.8 for filing patent applications for pharmaceutical and agricultural chemical products during the transitional period. The transitional period, which depends on the level of development of the country concerned, is contained in Articles 65 and 66. Developed country Members had a one-year transition period starting from 1st January 1996 during which they had to comply with all the provisions of the TRIPs Agreement. For developing countries, the general transitional period is five years, i.e., from 1st January 1995 up to 1st January 2000, and for those countries on the United Nations list of least developed countries, the period is eleven years.

Compliance with the provisions of the TRIPs Agreement is obligatory on all Members of the WTO. Therefore, developing countries have no other options than working towards strengthening their intellectual property rights (IPRs) protection. In fact, increasing credentials have been given to tighter property rights in developing countries, and confidence is building up that stricter IPRs protection can encourage indigenous technological capabilities, enhance technological activity through improved access to foreign multinational companies' (MNCs) new knowledge, including technology transfer and the enhancement of R&D capabilities.

3. WHY PATENT IS IMPORTANT IN TECHNOLOGY TRANSFERS?

The main argument for granting patent rights to non-residents on inventions and innovations developed and worked abroad, particularly in developing

countries, is to induce technology transfers[2] and foreign investment. Patents granted to

[2] There are two types of technology transfer, i.e., unpackaged transfer and packaged transfer (Gazda, 1996). Unpackaged transfer mainly involves transfer of title, the right in itself and basic engineering knowledge. It usually occurs between partners who are at the same technical level. Packaged transfer, on the other hand, involves not only grant of the right to use the technology, but also transfer of a good deal of other information related to the technology to the recipient. This type of transfer usually occurs between unequal partners, i.e., partners who are not at the same technical level. In developing countries, the type of technology transfer received is packaged transfer, where recipients are granted the right to use the technology under a licensing agreement. There are different kinds of agreements:

1. Licence as the main subject of the agreement (contractual main obligation). This includes:
   a. a licence for a patent, without collateral obligations (patent license agreement)
   b. an agreement concerning the transfer of know-how *per se* without any collateral service or delivery (know-how agreements).
   c. an agreement concerning a patent licence together with the transfer of know-how, or vice versa (agreement with a mixed subject)
2. Licence as a collateral subject (contractual collateral obligation). This consists of:
   a. an agreement for services within which a patent and know-how are also transferred.
   b. an agreement for the delivery of goods (agreement of sale for the delivery of equipment or a complete plant) in which a patent and/or know-how are/is also transferred.
3. Special agreements, e.g., an agreement for the foundation of an enterprise.

For more detail on issues related to technology transfer see Gazda (1996).

foreigners by less developed countries are unlikely to have much effect on the rate of innovation or invention in developed countries (see Penrose, 1973: 770). In addition, there are insignificant benefits to be gained by less developed countries from the 'national treatment' clause in TRIPs since they have little opportunity and possibility to patent their own invention or innovation abroad. Hence, the only economic advantage to be gained from granting foreign patents is that it will induce technology transfers and inflows of foreign investment.

The main objective of TRIPs in its effort to strengthen and improve the effectiveness of intellectual property protection world wide is to ensure that signatory countries grant the same rights to nationals and residents of other signatory countries as they grant to their own nationals. This is important given the fact that in all countries foreigners do own patent rights. Even in the developed countries, with the exception of the United States and Japan, more patents are granted to foreigners than to nationals (see Table 2).

In less developed countries, the majority of patents granted are owned by non-residents, where foreigners own from 75 to over 90 per cent of the patents granted, and these may be highly concentrated in the hands of a very few companies (Penrose, 1973: 769). A similar situation is also found in the Muslim countries. In Uganda, Gambia, Sudan, Syria and Saudi Arabia all patents that were granted in 1996 were owned by foreigners (see Table 2). Residents in Indonesia, Pakistan, Malaysia and Turkey owned only 2-8 per cent of total patents granted in the same year[3]. In comparison to this, residents in Japan and the US owned 87 per cent and 56 per cent of total patents granted in 1996.

Table 2
Patents granted to residents and non-residents in selected Muslim countries* and developed countries, 1996

Country	Number of patents granted				
	Residents	% of the total patents granted to residents	Non-residents	% of the total patents granted to non-residents	Total
Uganda	0	0	102	100	102
Gambia	0	0	98	100	98

[3] Muslim countries in Central Asia seem to have more patents owned by residents than foreigners, for example residents in Kazakhstan owned 78 per cent of total patents granted, while in Azerbaijan and Uzbekistan, the residents had 98 per cent ownership (see Table 2). This could be because of the inward-looking policy during the Soviet regime.

Sudan	0	0	97	100	97
Syria	0	0	49	100	49
Saudi Arabia	0	0	2	100	2
Indonesia	16	2.5	615	97.5	631
Pakistan	15	2.8	524	97.2	539
Malaysia**	79	4.4	1722	95.6	1801
Turkey	47	7.8	554	92.2	601
Tajikistan	12	15.6	65	84.4	77
Egypt	46	18.4	204	81.6	250
Tunisia	31	21.2	115	78.8	146
Kyghyzistan	51	40.8	74	59.2	125
Kazakhstan	908	78.2	253	21.8	1161
Azerbaijan	79	97.5	2	2.5	81
Uzbekistan	411	97.6	10	2.4	421
Japan	187681	87.3	27419	12.7	215100
U.S.A.	61104	55.7	48542	44.3	109646
Germany	19770	35.6	35674	64.4	55444

Source: WIPO (1996), "Patents applications filed and granted during 1996", IP/STAT/ 996/A.
Data for Malaysia are from the Ministry of Domestic Trade and Consumer Affairs, Malaysia.
Note: * Only countries for which data are available are included here.

Most of the technology required for industrial development is patented and the patents are owned by business corporations in developed countries. Furthermore, the innovative activity which is the source of technology generation tends to be highly concentrated in a handful of industrialised countries and dominated by a small number of larger corporations. Table 3 shows an extreme form of concentration with just ten countries accounting for the bulk of all technological activity in the world. The top ten countries account for as much as 84 per cent of global resources spent on R&D activity annually. They also control 95 per cent of the technological output in terms of patents taken out in the US, and receive 91 per cent of global cross-border royalties and technological fees (Kumar, 1998). The USA account for 39 per cent of total world R&D expenditure, 40 per cent of total technology fees received in 1993 and 30 per cent of total FDI outflows in 1995. This is followed by Japan, accounting for 17-18 per cent of global R&D expenditure and US patents, Germany (9 per cent) and France (6 per cent). In terms of global technology fees

Table 3
Major source countries of technologies, mid-1990s

Country	R&D expenditure, 1993[1]		US patents taken, 1977-96[2]		Technology fees received, 1993[3]		FDI outflows, 1995[4]	
	billion PPP $	% of total	'000	% of total	billion $	% of total	billion $	% of total
USA	166.3	39	985.3	570	20.4	40	95.5	30
Japan	74.4	17	307.6	18	3.6	7	21.3	7
Germany	37.1	9	136.2	8	7.3	14	35.3	11
France	26.4	6	52.7	3	2	4	17.5	6
UK	21.6	5	52.8	3	2.9	6	37.8	12
Italy	13.2	3	22.1	1	0.9	2	5.1	2
Canada	8.4	2	34.4	2	0.9	2	4.8	2
Netherlands	5.1	1	16.9	1	6.2	12	12.4	4
Sweden	4.8	1	17.3	1	0.4	1	10.4	3
Switzerland	4.2	1	25.5	1	2[6]	4	8.6	3
Subtotal	361.5	84	1650.8	95	46.6	91	248.7	79
World	428.58[5]	100	1732	100	51[7]	100	315	100

Source: Kumar (1998), Table 2.1, p.14.

Notes:

1 OECD(1996), *OECD in Figures: Statistics on the Member Countries.* 1996 Edition, Paris: OECD, pp.56-57.

2 US Patents and Trademarks Office (1997), *TAF Special Report: All Patents, All Types, January 1977 - December 1996,* Washington, D.C.

3 OECD (1996), pp.60-61.

4 UNCTAD (1996), *World lnvestment Report l996,* Geneva: United Nations.

5 UNESCO (1996), *World Science Report 1996,* Paris: UNESCO. This figure relates to 1992.

6 Estimates done by Kumar (1998), based on mirroring of payments by major OECD countries.

7 Estimates done by Kumar (1998), providing for non-reporting countries.

received, Germany ranked second, followed by the Netherlands, Japan and the UK. This ranking, however, is not consistent with the order of the share of US patent ownership and global FDI outflows. Japan owned 17 per cent of US patents, while Germany and France stood in the third and fourth positions in terms of US patent ownership. The second largest investor in the world in 1995 was Germany, followed by the UK, Japan and France.

In addition, innovative activity within the industrialised countries is dominated by a small number of large corporations (Tuldar and Junne, 1988). Table 4 shows that the top 165 US and foreign companies own 38 per cent of all patents granted in the US. The remaining 62 per cent of patents were shared by 130,431 corporations. Within the group of 165 corporations, the top 50 account for as many as 65 per cent of patents (Kumar, 1998:20-21).

Table 4
Trends in the ownership of US patents held by organisations/corporations, 1977-96

Category	Number of patents granted during the period		
	1977-82	1983-89	1990-96
Patents owned by organisations/corporations	303,096	453,836	621,815
Patents owned by the top 165 organisations	117,189	175,981	232,280
Patents by the remaining 130,431 organisations	185,907	277,855	389,535
Patents owned by the top 50 corporations	76,345	113,828	158,999
Share of the top 50 in patents owned by 165 organisations, %	65.015	64.68	68.45
Share of the top 50 in all organisational patents, %	25.19	25.08	25.57

Kumar (1998:20), Table 2.5.

It is clear therefore that most of the technology required for industrial development is patented and the patents are owned by business corporations in developed countries. Patented technology is only obtainable from firms holding the patents and they may refuse to sell their knowledge in the absence of patent protection. Thus, in such cases, patents become a necessary, though not sufficient, condition for the technology transfer (Penrose, 1973:771). Furthermore, the disclosure of the technology which is contained in the patent schedule (which is a public knowledge) is not sufficient for industrial application. The technical know-how and operational aspects of the patented technology will still be an industrial secret of the owner. Business corporations

will not release this know-how to maintain their technological edge and also to avoid the possibility of 'technology robbery' by their competitors. Owners of patented technology are willing to disclose their knowledge on condition that their technology would be protected from piracy and that they are rewarded in the form of licensing fees and royalties.

4. DOES STRENGTHENING PATENT PROTECTION ENHANCE TECHNOLOGY TRANSFERS?

A report published by the UN (1964) reviewed the patent legislation of 29 selected countries and did a survey on the importance of foreign patents for industrial development. It concluded that patents were a valuable aid to their development and assisted the spread of technology through publication, promoted manufacturing and investment and encouraged foreigners to licence their patents and assign their rights to local producers[4]. A study by Levin *et al.* (1987) on 130 companies in the USA shows similar results. It concluded that patents had equal impact on effectiveness in acquiring technology as other methods of technology transfer such as licensing technology, publications or technical meetings, conversations with or the hiring of employees of innovating firms, reverse engineering of a product and independent R&D (see Table 5).

Table 5
Effectiveness of alternative methods of technology transfer in learning about new products and processes

Method of technology transfer	Type of patent		
	Process	Mean score	Product
Licensing technology	4.6		4.6
Patent disclosures	3.9		4.0
Publications or technical meetings	4.1		4.1
Conversations with employees of innovating firm	3.6		3.6
Hiring R & D employees from innovating firm	4.0		4.1
Reverse engineering of product	4.1		4.8
Independent R & D	4.8		5.0

* Mean score on a scale of one (not at all effective) to seven (very effective).
Source: Levin *et al.* (1987), Table 6.

[4] In this study, India, Lebanon and Cuba stated that they did not benefit from international patenting.

However, there are other studies which show that intellectual property protection, particularly patents, have played an insignificant role in determining the effectiveness and enhancing technology transfers in developing countries. Wijk and Junne (1993) reported that a survey among multinational companies reveals that published specifications are the most important source of technical information, compared with technical conferences and meetings, academic and trade journals, fairs, exhibitions and the like. One of the reasons for this is due to limitations in the patent system itself. An essential condition for the grant of a patent is that the patent description must disclose the invention in a manner sufficiently clear and complete for the licensee to make it useful for their operational purposes. Patent documents are important means of obtaining information on state of the art industrial technology. But, the existing patent system provides avenues for patentees allowing them not to disclose their technological know-how completely nor to reveal essential information on the operational aspect of the technology (Wijk and Junne, 1993).

In addition, the relevance of patent protection in technology transfer is limited because it has not been regarded as an important criterion in transferring technology to developing countries. Lall (1976: 9) suggests that in the context of the LDCs, patent protection is not particularly significant in promoting technology transfers. According to him, a large number of industries do not seem to bother with patenting at all, and the transfer of their technology is totally unrelated to the patent system. Kunz-Hallstein (1975:432) argues that only the smallest part of the technology required by developing countries has been patented, that is, no more than 2 per cent of the transfer of technology is effected through patents. He further noted that questions of patent law cannot arise in many important forms of transfer of technical knowledge such as education, training or scientific co-operation. However, Kirim (1983) points out that patents may, in some cases, be the basis of licensing agreements which are contracted for the purpose of the transfer of the licenser's technology. But, the objective of patenting (and other IP law) in the technology transfer agreements can be manipulated. In their study on the impact of patenting on the behaviour of technology supplying firms in the pharmaceutical, chemical and electronics industries in the UK, Taylor and Silberton (1973:113-114) note that 'many industrialists (they) consulted said quite categorically that the main purpose of licensing is the exchange of know-how, with patents [being] a minor consideration added in small print at the end of an agreement to lend an air of extra security to the contract'.

Furthermore, it has been found that patent protection provided to foreigners serves solely to protect the patentee's market (Vaitsos, 1972). It has

also been found that it gives patentees the power to abuse in licensing agreements, e.g., by export restrictions (Sell and Mundkowski, 1979:566). This is indicated by the large percentage of patents granted to foreign investors that are not effectively used in production[5]. Katz (1973:67-69) found that the local utilisation of foreign patents in developing countries is rather small. In his empirical research in Argentina, Katz reported that out of 102 patents granted, only 15 were actually under exploitation, 29 covered current imports and the remaining 58 patents were not under present exploitation. A fraction of those 58 patents was 'abandoned', i.e., maintenance fees had not been paid regularly to keep them 'active', while yet another fraction was being kept active either for future utilisation or for the protection of future imports. This is clearly in contrast with US data, where 50-60 per cent of US-granted patents are commercially exploited (UNCTAD, 1975). Katz therefore remarks that the role of patents as instruments for import protection is quite apparent in Argentina. He further pointed out that whereas in the developed countries patents acted as the provider of an incentive to inventive activity, in developing countries it merely supported the overall investment strategy of multinational firms which started local operation with very low vertical integration.

The above discussion leads us to conclude that patent protection has not been an important factor in enhancing technology transfers in developing countries, and therefore Muslim countries. It also has not been an effective means of inducing technology transfers. So, where do we go from here? Since patent protection is compulsory on all Muslim countries, we expect to see

[5] Developing countries have strongly argued against the non-working of patents stating that if a patent is only used for import purposes, foreigners can exercise monopoly power over the protected market (Wijk and Junne, 1993). The early patent system provides for working obligations where the patent must be exploited within the country of grant, and importation of patented products itself is not a ground for forfeiture. However, revisions to the Article SA of the Paris Convention since 1911 resulted in several changes in its working obligation clause. An apparent modification is where protection is granted to patented imported products, and since then there was a progressive weakening of the patents working requirement in the Paris Convention. Developing countries voiced their concern on the importance of imposing more stringent working obligations on foreign patent holders and they argue that importation of patented products does not constitute the working of an invention (see Wijk and Junne, 1993: 24-25). Industrialised countries, on the other hand, argued that it may be uneconomical for a company to exploit its patent in all countries where the patent is recognised. They perceive that prevention of the unauthorised copying of a patented product or process in the importing country as one of the core functions of the patent. Therefore they asserted that definition of *working* a patent also includes importing the product.

more foreign multinational firms patenting their technology and products in the Muslim countries in the future. Given this, what should the Muslim countries do to maximise the potential benefits of strengthening patent protection (regardless of how little it would be)? The way I see it is that Muslim countries must upgrade and improve their education system, research facilities, and other infrastructure and focus on producing skilled manpower. Kumar (1995) found that there is a tendency for MNCs to use licensing and patents as a means of exploiting their knowledge abroad to be positively related to their overseas R&D. Thus, for an effective transfer of technology in the appropriate and priority sectors, Muslim countries must ensure that MNCs are attracted to locate their R&D activities in their country.

5. ENCOURAGING MNCs' R&D ACTIVITIES

There are several key reasons for MNCs to locate their R&D activities abroad. Mansfield, Teece and Romeo (1979) in a study on 55 US and middle-Atlantic firms found the proportion of overseas R&D to be positively related to the proportion of subsidiary sales, negatively to exports, and positively to firm size. Zejan (1990) found the size of the market and per capita income to have a positive and significant influence on affiliate R&D. Other factors which may encourage overseas R&D include the need for product or process adaptations for specific markets, cost rationalisations, and appropriation of knowledge from technological activities of rival firms (Kumar, 1995). The interesting point to note here is that MNCs tend to locate R&D in countries advanced in their own fields to benefit from the knowledge spillovers or to simply keep track of the activities of their competitors. This is particularly so in the case of advanced technology enterprises such as R&D investment in biotechnologies and microelectronics in the US by European and Japanese enterprises, the US chemical enterprises investing in R&D in Germany, and the European and US companies investing in semiconductors development in Japan (Kumar, 1995: 8). Dunning (1988) argued that US MNCs were likely to invest heavily abroad in R&D in the sectors where they were confronted with major international rivals whose home countries were sources of innovative activity. These R&D investments would be directed to most technologically advanced countries in the world.

The relative strength of intellectual property protection available in a country may be a factor in determining the overseas R&D activity by MNCs. However, the effect of intellectual property protection on location of R&D may depend on the type of R&D that is conducted. If the MNCs are interested in locating their R&D on advanced technology, or if they are keen to invest abroad in R&D to develop a new product in the overseas market, then the

strength of intellectual property protection in the host country would be a matter of concern. But, if overseas R&D is directed to local adaptations and providing other support to local production of MNCs, then the intellectual property regime may not be of much consequence for its location.

Mansfield (1994) reported that IPR protection would have a considerable effect on how much US investors will invest in facilities to manufacture components and complete products as well as R&D facilities. He found that the importance of products patents and trademarks was well-established for the pharmaceutical industry. For other branches of the chemical industry, Mansfield found that the protection of "know-how" was often the main concern, and patents had a lower relevance (except for some process patents). For textiles and clothing industries, industrial designs were the predominant form of SR, while patents and know-how were almost irrelevant.

In relation to MNCs' R&D activities in developing countries, critics argue that substantial changes in intellectual property protection are unlikely to change this situation, given the economies of scale associated with R&D activities, the importance of scientific facilities and manpower, and the close relationship between R&D and productive and marketing activities. Thus, we would expect that the prospect for Muslim countries to attract MNCs' R&D investment is very limited given the constraints explained above. In addition, R&D expenditure in Muslim countries is insignificant compared to that in the developed countries, hence the huge gap in technological development between them. For example, the annual R&D expenditure as a percentage of GNP in Benin, Egypt and Turkey was only 0.7-1.0 per cent between 1981-92 (see Table 6). In Tunisia and Nigeria, the share is much smaller, that is, 0.3 per cent and 0.1 per cent respectively. This is in contrast with R&D investment in the UK and USA,

Table 6
Number of scientists and engineers in R&D
and R&D expenditures in selected Muslim countries* and developed countries, 1981-92

Country Name	Scientists and engineers in R&D	Expenditure in R&D
	per million people, 1981-92	% of GNP, 1981-92
Benin	177	0.7
Egypt	458	1.0
Gabon	189	0
Guinea	264	-
Nigeria	15	0.1
Senegal	342	-

Tunisia	388	0.3
Turkey	209	0.8
United Kingdom	-	2.1
United States	3873	2.9

World Bank (*1997), World Development Indicators*, Washington, DC, World Bank.
Note: * Only countries for which data are available are included here.

where their annual expenditure was 2.1 per cent and 2.3 per cent of GNP during the same period. The difference in the actual amount of R&D expenditure would be more apparent if we were to consider the substantial disparity between the GNPs of these countries.

In addition, these Muslim countries also lack research infrastructure and manpower to induce MNCs to relocate their R&D activities. Table 6 shows that the number of scientists and engineers in R&D activities in these countries is far smaller than that in the industrialised countries. In Nigeria, the number of scientists and engineers per one million population involved in R&D was only 15 in the period between 1981-92. In other Muslim countries, the number ranged between 177 and 500. This is in contrast to 3873 in the USA. This explains why the bulk of overseas R&D activity of MNCs is concentrated in the industrialised host countries and why MNCs shy away from investing in R&D in Muslim countries.

MNCs, however, do invest in the developing countries but the amount is very insignificant compared with their investment in the industrialised countries. Together the developing countries account for only about 5 per cent of all overseas R&D activity of US and Japanese MNCs (Kumar, 1996). In developing countries, MNCs tend to invest in R&D related to local adaptations of their products and other aspects of production and process and not in developing or creating new inventions. Investments into such activities obviously do not have any link with the availability and the strength of patent protection.

In this section, we observe that MNCs tend to invest heavily abroad in R&D in the sectors where they are confronted with major international rivals whose home countries are sources of innovative activity. Thus, TRIPs will have a significant impact on attracting MNCs R&D investment in advanced technology and on the development of new production techniques and products only when Muslim countries themselves have the capabilities to break through the world technological frontier.

6. CONCLUSION

Efforts in strengthening patent protection, despite many criticisms, gained sufficient attention from developing countries (and therefore Muslim countries), which have been seriously working towards upgrading patent legislation and its enforcement. They also tend to ascribe a very important role to patent law in technology transfers and try to promote and improve the transfer of technical knowledge from industrialised countries, particularly

through patent legislation (Kunz Hallstein, 1975:432). Our discussion in this paper seems to lead to the conclusion that Muslim countries have a long way to go before they can fully benefit from patent law, particularly in relation to enhancing technology transfers. However, it is important to note that if the Muslim countries are able to use the legislation in favour of their long-term economic development, the benefits they can derive from having high standards of intellectual property protection will exceed the costs.

Technology transfer will have a significant impact on the development of skill- and technology-based industries only if it is accompanied by MNCs R&D activities. At present, R&D activities and technology transfer into the Muslim countries have been very limited. However, this is not due to the weaknesses in the patent protection but to the lack of indigenous technological innovation and insufficient supportive research and development facilities and manpower. In order to encourage MNCs R&D, enhance technology transfer and promote foreign investment in advanced technology and development of new production techniques and products, Muslim countries themselves must have an internationally competitive and commercially profitable local technological capabilities. What is important at this stage is to improve the educational system and research facilities, and to encourage more local R&D activities. Problems and constraints faced by local innovators either in technical, financial and other aspects of innovative activities must be resolved as soon possible. Without these supportive resources and facilities, Muslim countries still have a very long way to go before they can reap the claimed benefits of stronger patent protection via TRIPs.

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