

International Technology Transfer by Small and Medium-Sized Enterprises

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ABSTRACT. This paper attempts to summarize the key issues involved in the international transfer of technology by small and medium-sized enterprises. All the evidence suggests that small and medium-sized enterprises will not, in aggregate, be the major suppliers and transferrers of technology in the world economy, but they can fill crucial niche roles. The success of these niche roles will be partly determined by the key relationship between firm size and industry size and by small and medium sized enterprises being able to ride the dynamics of the industry.

1. Introduction

This paper attempts to summarise the key issues involved in the international transfer of technology by small and medium-sized enterprises (SMEs). It focuses on what is new in the area and relies for its empirical evidence largely on the UNCTAD report on small and medium-sized transnational corporations (UNCTAD, 1993).

After a brief review of the role of SMEs in the world economy, Section 3 of the Paper examines theoretical approaches to the internationalisation of SMEs. Section 4 attempts to reconcile internationalisation approaches to globalisation. Section 5 examines the technology transfer strategies of SMEs and Section 6 focuses on types of technology transfer and managerial strategies. Section 8 provides conclusions.

2. Small and medium sized enterprises in the world economy

Small and Medium sized enterprises (SMEs) (here the working definition of a company with less than 500 employees is used) play an important role in the world economy as employment generators, as innovators and as exporters. They are important job generators because they tend to be more labour intensive than larger firms and as well as internal growth of SMEs, much job creation is the result of small business start-ups. The extent of innovation by SMEs, as opposed to large firms, is controversial and it is clear that their exporting potential is generally less than the proportion exported by large firms. Nevertheless SMEs have a crucial role to play in developing and transferring certain types of technology and where there is a satisfactory niche for small firms, they can play a critical role in technological advances.

In terms of their international role, it is clear that SMEs account for a relatively small proportion of world foreign direct investment, but this proportion is growing. Global figures for SME FDI as a proportion of the total are unavailable (UNCTAD, 1993). Some information is available on a national basis, however. Unfortunately each major source country keeps the information on a different basis and uses a different definition of 'small' (or SME). This makes aggregation impossible. Representative figures for USA (Tables I and II), show some important regularities. However TNCs are measured, they represent a high proportion of outward investment in terms of numbers in each of these major source countries (28.3% of parent firms investing abroad in the USA [5.5% of all foreign affiliates] in 1988, 39.8% of equity investment in Japan in 1991, 66.3% of foreign investors in the UK in 1981, 74% of all transnational corporations in Sweden in

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TABLE I

United States: shares of parent firms and foreign affiliates of small and medium-sized transnational corporations in those of all transnational corporations, by industry of parent firms, 1988

(Percentage)

Industry	Number of parent firms	Foreign affiliates			
		Number	Assets	Sales	Employment
Primary	40.6	6.1	5.7	0.1 ^a	6.9
Agriculture, forestry and fishing	66.7	15.6	4.5	3.2	10.3
Mining and petroleum	38.0	5.8	5.7	0.1 ^a	6.5
Manufacturing	19.8	3.3	0.8	0.8	1.1
Food, beverages and tobacco	19.2	1.3	0.2	0.3	0.3
Textile products and apparel	23.5	8.9	3.9	3.1	6.5
Lumber, wood and paper products	17.2	3.8	1.1	1.1	0.9
Chemicals and allied products	17.6	2.2	0.7	0.6	0.6
Primary and fabricated metals	24.8	6.4	1.7	2.3	2.1
Machinery, except electrical	25.0	5.7	1.2	1.2	1.8
Electrical and electronic equipment	21.3	4.7	2.6	3.4	2.6
Transportation equipment	8.0	0.5	—	0.1	0.2
Other manufacturing	17.1	3.0	0.8	1.0	1.1
Services	39.9	12.8	4.1	3.2 ^a	3.1 ^a
Wholesale and retail trade	44.7	30.4	11.3	4.3 ^a	4.5
Finance (except banking), insurance and real estate	59.4	4.6	2.2	2.2	1.0
Hotels and other lodging places	20.0	21.2	23.0	—	—
Construction	27.6	7.0	8.7	3.0	0.6
Transportation, communication and public utilities	13.6	5.4	0.6	0.7	0.7
Other services	23.2	7.6	4.1	3.6 ^a	4.6 ^a
All industries	28.3	5.5	2.7	3.4	1.9

Sources: Based on special tabulation of United States TNCs by firm size by United States Department of Commerce at the request of United Nations Conference on Trade and Development, Programme on Transnational Corporations. UNCTAD (1993) p. 66.

^a Excludes data that are suppressed to avoid disclosure. Thus, the figures are underestimated.

1987, and 60.2% of all Italian transnational corporations and 28.8% of foreign affiliates in 1987). However, when we look at SME's contribution to aggregates such as foreign assets, sales or employment, the picture changes dramatically. For the same years as given above, SMEs accounted for 2.7% of foreign assets, 3.4% of foreign sales and 1.9% of foreign employment for the USA, 0.8% of the book value of foreign direct investment of the UK, 2% of employment in Swedish owned foreign affiliates and 7.4% of employment, 6.2% of turnover in Italian transnational companies.

The UNCTAD survey did show foreign direct investment by SMEs to be growing rapidly. Table III shows that they are rapidly becoming more international.

We should also note that SMEs which do inter-

nationalise tend to be larger, more capital rich, more productive and profitable and to have a higher export ratio than SMEs in general (Table IV). This is unsurprising, but it does produce a curious statistical artifact – SMEs which internationalise rapidly cease to be SMEs (on any of the definitions used)!

SMEs show a strong preference for non-equity forms of technology transfer such as licensing (rather than FDI). SMEs from advanced countries also concentrate their investments more in other advanced countries rather than in less developed countries (LDCs). In fact, their investments are locationally clustered near to the source country to a larger degree than large multinational companies (MNCs). This may be the result of limited horizons, risk aversion and the influence

TABLE II
United States: shares of foreign affiliates of small and medium-sized transnational corporations in those of all transnational corporations, by host country, 1988

(Percentage)				
Country	Number of affiliates	Assets of affiliates	Sales of affiliates	Employment of affiliates
Developed countries	5.7	2.0	2.5	1.7
Canada	9.1	2.1	1.9	1.9
Europe	5.3	1.2	1.8	1.6
Japan	4.8	—	—	1.6
Others	3.4	—	—	1.4
Developing economies	4.7	4.9	8.0	2.6
Africa	5.2	2.7	4.4	2.9
South and East Asia	5.8	9.9	17.6	4.2
Hong Kong	8.0	5.1	5.1	9.7
Philippines	4.4	—	—	3.4
Republic of Korea	3.1	—	—	—
Singapore	5.3	—	—	2.6
Taiwan Province of China	6.0	2.5	5.4	5.1
Latin America	3.8	3.1	1.8	1.7
Argentina	1.3	0.2	0.3	0.4
Brazil	3.5	0.6	0.8	0.8
Colombia	3.4	1.0	1.0	2.0
Mexico	2.8	2.2	1.7	1.4
Venezuela	3.0	1.5	1.7	—
Middle East	8.4	6.1	11.7	7.1
All countries	5.5	2.7	3.4	1.9

Sources: Based on special tabulation of United States TNCs by firm size by United States Department of Commerce at the request of United Nations Conference on Trade and Development, Programme on Transnational Corporations. UNCTAD (1993) p. 67.

of 'psychic distance' (Hallen and Wiedersheim – Paul, 1979) which all bear heavily on SMEs. Internationally oriented SMEs also tend to be industrially concentrated, specialising particularly in locationally bound services and manufactured and capital goods (UNCTAD, 1993).

It is against this background that the international technology transfer activities of SMEs needs to be set.

3. Theoretical approaches to internationalisation by SMEs

In a previous paper (Buckley, 1989), I reviewed the analysis of the internationalisation of SMEs under four generic headings:– the economics of the firm's growth, internationalisation and evolutionary approaches to growth, the gambler's earnings hypothesis and the corporate decision

making approach. There is no point in reviewing each of these in detail again; instead, this paper attempts to synthesise the key issues and update the arguments.¹

Several key arguments can be abstracted from the literature.

First, there is an important relationship between the firm and the market. There is a crucial relationship between the firm's size and overall market size. In one polar case, we can envisage a small firm attempting to grow (internationalise) in a 'big-firm' industry i.e. an industry where optimal scale is large in relation to market size. This poses problems in terms of resource acquisition, notably capital and management skills. In the other extreme case, there are industries with few economies of scale where many small firms prosper. Industries requiring a wide range of specialist intermediate inputs, in particular, present

TABLE III
Distribution of foreign-direct-investment cases by small and medium-sized enterprises, by period

Country/industry	Number of investments surveyed	Distribution by period (Percentage)					
		Before 1949	1950–1959	1960–1969	1970–1979	1980–1989	1990–1992
By home country							
Japan	142	–	1	5	25	55	15
United States	24	8	–	4	42	37	8
Europe	57	–	–	7	23	51	19
All countries	225	1	–	5	27	52	15
By industry of parent firm							
Primary	5	–	–	20	–	80	–
Manufacturing	156	1	–	6	29	49	15
High-technology industries	33	6	–	6	21	55	12
Medium-technology industries	71	–	–	4	37	44	15
Low-technology industries	52	–	–	10	23	52	15
Services	67	–	1	1	24	57	16
All industries	228	1	–	5	27	52	15
By host country							
Developed countries	129	2	–	5	27	51	15
United States	42	–	–	5	21	64	10
Europe	72	1	–	6	29	46	18
Others	15	7	–	7	33	40	13
Developing countries	99	–	1	5	26	53	15
South and East asia	91	–	1	5	26	54	13
Others	8	–	–	–	25	38	38
All countries	228	1	–	5	27	52	15

Sources: Based on the United Nations Survey.
UNCTAD (1993) p. 54.

a small firm in equilibrium with a small market. Thus we can make a distinction between absolute smallness and relative smallness. The role of small firms in filling a niche market has been noted as a key attribute of Third World multinationals whose key competitive advantage is their skill as versatile users of flexible equipment (Wells, 1983). There is a case to be made that the current 'downsizing' and moves towards 'lean production' and outsourcing mean greater opportunities for smaller firms to fill new supply niches. Table V shows the view that SMEs who have already internationalised have of the problems or opportunities given by small size. It was felt to be more of a constraint than an advantage in R&D, finance and recruitment of skilled employees. However, small scale was more often seen as an advantage than a constraint in economies (or diseconomies) of scale, overseas marketing and distribution and

information capacity. These factors give clues to the types of industries, contexts and markets in which SMEs internationalisation is likely to be successful. Where local skills are needed, small scale is a positive advantage and information processing is required (speedily) then SMEs are likely to feel more confident of success.

Second, there are several important constraints on the international activities of SMES. Perhaps the most important of these are internal constraints. Two key issues here are shortages of capital and of managerial skill. In raising capital, small firms face a 'catch – 22' problem – how to raise finance without disclosing its competitive advantages (in particular its proprietary technology). These institutional difficulties of capitalising knowledge are compounded by the necessity to retain (family) control. The shortage of skilled management in SMEs is often a more

TABLE IV
Comparison of some features of small and medium-sized manufacturing transnational corporations with small and medium-sized manufacturing enterprises in general

Features	Small and medium-sized TNCs ^a	SMEs in general
Size		
Average sales world-wide (millions of dollars)	89	3.3 ^b
Average number of employees in home country	286 ^c	30 ^b
Average number of employees world-wide	515 ^c	—
Average capital world-wide (millions of dollars)	42	0.3 ^d
Average value added world-wide (millions of dollars)	28	1.3 ^b
Labour-capital ratio (= number of employees/capital in millions of dollars)	13	58 ^d
Labour productivity (= value added in millions of dollars/number of employees)	0.06	0.04 ^b
Capital productivity (= value added/capital in millions of dollars)	0.5	1.8 ^d
Export ratio (= exports/sales, percentage)	22	15 ^e
Profit ratio ^f (= profits/sales, percentage)	7.9	4.2 ^d

Sources: Based on the United Nations Survey; tables I.1 and I.5; and Ministry of Finance, *Zaisei Kinyu Tokei Geppo (Monthly Report of Fiscal and Financial Statistics)*, No. 462 (Tokyo, Ministry of Finance Printing Bureau, October 1990). UNCTAD (1993) p. 86.

^a Based on 62 firms for average sales world-wide, 47 firms for the average number of employees in home country and world-wide, 57 firms for average capital world-wide, 39 firms for average value added world-wide, 55 firms for labour-capital ratio, 39 firms for labour productivity and for capital productivity, 56 firms for export ratio and 47 firms for profit-ratio.

^b Based on the data of Australia, Austria, Canada, France, Germany, Ireland, Japan, New Zealand, Norway and United States in table I.1.

^c There are a few firms with more than 500 employees in home country. These firms, however, employed fewer than 500 employees at the end of the 1980s, the criteria year in the United Nations Survey. These firms' data are included.

^d Only Japanese SMEs.

^e Data of France, Italy, Netherlands and Norway in table I.5 are used.

^f Defined here as income (sales minus costs) before taxes divided by sales.

TABLE V
Shares of small and medium-sized transnational corporations that think that firm size constitutes a constraint or an advantage for foreign direct investment^a

Category associated with foreign direct investment	Constraint	Advantage	No difference
Research and development	27	19	44
Finance	35	19	40
Recruitment of skilled employees	26	22	45
Economies/diseconomies of scale	21	26	45
Overseas marketing/distribution	27	42	29
Information capacity	23	32	35

Sources: Based on the United Nations Survey. UNCTAD (1993) p. 136.

^a Based on 108 company responses.

serious problem. Small firms, typically, do not have specialist executives to manage their international operations, nor do they possess a hierarchy of managers through which complex decisions can be filtered. Decision making is likely to be personalised, involving *ad hoc*, short term reckoning based on individual perception and prejudice (This not unknown in large multi-nationals!). A shortage of management time leads to the firm taking short cuts without a proper evaluation of alternatives. Information costs bear heavily on small firms and attempts to avoid or reduce these costs, for instance by making no serious attempt to evaluate a potential agent or joint venture partner, can be disastrous. The horizons of small firms are limited by managerial constraints and there is little 'global scanning' of opportunities. Therefore, when an opportunity presents itself, it is often seized without proper evaluation. Given this problem, why does the firm not recruit management from outside the firm? One problem is the desire of family owned companies to retain control inside the family circle; the other is the difficulty in obtaining specialist knowledge of how to evaluate outsiders. Lack of these crucial evaluation skills constrains recruitment and makes endemic the burden on management. Consequently small firms with inexperienced managers can behave in a naive fashion, particularly outside their normal cultural milieu. They can be politically naive because they lack public relations skills, lobbying power and the sheer economic muscle of larger firms.

The role of risk and uncertainty is an important one in determining SME internationalisation patterns. It is likely that the proportion of resources committed to a foreign direct investment will be greater than for a large, diversified multinational. Failure is thus more costly. This can interact with information costs in a negative way – in that costly information collection will not be undertaken. Thus 'short cuts' or spurning of opportunities can result. Alternatively, owner managers often act on impulse and are often greater risk takers than more 'managerialist' entrepreneurs. The rather erratic financial behaviour of SMEs may also be explained by these factors. The 'Gambler's Earnings Hypothesis' highlights an important empirical phenomenon – a small initial foreign investment eventually leading to a large

payback of profit in the form of dividends. An explanation is given by analogy with ploughing and harvesting. A period of ploughing may be set by the firm (say 5 to 7 years). In this time the foreign subsidiary is given a great deal of freedom of action. After that the foreign subsidiary either generates a stream of income for the next project (the next ploughing) or it is sold off to obtain a return on the capital. The short decision making horizon arises because of the restricted capital and management capacity. Thus a target rate of return and/or payback period are discovered by trial and error.

Fourth, we need to pay attention to the dynamics of growth in the industry. Large multinational firms often have highly sector specific expansion routes. This leaves niche markets or 'interstices' for SMEs to exploit. These niches are often in 'small firm industries' or exist as a fringe in 'large firm industries'. SMEs may thus be 'pulled' into foreign markets by large firms requiring suppliers or 'pushed' abroad by increasing competition in home markets. The flexibility of SMEs in adjusting to external conditions needs to be set against their vulnerability to radical change in technological, political, institutional and competitive conditions. The role of SMEs will vary over the life cycle of an industry. In the early stages, numbers of small firms will vie for position. As the industry matures, economies of scale become prevalent and only a few will survive. In the decline phase, established competitors will face a threat from new entrepreneurial, innovating SMEs (Vernon, 1966, 1979).

Table VI shows the relationships between SMEs and multinational firms both from the point of view of the SMEs growth and in relation to its foreign direct investment. The relationship, of course, varies according to the type of industry, even when such broad industry groupings as these are used.

4. Internationalisation, globalisation and SMEs

The motivation for SMEs to make foreign direct investments is remarkably orthodox. The three key motives which we observe for multinational companies – market seeking, resource seeking and

TABLE VI
Shares of small and medium-sized transnational corporations that think their relationship with large firms is important in their growth and foreign direct investment, by area of relationship and industry^a

Industry	Area of relationship with large firms				
	Customers/ suppliers	Information concerning technical development	Financial services	Advisory services	Marketing/ distribution
<i>Firm's growth</i>					
Manufacturing	37	25	5	7	30
High-technology industries	67	40	—	7	40
Medium-technology industries	26	20	3	3	26
Low-technology industries	35	23	10	13	29
Services	39	17	6	11	22
All industries	37	21	6	9	26
<i>Foreign direct investment</i>					
Manufacturing	16	7	6	9	15
High-technology industries	33	13	7	13	27
Medium-technology industries	14	6	3	3	9
High-technology industries	10	6	10	13	16
Services	8	14	3	6	11
All industries	13	9	5	7	13
<i>Both firm's growth and foreign direct investment^b</i>					
Manufacturing	14	7	2	5	11
High-technology industries	33	13	—	7	27
Medium-technology industries	11	6	—	—	6
Low-technology industries	6	6	6	10	10
Services	8	11	3	6	8
All industries	11	8	2	5	10

Sources: Based on the United Nations Survey.

UNCTAD (1993) p. 81.

^a Based on 123 small and medium-sized TNCs.

^b Answer to this is also included in separate responses to firm's growth and FDI.

efficiency (low cost) seeking investments are all present in the list of motivations for SMEs as they are for multinationals (Buckley, 1995). In terms of market related motivations, seeking growth in local markets is mentioned by 50% of the firms, strengthening competitive capacity by 27.3%, access to third country markets by 24.4% and information gathering by 20.6%. Low cost labour is mentioned by 14.5% and securing raw materials by 11.2%. This leads to a discussion of the overall strategies of SMEs in reaching foreign markets. Table VII shows the degree of internationalisation of SMEs in the UN Survey. SMEs in services were the most highly internationalised

in terms of their FDI presence, followed by medium-technology industries, whilst low technology industries had the highest proportion of exports to total sales followed again by medium-technology industries. It is possible to contrast internationalisation with globalisation. Internationalisation is the term normally used for the gradual, sequential incremental approach described in Scandinavian literature (Johanson and Wiedersheim – Paul (1975), Johanson and Vahlne (1977) and by the studies carried out at Bradford (Buckley, Newbould and Thurwell (1988), Buckley, Berkova and Newbould (1983)). In contrast, the globalisation approach suggests

TABLE VII
The degree of internationalization of small and medium-sized transnational corporations
(Percentage)

Industry	Proportion of exports to total sales	Proportion of FDI to total assets
Manufacturing	22	5
High-technology industries	10	5
Medium-technology industries	19	11
Low-technology industries	28	3
Services	14	20
All industries	18	15
Number of companies observed	81	66

Sources: Based on the United Nations Survey.
UNCTAD (1993) p. 88.

that firms can reach foreign markets in a simultaneous fashion – by a ‘big bang’.

Casson (1994) has attempted to synthesise these approaches by examining internationalisation as a corporate learning process. He posits a model where the cost of acquisition of information about a market generates a set-up cost of entry. The sequential approach to entry hinges on the exploitation of systematic similarities between markets. Because of such similarities, experience acquired in one foreign market is of potential relevance to another. If foreign markets were all totally different from one another, then nothing learnt in one market would have any significance for another. However, if markets are very similar, then a globalisation pattern – a single discrete simultaneous entry into all markets becomes feasible.

In a sequential approach, decisions about entering the second market are deferred until the first has been entered because this provides an option value which strengthens the case of sequential entry when some markets are only marginally profitable. However, this model assumes that each market is investigated before the local marketing strategy is determined. This can be contrasted with purely experimental learning where the market is entered *without* systematic investigation and learning results from responding to mistakes. The decision to learn by experience, Casson suggests, depends ‘first and foremost on the confidence of the management, and on the costliness

of mistakes, and only peripherally on the issue of sequential entry’ (1994, p. 15). Thus there is a key trade-off between exploiting economies of scope in knowledge (maximised by a sequential strategy), and the gains from exploiting profitable market opportunities without delay (a simultaneous entry globalisation strategy).

Casson’s piece is also illuminating on the issue of uncertainty. He suggests that there are two varieties of uncertainty facing the internationalising firm. They are – uncertainty about the state of the market (how similar it is to the home market and other previously – entered markets). The second is the cost of collecting information to overcome this problem. The cost of collection depends on the type of market which is not known in advance. The cost of ‘mistaken entry’ may well be below that of systematic investigation; thus making mistakes may be a rational way of expansion!

Table VIII shows the nature of the relationship between the foreign affiliate of the SMEs in developing countries and the parent firm. SMEs parallel multinational firms except that they are more conservative in conglomerate diversification abroad.

5. Technology transfer strategies of SMEs

The Unctad study of technology transfer (UNCTAD, 1993), found that SMEs, like MNEs, transferred technology internationally that was overwhelmingly from their parent firms. They are

TABLE VIII
Production relationship between foreign affiliates in developing countries and their parent firms^a

(Percentage)		
Kind of production relationship	Affiliates of small and medium-sized TNCs in developing countries	Affiliates of large TNCs in developing countries
<i>Horizontal relationship</i>		
Producing the same products as parent firm with the same technology	66	64
Producing the same products as parent firm with different or modified technology	23	29
<i>Varietal relationship</i>		
Turning raw materials into semi-manufactured products	15	19
Turning semi-manufactured products into final products	28	23
<i>No relationship</i>		
Producing completely different or unrelated products	10	14
Number of companies observed	79	129

Sources: Based on the United Nations Survey.
UNCTAD (1993) p. 99.

^a As some of the affiliates are engaged in different lines of production, there is more than one production relationship. Therefore, total adds up to more than 100.

not thus unbiased conduits but are vehicles for the international projection of parent firm driven technology (98% of affiliates – UNCTAD, 1993, p. 106). Table IX shows that SMEs do carry out a considerable amount of in-house R&D and that this is largely conducted in the home country. The most common vehicle for international transfer is via a joint venture with a host country company. Because SMEs have a constraint on their in-house set of capabilities (Penrose, 1959), joining with others enables international expansion to become profitable by adding to those pre-existing capabilities. A narrower range of technology is transferred through SMEs than MNEs, particularly lacking are transfers of management technology and marketing technology. This may be partly due to the mode of transfer-joint ventures – it may also result from the lack of development of these technologies in SMEs in general.

The UNCTAD survey shows that the means of technology transfer in SMEs is much less formalised than in MNEs. This is related to their management style and the crucial constraints referred to above. The channel of written instructions is used much less in SMEs than MNEs,

partly because of lack of personnel to codify the technology and partly because many of the skills in SMEs are acquired through personal experience. Sending technical experts abroad to aid in technology transfer is much more difficult for SMEs (the high opportunity cost of technical personnel is crucial here) and written instructions are used much less frequently. There is also less (expenditure on) specialised technical training to aid in the transfer. Only 40% of foreign affiliates of SMEs had technical training other than on-the-job training, compared to 70% for large firms (UNCTAD, 1993 p. 109).

Typically, therefore on-the-job training plus the supply of machinery and parts which embody the technology is the crucial transfer mechanism in SMEs. Manuals and technical handbooks are used by a minority of SMEs and even blueprints and drawings are only utilised in 51% of cases.

Efforts are made to adapt technology to host country conditions. Key factors causing adaptation are scale differentials, different factor endowments and gaps in technological capabilities between source and host countries. However, the UNCTAD survey found that a lower percentage of SMEs

TABLE IX
Research-and-development activities by small and medium-sized transnational corporations

(Percentage)					
Country/industry	Proportion of small and medium-sized TNCs that carry out R&D	Proportion of small and medium-sized TNCs that have a specialized R&D department	Proportion of small and medium-sized TNC that have R&D facilities abroad	Ratio of total R&D expenditures to sales	Ratio of R&D expenditures abroad-to total R&D expenditures
<i>By home country</i>					
Japan	66	34	7	10	4.3
United States	69	56	31	2.0	4.1
Europe	76	52	36	2.3	6.1
All countries	70	43	17	1.5	5.0
<i>By industry</i>					
Manufacturing	81	55	18	2.0	5.0
High-technology industries	86	64	7	2.4	8.7
Medium-technology industries	85	59	24	2.2	3.5
Low-technology industries	74	44	19	1.0	5.2
Services	43	20	10	0.3	7.5
All industries	70	43	17	1.5	5.0
Number of companies observed	109	109	109	56 ^a	46 ^b

Sources: Based on the United Nations Survey.
UNCTAD (1993) p. 96.

^a Ten out of 56 small and medium-sized TNCs report zero R&D expenditures.

^b Thirty four out of 46 small and medium-sized TNCs report zero R&D expenditures.

than MNEs made efforts to adopt their technology (77% against 86%). Several reasons can be adduced for this dissemination: (1) the lower level of technological mastery in SMEs, (2) the reliance of SMEs on the experience of skilled technicians (including owners) and the custom order nature of technology in SMEs reduces the need to formalise adaptation efforts (i.e. the tacit component of technology is higher in SMEs), (3) barriers to adaptation (e.g. poor local supplies) are greater for SMEs than MNEs, (4) adaptation may divert very scarce resources away from activities at home and (5) the technologies transferred by SMEs may be inherently more suitable to LDCs than that of large companies – thus there is a reduced need to modify SME technology.

6. Types of technology transfer by SMEs

Three types of technology may be picked out as appropriate for international transfer by SMEs:

small scale technologies, labour intensive technologies and specialised high-technology know-how.

In the first case, we can refer back to our earlier discussion of the firm and the industry. SMEs may be operating in industries where efficient scale is reached at a small volume of output relative to the total demand for the product. Thus the industry can accommodate a large number of SMEs. Second, there are industries where efficient scale is reached only at a large volume of production but demand still remains unsatisfied. Perhaps this is due to discontinuities in technology. One or two large plants of efficient scale do not satisfy demand, but unsatisfied demand is insufficient to attract a new entrant. Thus a fringe of SMEs fill unsatisfied demand. Third, SMEs can operate alongside large firms where there are not huge cost penalties in operating below efficient scale. Here, SMEs may use a different production mode – specialising in made-to-order, custom built or small batch production.

These three situations are very different. Technologies transferred in the first and third situations will be viable alternatives to MNE technology. In the second situation, the risk is that SMEs will possess an inferior or second best technology which will be vulnerable to not only technological change but also to changes in the competitive structure of the industry. Over time, the rate of decline of costs with respect to scale will be critical to the viability of SME transferred small scale technology.

In the case of labour-intensive technologies, it is obvious that SMEs operate in the most labour intensive sectors – notably services – and therefore they may be more suited to the international transfer of more labour intensive technologies. Here a distinction must be made between *processes* which are labour intensive and *collections of activities* (as in normal industry and firm accounting) which are labour intensive. It has long been observed that labour intensive stages of production are relocated in cheaper labour locations (Vernon, 1966) but this is mainly the prerogative of large, well organised multinational firms. The relatively internationally unsophisticated SMEs are not in a position to reconfigure their activities globally and it is usually the whole of productive activities which are relocated.

Third, new technologies are transferred internationally by SMEs; examples include biotechnology and microelectronics. We should also be wary of assuming that new technology aligns perfectly with industry (or even strategic group) divisions. Much new technology is disguised within traditional industries. SMEs face a general problem of capitalising in-house knowledge. They therefore need external funding to develop and spread their innovatory developments. Going to the market can be risky so firm to firm deals are often chosen to extend their range. Equity (joint ventures) and non-equity (licensing deals, alliances) routes are often used as a means of leveraging technology in a way which appears less risky than normal market capitalisation.

7. Managerial processes in small firms and technology transfer

Chen and Hambrick (1995) found (in a study of airlines) that the small firms tended to be more

active than large ones in initiating competitive moves, but in contrast large firms seemed to be more responsive when attacked. This is consistent with the flexibility and rapidity in strategy often ascribed to small firms. With regard to action visibility, small firms were more likely to be more low-key and even secretive. The authors characterise actions as follows “it appears that small airlines tend to hold their fire, calculating well developed, visible responses; large airlines act quickly but in rather straightforward, unexciting ways” (p. 474). Hence the title of the paper “Speed, stealth and selective attack: how small firms differ from large firms in competitive behaviour”.

This stereotype of small firms as fast moving opportunists may not be generalisable across industries or across cultures. Steinman, Kumar and Wasner (1981) found that German medium sized firms in the USA followed a rather cautious, managerialist approach to internationalisation. Briemann (1989) found that smaller British firms invested in search of new markets, whereas German firms were more concerned with securing existing market positions.

The multinational research project on the international transfer of technology by small and medium sized enterprises (Buckley et al., 1997) found that industry, national host and source country factors influenced the form and nature of technology transfer but that idiosyncratic management influences were strong in SMEs.

8. Conclusion

All the evidence suggests that SMEs will not, in aggregate, be the major suppliers and transferors of technology in the world economy, but they can fill crucial niche roles. The success of these niche roles will be partly determined by the key relationship between firm size and industry size and by SMEs being able to ride the dynamic of the industry. A second important success factor is the skill of management in SMEs being able to spot and to take opportunities in situations where resources are scarce and information is expensive.

The mechanism of transfer of technology in SMEs seems remarkably orthodox. In general, technology developed by the parent is transferred via an international network which relies rather

heavily on joint ventures, alliances and licensing links rather than on foreign direct investment. The key international transfer mechanism is on-the-job training in the host country.

The key technologies transferred are efficient small scale technology, specialised custom built or small batch production technologies and 'opportunistic transfer' of technologies which in the long run, will be more suited to larger firms. Managerial processes must play to the strengths of SMEs including their ability to be flexible and to make rapid strategic moves.

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Note

¹ Key references for each approach are

- a) Economics of the firm's growth
Penrose (1959) Buckley and Casson (1976)
- b) Internationalisation and evolutionary approaches.
Buckley, Newbould and Thurwell (1988)
Nelson and Winter (1982)
Vernon (1966) Buckley and Casson (1981)
- c) Gambler's Earnings Hypothesis
Barlow and Wender (1955)
Penrose (1956)
- d) Corporate decision making approach
Aharoni (1966)

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