

# Technological catch-up and strategic technology partnering in developing countries

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# Technological catch-up and strategic technology partnering in developing countries<sup>1</sup>

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Abstract: This paper examines the trends in strategic technology partnering (STP) by firms from developing countries over the period 1980-94. The evidence shows that a small group of countries, namely the Asian NICs and Eastern Europe dominate STP activity. We also examine differences in organisational modes and how these have evolved over time, suggesting an increasing similarity between the NICs and Triad firms. Although it has been argued that these trends demonstrate the technological and economic 'falling behind' of most developing countries, we suggest that it may also represent fundamental differences in the economic structure of these countries and the 'normal' process of structural upgrading with development.

## Introduction

Since the beginning of the 1980s, multinational enterprises (MNEs) around the globe have begun to engage in strategic technology alliances at an unprecedented pace. Driven by globalisation, which has manifested itself through, *inter alia*, faster technological change and intensified competition, firms have shown a growing propensity to link up with other firms - oftentimes competitors - in order to survive in an increasingly global market place. Globalisation, as used here refers to the convergence of incomes and consumption patterns, both across and within countries, rapid technological change and subsequent increased cross-border economic activity (Dunning and Narula 1997).

The reasons for this growth are relatively clear. As firms are faced with limited resources, they have found it convenient to establish collaborative activity with other

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<sup>1</sup> A first version of this paper was presented under the title, 'strategic alliances by developing countries: prospects and problems' at the expert group meeting on strategic business alliances at UNIDO, Vienna, November 1996.

firms, both in the same sector (through alliances along the same value added chain as well as horizontal agreements with competitors) as well as those engaged in activities in unrelated sectors as a means to enhance their competitive advantages. Like their industrialised country counterparts, firms from developing countries have also engaged in strategic alliances, albeit at a relatively slow pace. In this paper our intention is to focus on the growth of agreements amongst developing country firms, focusing on those that involve some level of technological interchange and/or innovatory activity, which provide some strategic benefit to at least one of the partners in the agreement, which we shall refer to as strategic technology partnering (STP).

The forces of rapid technological change and high uncertainty are especially intense in new and rapidly developing technological sectors, these new forms of inter-firm co-operation were critical in order to face global competition, particularly in innovative activity, where the risks and costs are very high. Indeed, these very sectors have seen the most growth in STP activity given the opportunities for growth, as well as technological leapfrogging, it is not surprising therefore, that a developing country firms have been actively involved in these sectors (Vonortas and Safioleas 1997). However, the participation of developing countries in these sectors, both in terms of production and R&D activities, as well as through STP is unevenly distributed across regions and countries. This paper investigates the extent to which strategic technology partnering by companies in developing countries has been characterised by similar evolution and modes of co-operation compared to those utilised by firms in the industrialised world.

This line of research has been explored previously, most notably in the work of Freeman and Hagedoorn (1994), and whose work we intend to build on. We have four primary objectives. First, we re-evaluate the situation regarding the propensity of developing country firms to undertake strategic technology partnering, in light of more recent data, up until 1994. Second, we evaluate, in greater depth than previously undertaken, the kinds and types of organisational modes of strategic technology alliances utilised by developing country firms. Third, we examine the reasons for the growth of strategic alliance activity by developing country firms, and, in particular, propose explanations for the considerable variation between countries and regions, both in terms of propensity and in terms of organisational modes, and propose that

while the issue of economic divergence and ‘falling behind’ remains valid, there are convincing arguments that the failure of developing countries to participate is also a result of fundamental structural differences in the economies of these countries.

## **Defining strategic alliances in developing countries**

It is important at the outset to distinguish between networks and strategic alliances: there remains considerable ambiguity as to what constitutes an alliance. Indeed, it has been common practice to include all kinds of collaborative ventures, from equity joint ventures between firms to Chaebol and Keiretsu type inter-firms relationships as examples of strategic alliances. However, recent work by Madhok (1997a, 1997b) and Narula and Hagedoorn (1997), has provided a basis to make a clear distinction, and thereby set the ground for our ensuing discussion.

The standard definition used for strategic alliance is that they refer to modes of governance that result in some organisational interdependence between the firms involved, such that there is a strategic benefit that accrues to either partner as the result of shared capital, technology or other resource. In other words, there must be some expected long-term effects of the agreement on the product-market positioning of at least one of the partners (Hagedoorn 1993). This definition, however, remains imprecise, for the term ‘strategic’ is open to interpretation. Our view, following that of Narula and Dunning (1997) and Madhok (1997a) is that both transaction cost minimising and value-enhancing reasons underlie most of the behaviour of firms and represent two ends of a continuum. In other words, there are two imperatives to the behaviour of firms (Figure 1).

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insert Figure 1 about here

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Decisions to vertically integrate through a collaboration or acquire with suppliers may tend to be primarily cost-economising, but also have a strategic element to them, in that by collaborating with the supplier firm you have pre-empted a similar move by a competitor. Collaborations such as Videoton’s sub-contracting agreement with Siemens in the Hungarian electronics industry are primarily cost-economising

and may be defined as networks. On the other hand, cooperative agreements such as the joint venture between Daewoo and General Motors in the Korean automobile industry was clearly aimed at improving the future value of at least one partnering firm in the alliance (Daewoo) and was thus more strategically motivated rather than cost-economising. As such they represent strategic alliances rather than networks.

It must be emphasised that most, if not all collaborative agreements are both cost-economising as well as strategically motivated, and it is often difficult to distinguish between agreements which have no strategic motivation (and are therefore simply inter-firm agreements) and those which have a strategic intent. For obvious reasons, companies do not make public all their motivations behind the agreements they engage in, thus making the process of classification exceedingly difficult. Our focus through this paper will be on strategic technology partnering, where the emphasis is primarily on technological development and/or joint innovative activity.

The analysis will be based on data from the MERIT-CATI data set, which contains information on almost 8,000 cases of strategic technology partnering between 1980 and 1994. It should be noted that the data is based on announcements of an intention to engage in technology partnering in a given year. Thus, the data do not allow us to determine whether in fact agreements are in effect, or were terminated, either successfully or unsuccessfully. Furthermore, our data set has a bias towards new and emerging technologies. Additionally, it should be noted that in our analysis the term 'developing country' includes the formerly centrally planned economies of Eastern Europe, and although we classify them together with 'traditional developing countries, it is important to realise that this qualification is based primarily on income levels.

## **Strategic alliances and catching up**

Freeman and Hagedoorn (1994) in a pioneering work on this subject, confirmed that most of the strategic technology alliance activity in the 1980s was conducted primarily by firms from the industrial countries, particularly those from the Triad. Firms from developing countries contributed only insignificantly to strategic alliance formation - less than 5% of agreements involved developing countries during the period 1980 - 1989. These results lent support to the argument that the technological and economic

catch-up by developing countries was subdued, and in certain instances (i.e., in new and emerging technological sectors) suggested that the vast majority of developing countries were increasingly lagging behind.

Our data show that the trend for newly established alliances in developing countries apparently continued during 1990s. Figure 2 shows the trend of strategic technology partnering between 1980 and 1994. Unsurprisingly, a majority of agreements between 1980 and 1994 have been agreement between firms from the Triad.

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Although there is some variation between years, Table 1 shows that the number of new agreements in Triad countries signed in a given year have seen a steady growth at an annual average rate of about six percent between 1980 and 1987. The corresponding rate for the period 1987-1994 was at about two percent. This suggests that there was a slowdown in the growth in newly established alliances in the early 1990s. Table 1 also reveals that considerable differences between the propensity to engage in STP by Triad firms and STP by developing country firms. As the data show, the growth in STP activity in developing countries has been slightly higher than in Triad countries over the whole period from 1980 to 1994. Although there was a modest decrease in the annual average rate of STP in developing countries in the early 1990s, this rate was still higher than the annual average rate in Triad countries in the same period.

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insert Table 1 about here

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Table 1 provides additional data on STP activity during these periods. In general, it can be observed that the percentage of newly established STP agreements by developing countries accounted for 6.15 percent of all STP between 1980 and 1994, increasing slightly in the early 1990s compared to the early and mid 1980s. It should

be remembered that since these represent newly established alliances in a given year, we are unable to ascertain whether the stock of agreements still in force are smaller or larger than the average for Triad firms. However, there is no reason to suspect that developing country agreements have a longer longevity or success rate than Triad alliances, which are believed to have a failure rate of at least 70% (Business Week, 1986). Moreover, as Table 1 notes, well over 90% of the STP involving developing country firms involve at least one Triad partner.

It is important to ask why these agreements have begun to play an increasingly significant role, especially among firms from the triad. The growth of alliance activity in general has been attributed in part to globalisation. It has done so through three means<sup>2</sup>. First, firms from countries in the triad have become increasingly similar in the kinds of technology and competitive advantages they possess. The traditional technological gap approaches were proposed during a period when technological innovation was dominated primarily by US MNEs, which enjoyed a technological hegemony, particularly since the end of the second world war. Over the past three decades, MNEs from Europe and Japan have been able to catch up technologically with US firms and now are able to compete directly with US firms, indeed, in many instances these other firms have developed superior technologies to the US firms. One effect is that there are a greater number of competitors with similar products that compete directly, thereby increasing the pressure on individual firms to maximise their market share as well as continually develop new products. Needless to say, this increases the scope for firms to engage in co-operative agreements as a way to minimise the risks and costs of maintaining or improving their competitive advantages.

Second, there has been an increasing homogeneity in consumer needs and preferences among the countries of the triad as markets have become global, and income levels have converged amongst the triad countries. This has encouraged firms to collaborate in order to develop world wide standards. Even where industry standards are not an issue, co-operative agreements become necessary in order to enter

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<sup>2</sup> This section has largely been adapted from Dunning and Narula (1997)

as many new markets as possible both to spread the rising costs of innovation, as well as to defend its existing markets, as a defensive measure.

Third, the development of new technologies has greatly accelerated the need and ability of firms to engage in cross-border activity. This has occurred through two primary means. On the one hand, new technologies have affected the structure and trend towards STP because of the improved co-ordination of cross-border activities. It is a fundamental feature of MNE activity that cross-border market failure exists in the supply of intermediate products, and especially intangible assets. Information and communication technologies have reduced both the costs of acquiring and disseminating information, and the transaction and co-ordination costs associated with cross-border activity. It has done so on two levels:

- a) Information about both input and output markets is more easily accessible. This allows firms which previously could not engage in international business transactions now to do so. Indeed, a UN study (1993) has indicated that there is an increasing number of small and medium enterprises engaging in international activity than was hitherto the case.
- b) MNEs are better able to integrate the activities of their various affiliates through the use of these technologies and to more quickly respond to changing conditions in the countries in which they operate.

Taken together, these transaction cost-reducing processes have enabled MNE activity to be much more efficiently organised across borders. They have also facilitated a shift towards more rationalised and strategic asset-seeking MNE activity, and away from the more multi-domestic approach which was more prevalent prior to the 1970s.

While the decline of transactions and co-ordinating costs has led to an increased efficiency of *intra-firm* networks, there have also been substantial cost-savings in the co-ordination and monitoring costs associated with *inter-firm* networks. Indeed, the growing use of organisational modalities which permit firms to engage in quasi-internalised arrangements is attributable, at least in part to the ease with which collaborators and competitors may be monitored, and the extent to which the risks of shirking have declined (Narula 1996). Larger markets for similar products and the ability of MNEs to organise production activities on a rationalised basis has led,

*ceteris paribus*, to higher rents, allowing MNEs to exploit economies of scale, since similar products may be sold in several countries at the same time.

New technologies have also influenced the world economy because of the emergence of entirely new industries, which have generated entirely new sources of employment both in the manufacturing and services sectors. The difference in the extent to which these developments have affected the converging and the diverging countries is not as acute as elsewhere for the simple reason that because these are new technologies, there is not likely to be as large a 'gap' between the lead and lag countries. Indeed, developing countries have attempted a 'niche' strategy in developing created assets by specialising in particular new technologies as a way of achieving competitiveness - the often cited example of India's burgeoning software sector and the focus of other nations in biotechnology is another (Acharya 1995). However, the failure of the majority of developing countries to exploit these new technologies has acted as a centripetal force, encouraging centralisation of production to within the Triad by MNEs.

New technologies have also led to a shortening of product life cycles which has led to new or modified products to be more rapidly developed and brought to market. Firms are able to undertake technological developments and are able to bring them to market much more rapidly than was previously the case. Computer-aided design (CAD) as well as developments in 'flexible' manufacturing systems and computer-aided manufacturing have further reduced the set-up costs and time taken to bring a new product to market. Although this has led to a reduction in fixed costs associated with new products, these technologies are not costless. First, rapid product life cycles imply a relatively high R&D intensity if firms need to remain competitive. They also suggest that an innovating firm needs to quickly recoup these high fixed costs, before its technology become redundant especially so if a rival firm wins the 'race' to innovate the next generation product<sup>3</sup>. It must therefore (a) sell at a relatively high cost per unit, and/or (b) develop a production process with a low minimum efficient scale and/or (c) recoup its investment by acquiring a large market for its

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<sup>3</sup> Patent protection is a highly imperfect tool to protect an inventor from competition, especially so in industries where technological change is rapid and competition high. As such, an innovating firm's

products so as to spread its fixed costs. However, whichever strategy a firm undertakes, it generally enhances the need for it to seek and expand overseas markets. Once again, target markets tend to be those with similar income and consumption patterns, rather than the diverging developing countries, where multidomestic strategies still prevail, and for whose markets products for which the R&D costs have already been amortised.

It is to be remembered that strategic alliances are most used where collaboration may lead to the potentially improved position of at least one of the partners. In industries where the technology is tangible and codifiable, as in mature, stable sectors, firms will prefer to engage in equity type wholly or majority owned subsidiaries (see discussion in the following section). It is a well known feature of development that as countries experience growth, they will experience economic restructuring to progressively higher technology levels. At the same time, the modalities with which international transactions are conducted and the organisation forms with which domestic firms engage in will also become increasingly complex. Indeed, alliances call for a particularly high level of managerial and organisational expertise which is generally not available to developing country firms.

Therefore, for the most part, the countries where R&D activities by domestic firms and/or affiliates of foreign MNEs is high tend to have the highest propensity to engage in strategic technology partnering (Hagedoorn and Sadowski 1996). These tend to be the eastern European countries and East Asian economies. The rest of the developing countries R&D activities tend to be sparse and concentrated in a few conglomerates which dominate the alliance activity undertaken by these countries.

Despite the fact that the data presented in Table 1 suggests that developing countries have managed to keep up with the growth of technology partnering at more or less the same growth rate as those of the Triad, not all countries have benefited from globalisation to the same extent. The increasing homogeneity of technologies across countries and firms has enabled companies, especially in the newly industrialised countries, to use strategic technology alliances as a means to acquire technological competencies and capabilities as well as support export marketing. With

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only way of maintaining its competitive advantage may be by being 'first', and remaining in the lead in

every new wave of innovation, a window of opportunity opened up for companies in developing countries to catch up a little, closing the technology gap between themselves and the market leaders. Especially in the newly industrialised countries, catch-up development occurred on a firm and industry level based on technological learning. In these countries, technological learning allowed firms to slowly graduate from the manufacture of simple goods to the design and development of more complex products for export markets. Technological partnering with firms from Triad countries played an important part in technological learning (Hobday 1995).

It has been shown (Verspagen 1993, Dowrick 1992, Dowrick and Gemmell, 1991, Alam and Naseer, 1992, Narula 1997) that only a handful of developing countries (mainly the Asian NICs and some East European economies) are experiencing convergence with the industrialised world, while a majority of developing countries are in fact diverging away from the industrialised world, both as a group and individually. With ten developing host countries accounting for 67% of inward FDI stock and 79% inward FDI flows in 1993 (Dunning and Narula 1997), this would suggest that, with the increasing reliance of less developed countries on FDI as a source of capital, technology and knowledge, there is increasing likelihood that there will be further polarisation of the world economy and widening of the gap between the Triad and the bulk of developing countries. In an analysis of the effects of global integration on development, Gray (1996) predicts that the marginal net benefits from international involvement will decline with globalisation for the least developed countries, as he suggests that the benefits of globalisation are self-reinforcing.

Such a similar event is occurring for the involvement of developing countries in alliances. As Table 2 amply illustrates, as with FDI, trade, productivity and economic development, the growth of strategic technology partnering has not been even across regions and countries. In the 1980s and early 1990s, the highest proportion of STP has certainly been in the newly industrialised countries in South East Asia. More than half of all STP have taken place in this region but - as the data show - with a decreasing tendency during the late 1980 and 1990s. It seems that companies in other regions in the world increased their importance in strategic technology partnering. Companies in Eastern Europe, in particular, increased their

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subsequent rounds of innovation (Levin et al 1987).

engagement in STA in the 1990s remarkably. There was a proportional decrease in the participation of firms from Latin America and Africa.

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## **Organisational modes and developing country STP**

Recent theoretical and empirical contributions have highlighted the variation in type of strategic alliance activity, in terms of choice of organisational modes, both on a country and firm-specific basis (Osborn and Baughn 1990, Hagedoorn and Narula 1996, Narula and Hagedoorn 1997). For developing countries in particular, contributions have been made by Freeman and Hagedoorn (1994) and Vonortas and Safioleas (1997). Following these efforts, in this section we wish to evaluate the propensity to utilise different forms of STP agreements.

Figure 3 illustrates some of the primary options available. There exist a spectrum of organisational modes through which the firm may conduct such international operations. At the one extreme, the firm can establish a wholly owned subsidiary through foreign direct investment (FDI), or an M&A such that it has ownership and control over its subsidiary operations. Such an arrangement would provide it with complete control over the activities of its subsidiary, but it would also involve a degree of risk, given its unfamiliarity of the target market. If it were to engage in a purchase of assets on the open market, there is no expansion of the firm, and it simply engages in arms-length (or spot) transaction, leaving the risks and benefits to another firm. Between these two extremes lie several other options that represent a compromise between a wholly owned subsidiary that involves internalising all transactions within two organisationally interdependent affiliates of a single firm and, and a spot transaction that involves two separate independent firms. These intermediate options represent varying extents of organisational interdependence between the two firms, and a consequent sharing of the risks and benefits between them.

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A strategically motivated agreement is based on improving the position of a firm relative to its competitors. For example, in order to sustain its competitive position vis-à-vis new entrant firms from mainly Western Europe, Videoton, the largest Hungarian-owned electronics company, began to engage in 1992 in a series of subcontracting with a number of major Western electronics and engineering firms. The aim of these agreements was to secure market access of Videoton against new entrants in the Hungarian electronics market while sharing the cost of research and development in this rather risky industry (Havas 1996). This sort of agreement is aimed at gaining sufficient market share away from their common competitor, therefore the increase in sales volume may make up for the loss of profit margin in the long run.

Strategically motivated agreements may be both offensive and defensive. If two firms make a horizontal agreement to protect their market from a large (and more cost efficient) competitor, they may do so by mutually agreeing to lower their prices to gain market share, or exchanging technologies to become more efficient. Such an action would lower their profitability in the short run, but if they succeed in increasing their joint market share there may be long term benefits. If the firm participating in an agreement are simply intent on maximising profits, a cost-economising motive is more likely to achieve this.

However, thus far we have simply re-visited our earlier discussion of the motive underlying collaborative activity. If the motives of developing country firms and industrialised country firms were similar, one might expect them to utilise similar organisational modes. From Table 3, this is clearly not the case. Overall, during the period 1980-1994, less than 30% of developing country STP were non-equity based, while almost 70% of triad firms' STP was non-equity based. Even amongst developing countries, there was considerable variation, with NICs showing the lowest propensity to utilise equity, and 'other Asia and Africa' with the highest propensity.

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In terms of changes over time, there would seem to be an across-the-board decline in the use of equity agreements between the two periods, with the exception of Latin America which remained more or less at the same level. Indeed, as Figure 4 dramatically illustrates, the ratio of equity to non-equity STP for the NICs has declined considerably, and would seem to be converging to that of the Triad firms. Indeed, when the data is examined on an annual basis for NICs, it is observed that in the most recent years, the equity/non-equity ratio is identical to that of the developed countries.

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## **Differences in industrial specialisation of countries**

The above discussion indicates that developing countries are heterogeneous in their STP activity. It also illustrates that certain developing countries are in danger of 'falling behind', but this does not take into account the question of industrial differences. The data presented in Table 3 would seem to suggest that countries and regions that are 'closer' in terms of economic development to the Triad (i.e., have been experiencing convergence) show a similar propensity to engage in non-equity agreements relative to those firms that hail from countries that are further away from the economic development levels of the triad countries. Nonetheless, this cannot be taken as positive proof that the differences between these groups of countries and the changes over time indicate that the gap is either widening or decreasing, although this might be taken as a simplistic explanation. Indeed, as we will argue in this section, these differences and the changes over time may find their explanation in structural changes and industry-specific differences. Osborn and Baughn (1990), and Hagedoorn and Narula (1996) have illustrated that there are concrete differences in the choice of

organisational mode that derive from the rate and uncertainty of innovatory activity, as well as the technological intensity of sectors. For instance, non-equity forms of agreements are more efficient for undertaking more research intensive activity. However, where the aim of the alliance is to learn and transfer tacit knowledge to its other operations, equity agreements are often preferred (Osborn and Hagedoorn 1997). A finding by Hagedoorn and Narula (1996) showed that for STP, equity agreements were preferred in relatively mature sectors, while non-equity agreements are utilised in high-tech sectors. Given the bias of our dataset towards core technologies such as biotechnology, new materials and information technology, it is therefore only natural to expect such differences to manifest themselves in our analysis. Indeed, as Table 4 shows, on a simple disaggregation of data by sectors, there are differences in the choice of organisational mode on a global level, and although there are relative differences between groups of countries, there are also differences between industries. For instance, non-high-tech sectors display a higher preference for equity than any of the core high-tech sectors.

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Therefore, some of the differences in the propensity to undertake STP as demonstrated by our data may be due to the fact that some of these developing countries are specialised in other sectors, rather than an indicator of their failure to catch-up (on a technological or economic level). In other words, this may simply indicate path-dependent differences in the industrial specialisation of countries, or at most a divergence or ‘non-catch-up’ scenario in particular sectors<sup>4</sup>.

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<sup>4</sup> Country specific characteristics that are a function of exogenous supply and demand conditions, such as country-size, natural resource availability. For instance, Chinese firms, by virtue of their home country market size, are much more desirable partner for industries where economies of scale is important, than, say, Taiwan. Furthermore, sectors which rely on natural resource based inputs, such

However, the story is not quite as simple as all that. Our data is very much biased to new, core technologies, where path dependent country-specific characteristics do not play a significant role. These are sectors where the stock of knowledge is limited given their novelty, and where developing countries are not faced with a huge backlog of learning. These sectors represent an opportunity for leapfrogging, since the economic cost of acquiring a competence in state-of-the-art is relatively low. In these situations, strategic technology partnering represents a very important option, both as a means to advance and modify a product developed in a third world environment to developed country market conditions and requirements. Alternatively, from a Triad firm perspective, STP with a developing country firm represents a low-cost technology development option.

Nonetheless, despite the decision of countries to target particular sectors within these new technologies, such an overt intention assumes a certain basic competence in the manufacturing sectors, and within manufacturing, prior experience with technology-intensive sub-sectors. What we are trying to suggest here is that the propensity of firms in a given country to be involved in technological activity in a given sectors is not solely based on its desire to be in a given sector, but also reflects country-specific differences that are specific to its stage of economic development.

It is well-known that the economic structure of a country is a function of its stage of economic development. This thesis has been examined most thoroughly in the work of Chenery and associates (see for instance Chenery and Taylor (1968), Chenery (1979), Chenery et al (1986)). This line of research argues that countries' economic structure evolves with their stage of development to reflect the comparative advantage of the country as well as the nature of its natural and created assets. More recently, efforts have been made to relate evolving economic structure to the pattern of foreign investment activities (see e.g., Narula 1993, 1996, Dunning and Narula [eds.] 1996, Ozawa 1995, 1996). These contributions have taken a general view of foreign investment activities to include all forms of MNE activity, whether it be through licensing or wholly owned activity. It is not our intention to discuss this body

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as say petroleum in the case of either Indonesia or Venezuela, are more likely to be industries which domestic firms in these countries have a competitive advantages, or would like to acquire one.

of research in detail. Instead we present the salient features from this research through a set of stylised facts:

1. The comparative advantage of countries evolves gradually with development from primary to manufacturing to services;
2. This gradual shift reflects the upgrading of the capabilities and resources of both the country in terms of the quality and quantity of its infrastructure, technological assets and manpower, and the competitive advantage of its firms;
3. there is a systematic relationship between its economic structure and the kind and extent of the exports of its firms, inward investment activity by foreign firms, and the outward FDI activity of its firms;
4. Although this relationship is idiosyncratic and country-specific, depending upon its exogenous and endogenous country-specific characteristics, there is a broad similarity of this relationship across countries;
5. within the manufacturing sector, there is a general evolution in four phases, which can be linked to the development of particular types of industries: (1) labour intensive light (Heckscher-Ohlin) industries, (2) heavy and chemical (undifferentiated Smithian) industries, (3) assembly based industries (differentiated Smithian) and, (4) innovation-intensive (Schumpeterian) industries. In other words, countries and their firms evolve through successively higher levels of skill and technological intensity with economic growth;
6. The motive and extent of inter-firm activity, and the organisational mode utilised by domestic firms in undertaking international activities (including collaboration) varies with the stage of development. Likewise, the organisational mode utilised by foreign firms engaged in inward investment in the host developing country will also vary with the motive of their investment, and stage of development of the host (which is itself determined by *inter alia* the stock of accumulated technology possessed by it).

Given these stylised facts, it is not reasonable to expect that countries engaged in the first two phases of Ozawa's typology to engage in STP in technology-intensive sectors, and indeed, with some exceptions, until the end of the third phase. In fact, the countries that Ozawa predicts will be engaged in Schumpeterian-type innovation

industries are the Asian NICs and the eastern European countries, although some of the more advanced ‘new’ NICs are attempting to acquire in several phases simultaneously (such as China and Malaysia). In relation to this attempt to acquire mastery across a range of sectors, it is important to note that there are fundamentally different motives attributed to developing country firms which engage in STP. When, say, Samsung enters into a partnering agreement to develop a new memory chip, it is more likely to result in a technology exchange, than, say a collaborative effort on the Indonesian aircraft project. Therefore, it may be postulated that the kind of knowledge that the developing country firm brings to the bargaining table considerably effects its ability to acquire additional technology through STP, and indeed, its ability to internalise it.

As such, with the exception of some ‘white elephant’ projects, most STP in high tech sectors is undertaken by the NICs and Eastern European countries, as the evidence so far has demonstrated. Indeed, as table 6 shows, the majority of developing country STP in the core technologies tends to be dominated by these countries.

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insert Table 5 about here

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A caveat needs to be noted here. The growth of strategic asset acquiring MNE activity, has continued to grow in popularity, particularly given its success as part of the industrial development policy of countries such as Japan, Korea and Taiwan. Nonetheless, there is considerable variation between countries as to the level of intervention and the industrial sectors targeted, as well as the predominant use of particular technology acquisition modes (see Dunning et al (1996) and van Hoesel (1997) for a discussion on Taiwan and Korea). The economic success of these countries has prompted imitators throughout the developing countries, with varying degrees of success. However, what is clear is that the growing use of strategic technology partnering is an increasingly important tool in the process of structural upgrading.

This is further buttressed by the fact that during the two periods, a large number of the STP by the NICs tend to be in the medium and non-core technologies in the first period. Table 6 gives the breakdown of alliance activity between the two time periods, 1980-87 and 1988-1994. It is clear from this breakdown, that the gradual restructuring that has been experienced by these countries is also apparent in their STP activity. For instance, there has been a gradual decline in the importance of the medium and low tech sectors, which in the first period accounted for over 50% of all STP activity. During the second period they accounted for less than one quarter of all agreements, with much of the growth having taken place in the information technology sectors. It is interesting to note, however, that biotechnology has not as yet seen much growth in STP activity, a sector in which none of these countries has made large investments in developing.

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insert Table 6 about here

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## **Conclusions**

Although the analysis conducted here has mainly been qualitative, and our empirical evidence not empirically rigorous, some clear trends have been identified. We succinctly summarise these here. First, the number of strategic technology alliances involving developing country firms has increased only marginally to approximately 7 percent of all agreements between 1988 and 1994, up from 5.5% between 1980 and 1987. However, although the increase has been minimal, this does nonetheless reflect marginally faster growth rates, which have been higher than the growth rates of Triad STP.

Second, within the developing countries, there is a clear difference between regions and groups of countries. STP activity is dominated by the East Asian NICs and eastern Europe, and this dominance has become even more acute. On the surface, this increased dominance can be attributed to the increasing divergence between the countries which have converged, from those that are in danger of diverging. It also, in the case of the Eastern European firms, is a result of the entry of these countries in the

late 1980s, thus acutely increasing the number of alliances by former socialist states in the second period.

Third, we examine the propensity of developing country firms to use different organisational modes of strategic technology alliances. The data demonstrates that although developing country firms have a higher propensity to undertake equity-type agreements, this too varies between groups of countries and regions.

Fourth, there is a gradually declining propensity to use equity-based agreements, and the decline is most noticeable amongst the Asian NICs, with equity to non-equity ratio approaching Triad levels. However, the decline in the use of equity-type agreements does not, apparently reflect differences in growth rates.

Fifth, although there are differences between countries in the use of equity-based agreements, there remains a clear difference between industrial sectors. However, unlike in the case of the Triad countries, differences do not seem to be completely explainable by industry-specific sectors.

Sixth, we propose that the failure of certain countries to participate in strategic technology partnering cannot be entirely attributed to their economic divergence or their 'falling behind'. Based on scholarly research that has studied the process of structural change and economic development, we suggest that the low levels of participation can be explained by a combination of the 'natural' process of structural upgrading and the nature of our empirical evidence. We elucidate. On the one hand, firms from a large number of developing countries (with the exception of the NICs and eastern Europe) do not as yet have the competitive advantage to engage in innovative activities in technology intensive sectors, given their stage of economic development. On the other hand, the dataset we have used here has a strong bias towards technology intensive, new and emerging sectors, such as information technology, biotechnology and new materials.

Our narrow focus on strategic technology partnering raises questions about the most efficient means to undertake innovative activity, given its costs, particularly in terms of resources. With increased global competition, firms then are forced to increase their own R&D activity which requires capital and access to complementary created assets. Partly as a result of this and partly due to globalisation, there has been

an increase in the use of strategic asset acquiring MNE activity as a means to develop assets. This includes the use of intra- and inter-firm networks, primarily through strategic alliances and other forms of collaborative agreements. A second means has been the use of outward strategic-asset seeking FDI, where MNEs from these countries invest in affiliates located in close proximity to a major competitor in order to maximise the internalisation of spillovers and externalities (see Dunning *et al* 1997 for a discussion).

As we have emphasised in this paper, these activities, however, require considerable organisational skills, and are generally associated with firms that have already considerable experience with international operations, and innovative activities. Indeed, the growth of the use of strategic alliances has tended to be primarily one associated with the converging economies: the Triad firms, and some of the rapidly industrialising Asian economies and more recently the Eastern European Economies in Transition (EET). Most of the developing countries have tended to experience a divergence in growth rates and are focused on relatively low-technology sectors, and have domestic firms which have relatively few competitive advantages.

Indeed, from our discussion here it would seem that technology agreements tend to be the domain of firms from the more advanced ‘developing’ countries. In general, it would seem, that countries with the most advanced technology stocks and those with firms that have competitive advantages that are world-class, dominate technology alliance activity.

As Ozawa (1995) suggests, the Asian NICs have now entered a stage of industrial restructuring where their competitive advantages are focused in technology intensive, Schumpeterian type industries, and away from low and medium-tech industries. strategic alliances in these high tech sectors are more amenable to non-equity alliances given the high costs of R&D and uncertainty in these sectors.

Unfortunately, many developing country firms do not possess these characteristics described above to be able to operate as “partners” to relatively sophisticated MNEs from the industrialised world, often becoming ‘junior’ in any relationship. The technological gap and managerial know-how that is required to manage and sustain a strategic alliance is considerably greater than for international operations. As such only countries such as the Asian NICs and the EETs are really in a

position to undertake these agreements. The EETs possess technology but not the managerial know-how relative to the NICs, which explains the high failure rate of these alliances (Paliwoda 1995).

Another point that is often forgotten is that one of the most important advantages of strategic alliances is the relatively quick response rate that these provide in developing new innovations. As such they seem to be used most often in industries which are marked by high uncertainty and/or rapid technological changes. Developing country government regulations and red tape, however, tend to discourage such quick response rates.

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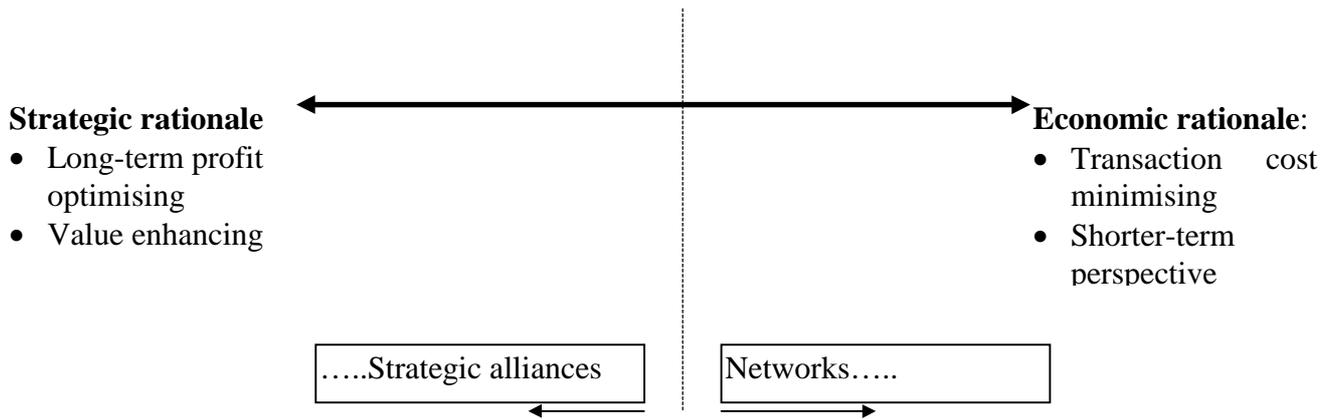
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Source: Narula and Hagedoorn (1997)

Figure 1: Continuum between strategic and economic motivation of inter-firm cooperation

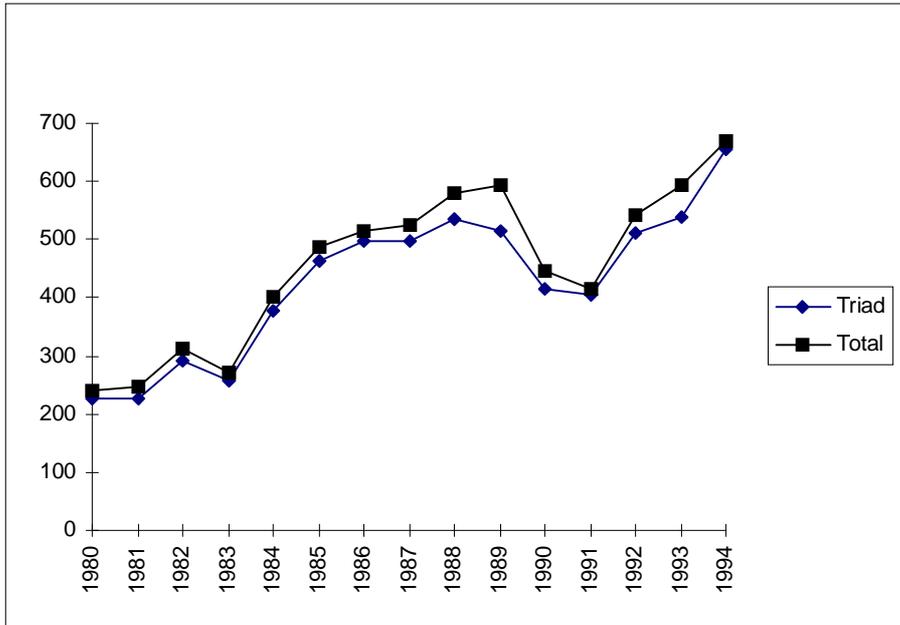


Figure 2: Growth of strategic technology partnering, 1980-1994

	1980- 1994	1980- 1987	1987- 1994
Percentage of Triad STP (annual average)	93.85	94.51	93.11
annual average growth rate (%)	4.15	6.05	2.24
Percentage of agreements in developing countries	6.15	5.49	6.89
Annual average growth rate (%)	5.98	7.03	4.93
percentage of DC STP involving Triad firm	91.24	90.29	92.19

Table 1: Newly established strategic technology alliances in Triad and developing countries, 1980 -1994.

Regions/countries	Percentage of alliances (1980-1994)	Percentage of alliances (1980-1987)	Percentage of alliances (1987-1994)
East Asian NICs	58.41	63.95	55.84
Other Asia and Africa	8.84	17.01	5.05
Latin America	4.31	6.12	3.47
Eastern Europe	28.45	12.93	35.65

Table 2: Strategic technology alliances in developing countries by region, 1980- 1994.

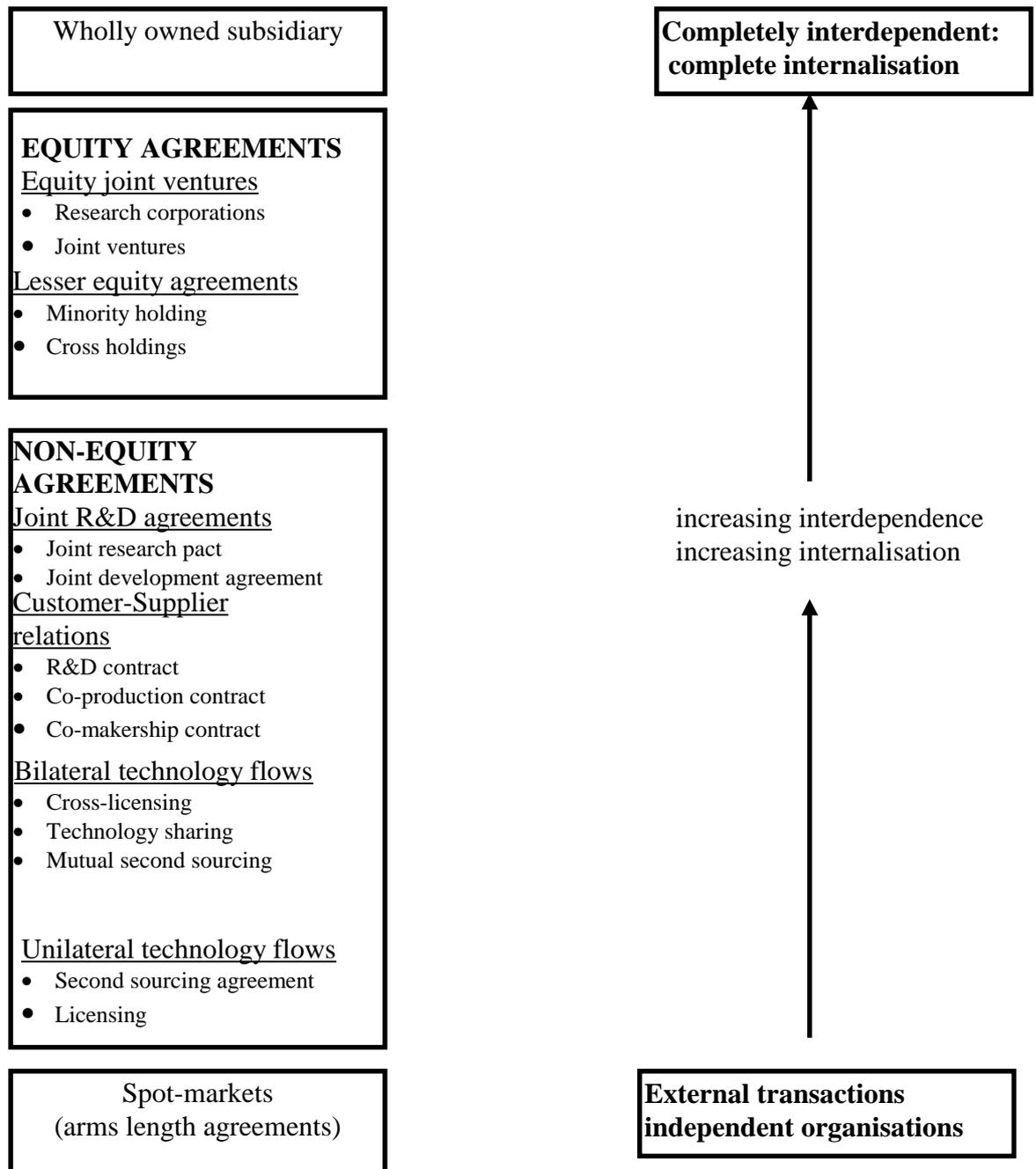


Figure 3: Organisational modes of inter-firm cooperation and extent of internalisation and interdependence

	All STP	DC STP	East Asia	NICS	Eastern Europe	Other Asia and Africa	Latin America
1980-1994							
Equity modes in %	32.96	72.45	68.46	49.77	75.76	90.91	72.00
Non-equity modes in %	67.04	27.55	31.54	50.23	24.24	9.09	28.00
1980-1987							
Equity modes in %	40.06	82.05	79.84	77.03	80.00	92.86	71.43
Non-equity modes in %	59.93	17.95	20.16	22.97	20.00	7.14	28.57
1988-1994							
Equity modes in %	31.98	62.94	58.67	49.46	73.91	84.62	72.73
Non-equity modes in %	68.02	37.06	41.33	50.54	26.09	15.38	27.27

Table 3: Equity and non-equity modes of strategic technology alliances in developing countries, 1980 - 1994.

Notes: For definitions of organisational modes, see Figure 4 and Narula (1996c)

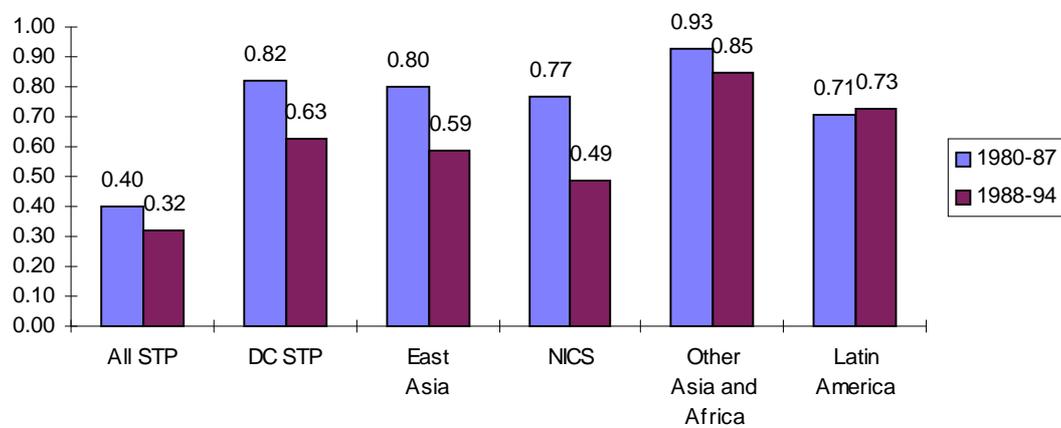


Figure 4: Ratio of equity to non-equity strategic technology alliances in developing countries, 1980 - 1994.

Ratio of equity to non-equity	All countries	Developing countries	Developing countries excluding NICs	Eastern Europe	NICs
Bio technology	32.30	62.96	75.00	100.00	51.45
Information technology	28.92	59.13	85.00	88.89	45.33
New materials	39.97	83.33	75.00	66.67	91.66
Non-high tech sectors	53.83	79.20	80.25	100.00	74.65

Table 4: Equity-non-equity ratio by major industries and regions, 1980-1994

Industrial sector	NICs	Eastern Europe	Latin America	other developing countries
Biotechnology	40.74	18.52	14.81	25.93
Information technology	65.22	7.83	3.48	23.48
New Materials	52.17	13.04	8.70	26.09
Other high tech sectors	37.50	25.00	6.25	31.25
Medium tech sectors	35.15	6.06	5.45	53.33
Low tech sectors	6.25	6.25	6.25	81.25

Table 5: Distribution of STP activity by regions with developing countries, 1980-1994

Newly industrialised countries (NICs)	1980-1987	1988-1994
Information technology	36.49	51.61
Biotechnology	2.70	9.68
Other high tech	9.46	13.98
Medium tech	35.14	11.83
Low technology	16.21	12.9
	100%	100%

Table 6: Distribution of STP activity for the Asian NICs, 1980-1994.