CHAPTER 2 - TECHNOLOGY TRANSFER THROUGH VERTICAL LINKAGES, AND PRESENTATION OF HYPOTHESES

2.1 Introduction

This chapter, the literature review, aims to provide a theoretical background to the research problem described in Chapter 1. The review is in five sections, beginning with the evolution of technology transfer and a discussion of the spillovers that flow from it (Sections 2.2 and 2.3). The review continues with discussion of the taxonomy for firms' technological capability building (Section 2.4); the characteristics of firms in developing countries and how they try to increase their technological capabilities (Section 2.5); and how backward linkages between foreign affiliates and domestic suppliers are the most promising channel through which FDI can transfer technology to the host country (Section 2.6). In Sections 2.7-2.9, the review discusses the development of the analytical framework for this study: 1) the forms of backward linkage; 2) the strategies of MNC subsidiaries and their linkage effects; and 3) the technological capabilities of local suppliers and their linkage effects. The chapter concludes by presenting the hypotheses for this research.

2.2 Technology Transfer in the Catching-up Strategy

Technology transfer is broadly defined as the processes covering the flow of knowledge, expertise, know-how, equipment, machinery, software, medium ware and techniques between stakeholders and markets around the world (Lan, 1996). This includes how stakeholders learn to understand, choose, utilize, adapt and replicate technology (Gross, 1996). In developing countries, external technology transfers have become a major source of technology imports (UNCTAD, 1999). Much attention has been paid in the literature to the capacity of firms and countries to absorb, generate and

disburse technological competence (Dunning, 2000a; Narula and Dunning, 2000; World Bank, 1998). There has been extensive research into how technology is transferred and how some countries benefit from the transfer (Mzenda and Buys, 2006).

Technology transfer in developing countries is based on inter-linkages among several actors (Mzenda and Buys, 2006:1829), including the technology sender, the technology receiver, the home-country and host-country governments, and the technology itself. Effective technology transfer depends on the capabilities and willingness of both the sender and the receiver of the technology. The government of the receiving country will have an influence on the transfer of technology through the various policy tools and the country's NIS.

However, improvements in communications, transportation, and information technology, as well as the development of new materials, mean that the pace of technological change is ever more rapid. This facilitates the expansion of international economic activity, which in turn further accelerates technological change (Pietrobelli, 2000). As a result, the product cycle of technology is getting shorter and technology can be transmitted more quickly from one country to another. This can result in cycles of cumulative causation linking faster technological change to international competitiveness and improved access to international knowledge, and so to further technological changes (Pietrobelli, 2000). Pietrobelli believes that such cycles may enable less developed countries to catch up with the technological leaders.

Catching up is a phenomenon in which 'latecomer' countries – countries that arrive late on industrial scene – manage to narrow the productivity and income gap between themselves and the technological leaders or 'frontier' countries (Fagerberg and Srholec, 2005:2). For example, in the 19th century, present-day frontier countries such as the

United States and Germany had to catch up with the United Kingdom (Fagerberg and Srholec, 2005). Japan and then South Korea caught up with these same countries after the Second World War, while recent examples of catching-up countries are Mexico, Brazil, Singapore, Thailand and Malaysia.

In the field of development theory, the idea of building a catching-up strategy is related to the objective of improving the economic position of latecomer countries by finding ways of narrowing the economic distance between them and the advanced countries. The catch-up strategy is based upon the understanding that latecomer countries suffer limitations, but at the same time enjoy some advantages, from being late arrivals on the industrial scene (Mathews, 2006). The main advantage for latecomer countries is that they need not repeat every individual step that the advanced countries have already negotiated during their own industrialization.

The literature on catching-up strategies can be categorized into three main orientations (Mathews, 2006). The first catching-up strategy is the orientation of countries to participate in the development of mature technologies. This strategy stems from the common notion that industrialized countries dominate the generation and initial commercialization of technologies while latecomer countries are more involved in the production of goods and the actual use of the technologies. It is influenced most by the product life-cycle theory, which describes technological development as a cumulative, fixed and unidirectional process from innovation to maturity (Vernon, 1966). This approach suggests that early in a product's life-cycle, resources associated with the product come from the area in which it was invented. After the product is adopted and widely taken up in world markets, production gradually moves away from the point of origin.

The main policy prescription from this view is that, as products reach maturity, they are more compatible with the comparative advantages usually associated with latecomer countries – namely, cheaper human capital and raw materials. This approach is in line with Akamatsu's (1962) 'flying-geese' model of economic development, where latecomers develop at a lower cost an industry that has been perfected elsewhere. However, this strategy of economic development has been criticized due to its high dependency on technology from advanced countries.

The literature recognizes that catching-up strategies are changing from a reliance on static efficiency (production of goods by use of existing technologies) to greater emphasis on dynamic efficiency (the improvement and generation of technologies). The main notion under this perspective is the view that latecomer countries can catch up by 'learning' to adapt and improve technologies continuously at the growth phase of the technology life-cycle. This idea is exemplified by the success of some East Asian countries in creatively imitating or reverse engineering existing foreign technologies. Following a 'reverse product-cycle' (Hobday, 1995) or 'acquisition-assimilation-improvement sequence' (Kim, 1997), these countries have established a strong technological capability.

The third catching-up strategy is early entry, which is associated with dynamic efficiency. In this strategy, latecomer countries participate directly in the generation of new technologies. Peroz and Soete (1988) link this strategy to 'windows of opportunity,' specific opportunities that can be exploited by latecomer countries during the early stage of a technology's life-cycle.

2.3 Channels of International Technology Transfer

In the quest by developing countries to catch up with the advanced countries, technology transfer has become a phenomenon for many of them (Nelson and Pack, 1999). The catching-up success of Japan, South Korea, Taiwan and Singapore (and to a lesser extent that of Malaysia, Thailand and Mexico), even as others lagged behind, has led economists to focus on the analysis of technology transfer (Jabbour and Mucchielli, 2007). Their interest also derives from a new theory of economic growth that emphasizes technological progress as the main contributor to growth (Romer, 1990). All the countries mentioned above have used catch-up strategies and various channels of technology transfer in order to attain technological progress (Mathews, 2006).

Among the main channels are foreign direct investments (FDI); market transactions, such as the international trade in capital goods; and selling directly through technology licensing arrangements (Lall, 1979, 1980; Romer, 1990; Coe and Helpman, 1995). Other channels include joint ventures and strategic alliances (Mowery et al., 1996). Lall (1993) notes that since the 1960s there have been a number of other means of technology transfer, such as minority joint ventures (with local control), licensing, turnkey projects, management contracts, and subcontracting. Technology transfer also occurs because of patent disclosures, publication or technical meetings, conversations with employees of innovating firms (possibly in the context of informal networks), the hiring of employees of innovating firms (possibly in the context of informal networks), the hiring of employees of the innovator (international consulting services) and reverse engineering (Caves, 1974:185; Mansfield, 1985:269).

Taken collectively, these various means of technology transfer are called the ‘entry mode’ (Ekeledo and Sivakumar, 1998). The selection of an appropriate entry mode is

among the most critical issues in international market-entry studies (Terpstra and Sarthy, 1994). Many of the early studies on the choice of entry mode into foreign markets were based on knowledge accumulated from the manufacturing sector (Erramilli, 1990), and today studies on entry mode for services firms are based on those manufacturing sector studies. Table 2.0 outlines the major characteristics of manufactured goods, hard services and soft services for market entry mode. It provides examples of each product group in the venture and lists entry mode options available to each group. A hard service permits separation of production and consumption and has both a manufactured-good component and a service component (Ekeledo and Sivakumar, 1998). Thus a soft service can be considered as a hard service industry if the production and consumption aspects of the soft service can be decoupled.

Table 2.0: Characteristics of Manufactured Goods, Hard Services and Soft Services

Product	**Examples**	**Characteristics**	**Typical Entry Mode Options**
Manufactured goods	Toys, automobiles, and shoes	Tangibility, storability, separability, homogeneity	Licensing, exporting, foreign manufacturing agreement, joint venture, sole ownership
Hard services	Computer software, advertising, and equipment leasing	Intangibility, storability, separability, homogeneity, depends on a physical object for storage and export	Licensing, exporting, management contract, joint venture, sole ownership
Soft services	Restaurants, lodging (hotels), and health care (hospitals)	Intangibility, perishability, inseparability, heterogeneity	Franchising, management contract, joint venture, sole ownership

Source: Ekeledo and Sivakumar, 1998

In explaining the success of technology transfer to developing countries, Lall (1993) believed it was in part due to investors or multinational corporations from developed countries becoming more willing to transfer technology from their less valuable technologies. Since then, sources of technology to developing countries have diversified as new firms and countries have entered the international arena. This augurs well for the desire of many developing countries to establish independent industrial bases.

In explaining the reasons for the importance of technology transfer, Hansen and Schaumberg-Muller (2006:30) use two perspectives: an industrialization policy

perspective, and a business strategy perspective. From an industrialization policy perspective, technology transfer or foreign linkages can provide developing countries with the human skills and technology upgrading they need to better exploit their existing endowments, to improve productivity and to develop new competitive advantages. From a business strategy perspective, technology transfer is important for both MNCs and local firms. The changing nature of competition (for example, rapid technological development and the growing integration of economies) challenges MNCs to formulate strategies that take into account the market and resource potentials of developing countries.

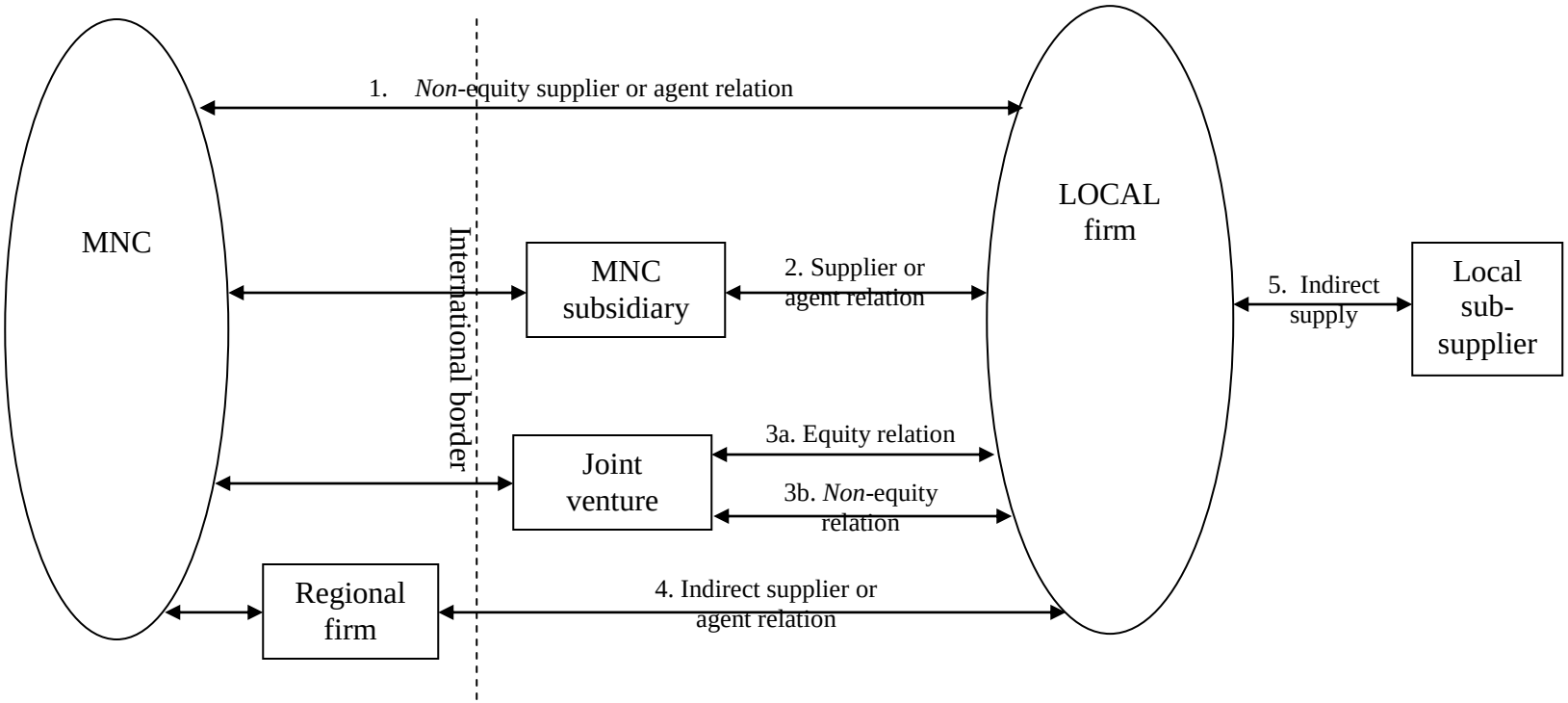
To exploit these potentials effectively, MNCs typically have to foster linkages to local firms in order, for example, to gain access to knowledge about local markets or to get access to human skills and other resources. For local firms, the changing nature of global competition challenges existing strategies because it offers new opportunities for market access and technological upgrading, while exposing protected industries to international competition. One way for developing-country firms to address these global competition challenges, Hansen and Schaumburg-Müller suggest, is to foster linkages to foreign firms. Such linkages may simultaneously provide a fast track to gain access to foreign markets and/or to opportunities to upgrade technical, organizational and management capabilities.

Noting that developing countries have a limited capacity to generate new technology, Ivarson and Alvstam (2004:241) argue that the ability to combine imported technology with host countries' domestic resources and know-how is crucial for their economic growth. One source of technology in-flow to developing countries is related to externalities or spillovers resulting from the linkages extended by MNC subsidiaries to local suppliers (Ivarson and Alvstam, 2004; UNCTAD, 1999, 2001). Technology in-

flow occurs differently in developing countries and industrialized countries, however. In industrialized countries, economic growth is generated to a large extent by technological change and closely integrated production systems across firms and regions (Best, 1990; Ernest et al., 1998; Lall, 1998).

Hansen and Schaumburg-Müller (2006:10) provide spatial dimensions of technology transfer or cross-border linkages (this is the term they use) between MNCs and local firms in five main types of relations, as in Figure 2.1. The first type is the non-equity supplier or agent relation, under which the MNC establishes direct relations with a local firm but has no equity participation in the host country. This non-equity relation includes licensing, franchising or subcontracting. The MNC may be present in the host country but not as a direct investor, depending on the host country's regulations. The second and third types constitute FDI, with the second type being a wholly owned subsidiary of the MNC that may involve upstream or downstream linkages to local suppliers or agents. The third type involves a joint venture between the MNC and local firms. As shown in the Figure, there are two types of joint-venture relations, the first being a joint venture between the MNC and a local equity partner, and the second being a non-equity relation between the joint-venture firm and local suppliers or agents. The fourth type of relation is when the MNC forms linkages through a regional firm that acts as an intermediary between the MNC and local suppliers or agents. In this type of relation, the production specifications and contractual conditions are determined by the MNC. The final type is the indirect suppliers or agent relation, where local firms become sub-suppliers or agents to MNCs through the same host-country firms.

Figure 2.1: The spatial dimensions of linkages (Source: Hansen and Schaumburg-Müller (2006))



Despite the existence of these mechanisms of technology transfer, empirical evidence indicates that the dominant channel of resource and technology transfer from developed to developing countries is FDI (Lall, 1993). Policymakers in developing countries place attracting FDI high on their agendas since they expect FDI inflows to bring capital, new technologies, and new marketing techniques and management skills (Javorcik, 2004) to the country's economic development. While all of these potential benefits are viewed as important, particular emphasis is placed on FDI's contribution to increasing the productivity and competitiveness (Javorcik, 2004) of domestic firms, which is termed a spillover effect (Hansen and Schaumberg-Muller, 2006).

Although FDI is clearly a powerful and important mode of technology transfer, the relationship between FDI and indigenous technological development is not straightforward (Lall, 1993). Lall suggested that there are several stages to be considered between the import of technology and the development of local capabilities. He noted that the assimilation, adaptation, and further development of the imported knowledge usually requires a process of building new capabilities that do not initially exist in developing countries. Other studies on developing technological capabilities in firms and developing countries also suggest that the process of becoming and remaining technologically efficient is a complex one (Dahlman et al., 1987a 1987b; Lall, 1990 and 1992).

2.4 Technological Capabilities Taxonomy

A successful transfer of technology will produce technological development in a developing country's industry, which in turn will produce economic growth for the country (Romer, 1990). But as Lall pointed out nearly twenty years ago, host-country firms need a technological capability in order to transfer technology successfully (Lall, 1993). Lall had

previously defined technological capability as the required human skills to set up and operate industries efficiently (Lall, 1990). His technological-capability taxonomy identifies two levels of technological capabilities: the firm level and the national level. At the national level, technological-capability building relates to the public capacity to provide firms with an environment conducive to business. At the firm level, it is the firms' own capacity to acquire, use, adapt, improve and create knowledge (Lall, 2000), or the firms' absorptive capacity (Cohen and Levinthal, 1990).

Lall (2000) identifies three factors that influence the ability of the public domain to provide firms with an environment conducive to business: 1) incentives; 2) factor markets; and 3) institutions. The first factor, incentives, stresses the aspects that affect investment, such as trade policy, domestic industrial policy and domestic demand. The second, factor markets, consists of three broad areas: 1) the promotion of education and training for human capital development; 2) a capital market for technological investment; and 3) a means of assessing domestic and foreign information. Lastly, the institutions factor involves organizations or knowledge infrastructure that provides resources to support firms in their technological-capability building (Mowery and Oxley, 1995; UNIDO, 2005).

This study focuses, however, on technological-capability building at the firm level – the absorptive capacity of the firms themselves. A 1985 study by the World Bank categorized technological capability into three independent capabilities: 1) production capability, consisting of production management, production engineering, maintenance of capital equipment and marketing of produced output; 2) investment capability, consisting of project management, project engineering, procurement capabilities and manpower training; and 3) innovation capability, which creates and carries on new technical possibilities for profit-making purposes. The taxonomy devised by Lall five years later identified also

three types of capabilities that firms should possess: 1) entrepreneurial; 2) managerial; and 3) technological (Lall, 1990). In terms of technological capabilities, Lall identified three elements as important for firms to develop, namely investment capability, production capability and linkages capability. Investment capability involves the skill required to utilize the invested resources effectively, while production capability includes all the necessary skills required to produce the products, including the firms' processes and other industrial engineering activities. The third element, linkages capability, concerns the transfer of technology between firms and the whole industrial supporting system, including R&D and training.

Following their study of the economic development of countries in East and Southeast Asia, Ernst et al. (1998) produced a technological capability taxonomy that seems quite operationally useful. Ernst et al. divided technological capability into six categories, with knowledge and skills placed as the core elements that firms need in order to acquire, assimilate, use, adapt, change and create technologies. Table 2.1 presents the six elements of technological capabilities that firms should have.

Table 2.1: Six elements of Technological Capability

Production Capability	The ability to operate plants, where shop-floor experience and learning-by-doing have an important role. It has the elements of production management and engineering, and of repair and maintenance of physical capital.
Investment Capability	The ability to undertake the functions of identification, preparation, design, setting up and commissioning of new industrial projects, and the expansion or modernization of existing plant/projects. It has the elements of pre-investment feasibility studies and project implementation.
Minor Technical Change Capability	The ability to continuously adapt engineering and organizational features.
Marketing Capability	The ability to deal with demand patterns and market trends to collect marketing intelligence.
Linkage Capability	The ability and organizational competence to transfer technology at three levels: within a firm, among firms and between firms and their scientific and technological infrastructure (network and system).
Major Technical Change Capability	The ability to create technology that is new in principle, design new features of products and processes, and to deploy scientific knowledge commensurate with newly invented products and newly introduced processes.

Source: Ernst et al., 1998

The technological capability taxonomy by Ernst et al. (1998) is quite similar to the earlier ones, but its focus is functional. Like its forerunners, the Ernst et al. taxonomy includes investment, production, minor change/adaptation, major change/innovation, and linkage capabilities. Marketing capability is included as a capability in its own right, while in the

earlier taxonomies it is subsumed under different capabilities. In categorizing marketing capability as a separate entity, the taxonomy acknowledges marketing as an important innovation activity of firms. Linkage capability is included in all these taxonomies of technological capabilities.

This study will focus on only one aspect of the technological capability taxonomies: linkage capability (Lall, 1990; Ernst et al., 1998). Linkage capability is concerned with the skills necessary for transferring knowledge and technology infrastructure. The taxonomy of linkage capability includes the transfer of technology within firms, among firms and also between firms, and the whole industrial supporting system that includes R&D and training. This also means that linkages capability is very broad, encompassing technology transfer occurring not only from firms to other firms, but also from the whole S&T infrastructure to the firms. In this study, only linkage capability that deals with the transfer of technology among firms is considered.

Whilst technology transfer through FDI is an important source of knowledge for developing countries, MNCs are changing their strategies in order to exploit new opportunities for division of labor on a global scale (Hansen et al., 2009:121). The surge in global sourcing and global integration within MNCs is widely mentioned in the literature (Dicken, 2003; Kotabe and Murray, 2004). With this new phenomenon, firms in developing countries will find it more challenging to compete in the globalized world unless they are able to compete by upgrading their technological capabilities.

2.5 Upgrading of Technological Capabilities: The Effects of Technology Transfer to Local Firms

Hansen and Schaumburg-Müller (2006:11) argue that the extent of interactions between MNCs and local firms can have huge implications for technology transfer to developing countries. It may influence the performance or the competitiveness of local firms, which in turn can have profound effects on the countries' overall competitiveness and industrial development. For example, the interactions (in this case, linkages) between MNCs and local firms may produce either static effects or dynamic effects (Hansen and Schaumburg-Muller, 2006:12), or they may have no effect or a negative effect on domestic firms in the same sector (Javorcik, 2004). Static effects are when firms in developing countries increase the volume of production and/or receive higher income from the sales of products or services (Hansen and Schaumburg-Muller, 2006). Dynamic effects, on the other hand, are associated with the upgrading of technology, human skills, organization and knowledge.

Upgrading indicates a positive change in the performance of local firms. As upgrading is associated with dynamic effects in building linkages, it is important for local firms to pursue upgrading if they want to compete effectively in the globalized world (Hansen and Schaumburg-Muller, 2006). As a result of technology transfer or linkage building with MNCs, local firms are able to upgrade their technology, human skills, organization and knowledge (Hansen and Schaumburg-Muller, 2006).

There are various classifications of upgrading in the value-chain literature. Schmitz (2004) divides upgrading typology into: 1) process upgrading (producing more effectively); 2) product upgrading (moving into more advanced product lines); 3) functional upgrading (moving into new functions in the value chain); and 4) value chain upgrading (moving into a new value chain). As is known in Electrical and Electronics industry, upgrading occurs

when local firms fulfill different roles in the global value chain, from assembly-type production to original equipment manufacturing (OEM), own-design manufacturing (ODM), and original brand manufacturing (OBM) (Iguchi, 2008). Meyer (2003), on the other hand, classifies upgrading in international business literature as: 1) technical upgrading (quality, scientific and engineering); 2) systemic upgrading (coordination of integrated production systems, production control and budgeting systems); and 3) strategic upgrading (in-depth understanding that enables management to initiate innovation and select and adapt new technology, as well as taking strategic decisions).

Having MNC linkages with local firms thus affects the upgrading of the latter. As a result of this upgrading, more technology is transferred between MNCs and local firms as the transfer of technology is seen to be of importance to both parties (Cohen and Levinthal, 1990). This can be observed by the fact that more than a third of world trade now takes place between MNCs and their foreign partners (UNCTAD, 2004).

Intended Versus Unintended Upgrading Effects on Local Firms

This study seeks to understand the effects of the interactions (dynamic effects, which are associated with upgrading) between MNC subsidiaries and local firm suppliers in developing countries after they have gone through linkage collaborations. The dynamic effects will produce both intended and unintended upgrading effects (Hansen and Schaumburg-Muller, 2006:13). Intended effects are accounted for in agreements known as inter-organizational linkages (Iguchi, 2008) or cross-border linkages (Hansen and Schaumburg-Muller, 2006) between the two linkage partners. Unintended effects are accidental outcomes of the linkage collaboration (Hansen and Schaumburg, 2006), which may also known be as ‘spillover effects’ or ‘externalities’ (Blomstrom and Kokko, 2000),

The unintended effects of linkages or spillovers can be divided into two types: productivity spillovers and market access spillovers (Blomstrom and Kokko, 2000). Productivity spillovers take place as competition forces local firms to become more efficient or when local producers diffuse their knowledge to their local partners. Market access spillovers take place when, as a result of the linkage collaboration, host countries' firms gain knowledge that enables them to get better access to foreign market for their exports.

This study is interested in measuring the extent of the interactions or inter-organizational linkages between subsidiaries and their local suppliers by the breadth or diversity of the intended effects of linkages between them. The extent of these interactions or intended upgrading effects will in turn produce spillover or unintended upgrading effects, but these (unintended effects) are outside the scope of the study. To pursue the study of linkage effects we need to review the literature on the strategies and capabilities of both MNCs and local suppliers, and the linkages that are formed between them. As there is inconsistent usage of the terminology regarding spillovers (unintended effects) and linkages (intended effects), the difference between linkage effects and the spillover effects they create is also reviewed.

2.6 Conceptual Framework of the Study: Linkage Collaboration between MNC Subsidiaries and Local Suppliers and its Effects

The focus of this study is the linkage effects that FDI creates when MNCs enter foreign markets in developing countries. Many studies have analyzed the direct and indirect effects of FDI on developing countries (Blomstrom and Kokko, 2000; UNCTAD, 1999, 2001). Linkage formation between MNCs through their subsidiaries and local firms is seen by scholars as an essential prerequisite for FDI to have a lasting and sustainable effect

(Altenburg, 2000; Dunning and Narula, 2004; Giroud, 2000, Scott-Kennel and Enderwick, 2005; UNCTAD, 2001). It has also been argued that linkages constitute a 'black box' in the discussion of how FDI induces economic development (Scott-Kennel and Enderwick, 2005). Certainly linkages are seen as mechanisms through which technology and know-how are transferred from MNCs to local partner firms in developing countries. Without linkages, FDI may simply create enclaves in the local economy (Singer, 1950 in Hansen and Schaumburg, 2006). This happens when MNCs go no further than exploiting natural resources and labor pools, thereby limiting the lasting and positive effects on the host country. Yet, while linkages are generally seen as prerequisites for upgrading local industry, there are studies that point to limitations in linkage-based economic development strategies (Humphrey and Schmitz, 2001; Gereffi, Humphrey, and Sturgeon, 2005). These studies have found that there are limited upgrading opportunities for linkage partners in global value chains, and that they risk being 'locked' into low value-added activities.

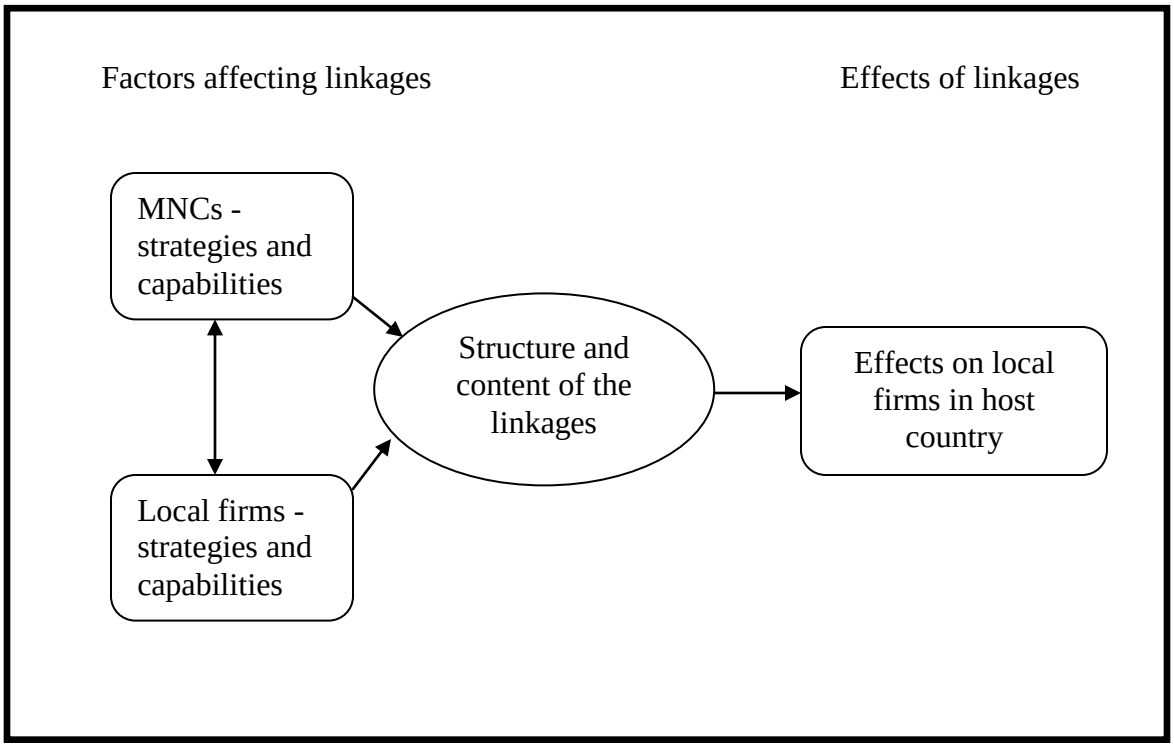
In the study, a broad definition of linkages is used that includes transactions between MNC subsidiaries and local firms. These are termed *inter-firm* linkages. The other type of linkage are those formed between subsidiaries and non-business entities such as universities, research institutes, training institutions, export promotion agencies, associations and other public or private institutions. These are termed *outside-firm* linkages. The study focuses only on inter-firm linkages and excludes transactions between firms and non-business entities. In concurrence with the definition of UNCTAD (2001), it defines inter-firm linkages as transactions that go beyond arm's length, one-off transactions and involve longer-term collaborations between the parties concerned. In terms of linkage effects, this study focuses on local linkage partners in the host country but not on the MNCs themselves or on the MNCs' competitors. The study is stimulated by the

typology of different linkage dimensions between MNCs and their local suppliers proposed by Giroud (2000) and Iguchi (2008).

2.6.1 Factors that Shape the Extent of Linkage Collaboration

Having analyzed the effects of linkage collaboration on firms, the discussion now turns to the factors that shape the structure, content and effects of linkages. Seen from the vantage point of the taxonomy of linkages capability espoused by Ernst et al. (1998) and Lall (1990), there are three main actors that shape the structure of linkage collaboration: MNCs, local firms and governments (Hansen and Schaumburg, 2006). As this study is looking only at firm-level technological capability building and inter-firm linkages, the government aspect of linkage collaborations is not incorporated in the present discussion. Thus the study is limited to linkages formed by the strategies of only two actors – MNCs and local firms – and their capabilities to pursue the collaboration. Figure 2.2 shows the framework of the study from the arguments so far. It shows the actors involved in the shaping of technology transfer, which in turn shapes the structure and content of the linkages. In the final analysis, these factors are the ones that affect the formation of linkages in firms.

Figure 2.2: A Framework of Analysis in Linkage Collaborations for this Research



Source: Adopted framework for this study

The next section will discuss the factors (subsidiaries and suppliers) that shape the structure and content of linkages and their direct effects, that is, static effects and dynamic effects. The discussion breaks the factors into three components, corresponding to the perspectives of the MNC subsidiaries, the local firms and the linkages. In discussing these factors, three analytical frameworks are used: 1) Forms of Backward Linkages; 2) Strategies, Capabilities and MNC Subsidiaries Typology; and 3) Strategies, Capabilities and Local Suppliers Typology. The discussion then moves on to the effects of the linkages that are formed between subsidiaries and local supplier firms in host countries.

For this research, the static and dynamic effects of linkages were measured using questionnaires, adapted from Iguchi (2007), that were distributed to both MNCs and their

suppliers. As discussed above, static effects of linkages are effects related to increases in the value and volume of activities exercised by the local linkage partner in lieu of collaboration with MNCs. Dynamic effects on the other hand are effects related to the upgrading of a local partner's capabilities due to collaboration with an MNC. The linkage categories were measured and then transformed into indexes. The indexes gauge the strength and breadth of the types of linkages formed between MNCs and local suppliers. Apart from the questionnaire, personnel from both MNCs and local suppliers were interviewed to get their feedback on how the capabilities of the local firms were upgraded as a result of the presence of the MNCs in the host countries.

Before turning to the structure and content of linkages, the discussion below elaborates on the distinction between spillovers and linkages in order to avoid inconsistent usage of terminology. It then considers the different types of linkages that produce positive effects, negative effects, or no effect, from inter-firm linkages or collaboration.

2.6.2 Linkages among Firms (Inter-firm Linkages)

Linkage collaboration among firms results in both intended effects and unintended effects on the host country's industry. However, it is difficult to differentiate between one and the other, as "most spillover studies are unable to disentangle direct and indirect effects at an aggregate level, and therefore capture both indirect and direct mechanisms for spillovers" (Giroud and Scott-Kennel, 2006:5). The section below defines the difference between the two.

Defining Technology Spillovers

According to Moran (2001), spillovers can be defined as indirect impacts or externalities on the industry of host country as a result of foreign firms' presence via FDI. In short, spillovers are a byproduct of an MNC's activities in a host country's economy. Javorcik (2004) views spillovers or externalities as one of the most important ways that MNC technology is transferred to host countries. Hansen and Schaumberg-Muller (2006) term spillovers as unintended effects of linkages.

Spillovers can be divided into two types: productivity spillovers and market-access spillovers (Blomstrom and Kokko, 2000). Productivity spillovers take place as competition forces local firms to become more efficient or when local producers diffuse their knowledge to their local partners. Market-access spillovers take place when, as a result of linkage collaboration, host countries' firms are able to use their improved knowledge to get better access to foreign markets for their exports.

Several studies have shown that technological spillovers to locally owned firms from the activities of MNCs may occur through a variety of channels or modes. Four main channels are identified in the literature (see Lall, 1980; Blomstrom and Kokko, 1997; Saggi, 1999; Pack and Saggi, 1997; Kokko, 1994; Rasiah (1995); Rasiah and Gachino, 2005; Lan, 1996; Moran, 2000; and Saggi, 2002). Some of the ways that MNC technologies can spill over to host country firms are:

i) local firms attempt to copy the MNC's product or process technologies (the demonstration effect);

ii) linkages between the MNC and its suppliers and buyers facilitate learning-by-doing among local firms, creating a mechanism that reduces the provision cost of technology transfer;

iii) training of local employees by the MNC provides a more highly skilled labor pool for other firms and a potential source of new start-up firms, thus creating an external benefit for other firms;

iv) entry of an MNC generates more competition within an industry, so that local firms are forced to use existing technology more efficiently or to upgrade their technology in order to remain competitive (the competition effect);

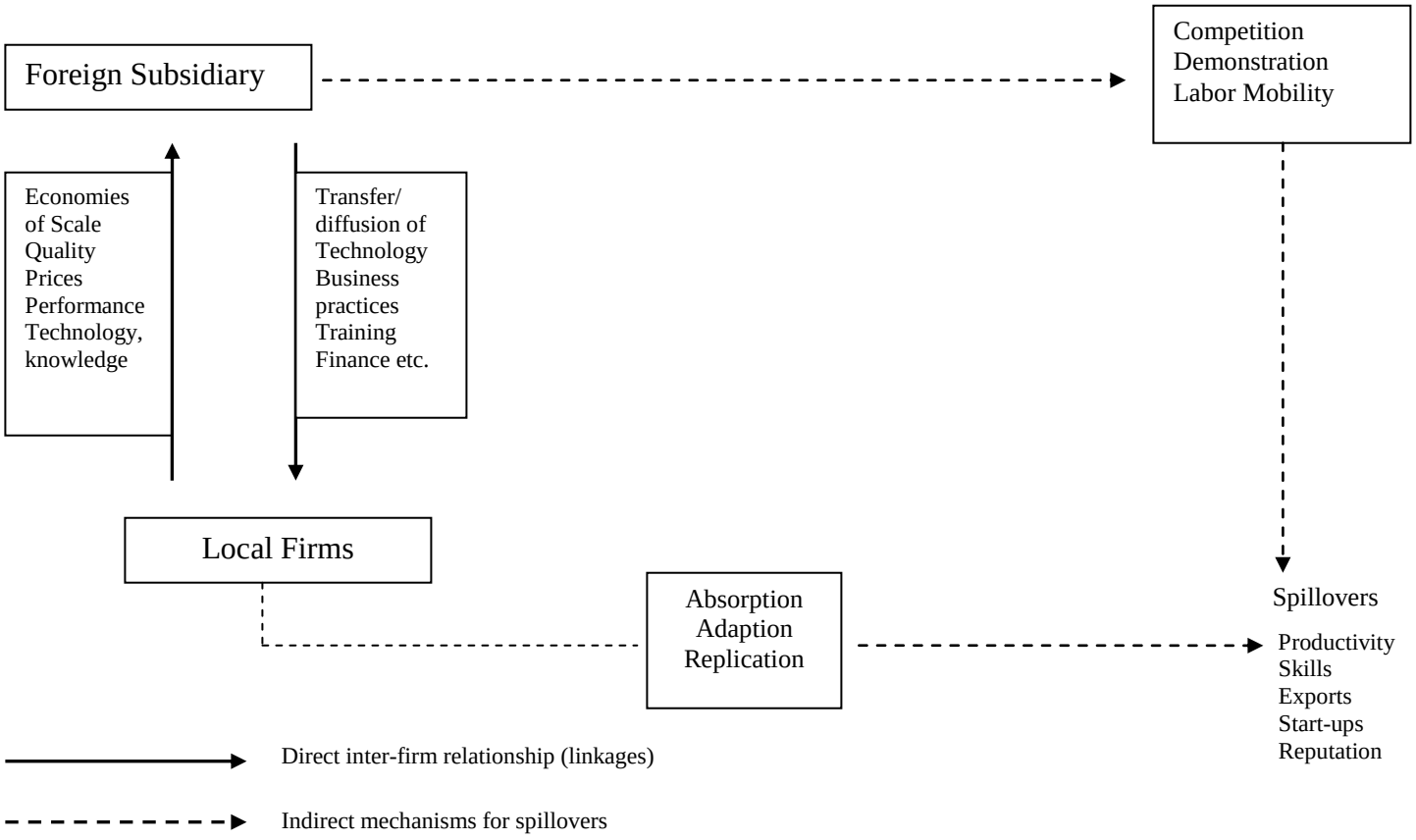
To the extent that local firms and MNCs operating in the same sector compete with one another, the latter have an incentive to prevent technology leakage and spillovers from taking place. This can be achieved through formal protection of their intellectual property, trade secrecy, paying higher wages to prevent labor turnover, or locating in countries or industries where domestic firms have limited imitative capacities to begin with. Studies by Aiken et al. (1996) and Girma et al. (2001) have documented that foreign firms pay higher wages than domestic firms to avoid labor turnover that may cause technology to be transferred out of the workplace. For upstream sectors, by contrast, MNCs have no incentive to prevent technology diffusion, as they may benefit from improved performance on the part of intermediate input suppliers (Iguchi, 2008). This finding forms the basis for the present study and is discussed below.

Defining Linkages

Linkages between MNC subsidiaries and local firms receive a lot of attention in economic development literature, as well as in international business literature (Hansen and Schaumburg-Muller, 2006). Hirshman (1958) argued that in developing countries there was a lack of interdependence and linkages in industries, and that strategies for economic development in such countries should focus on those industries where there were strong forward and backward linkages. From the international business perspective, the study of linkages looks at the implications for firms' growth and competitiveness. In both fields, linkages are important: studies on FDI in the 1990s assert that without linkages, foreign investment in developing countries remains an enclave in the local economy (Cypher and Dietz, 2004).

Linkages are the relationships established by the foreign firms with local firms. Spillovers, on the other hand, are spin-offs that may result after linkages have taken place (Giroud and Scott-Kennel, 2006) – although Dunning (1993) asserted that spillovers take place as a direct consequence of linkages forged between foreign firms and other economic agents in host countries. A graphical representation of the relationships between linkages and spillovers appears in Figure 2.3, below. The Figure emphasizes the difference between spillovers and linkages. It portrays linkages as direct mechanisms for spillovers that occur via inter-firm transactions, interactions and on-going relationships.

Figure 2.3: Interdependence between Spillovers and Linkages



Source: Giroud and Scott-Kennel, 2006

In short, what the Figure shows is that after MNC subsidiaries establish business relationships and linkages with various economic agents in a host country, a supplier may learn a new technology. If the supplier then goes on to use that technology to develop new and different products, this would be a spillover. Spillovers therefore arise from direct relationships as local firms absorb, adapt and replicate the knowledge and technology transferred. As a result of these linkages, local firms have the opportunity to benefit from spillovers and the transfer of knowledge from MNC subsidiaries (Driffield and Love., 2003). This is why the study of linkages is important. By knowing the types of linkage that are being formed between subsidiaries and local firms over a period of time, a longitudinal study can monitor whether the linkages are increasing or diminishing. This can be used as a gauge of whether the type of technology transfer is successful or otherwise.

According to Giroud and Scott-Kennel (2006), there are four kinds of study on linkages: 1) case studies that describe particular foreign firms and list their relationships; 2) industry-level case studies; 3) studies drawn from surveys conducted directly with MNCs; and 4) studies using firm-level panel data. Such studies benefit from large-scale data, but do not give a good understanding of the intricacies of buyer-supplier relations.

Linkages can be divided into two main groups: 1) vertical linkages with suppliers and customers and 2) horizontal (relational) linkages with alliance partners and competitors (Iguchi, 2008; UNCTAD, 2001; Battat et al., 1996). Vertical linkages involve two types of direct relationship: those between a subsidiary and local suppliers (termed ‘backward’ or ‘upstream’ linkages), and those between a producer and customers (termed ‘forward’ or ‘downstream’ linkages) (von Tunzellmann, 1995). Vertical linkages, while mostly based around market transactions, may also involve voluntary assistance and transfer of resources

or technology to the local firm (Saggi, 2002). The term 'backward linkages' describes all transactions and relationships between foreign subsidiaries and local suppliers in the host country. What is important about backward linkages is that, in their case, spillovers may take place through direct knowledge transfer from subsidiaries to local suppliers. Furthermore, local firms may use backward linkages to upgrade their production management or their technology as a result of a knowledge transfer (Javorcik, 2004).

Forward linkages are defined as "local production of more specialized inputs which allows the production of more complex goods at competitive costs" (Rodriguez-Clare, 1996: 853). Therefore forward linkages describe downstream relationships between foreign subsidiaries or producers and host-country firms (as customers). The host-country firms in this relationship take the role of customers for intermediate or final products, and of agents for marketing and distribution.

Horizontal linkages, on the other hand, refer to collaborative activities between foreign and local firms, typically associated with alliances and other inter-firm network relationships (Giroud and Scott-Kennel, 2006). They do not center on transactions, as vertical linkages do. Rather, horizontal linkages involve direct inter-firm relationships, such as alliances, technology sharing agreements, management contracts and co-production. Joint ventures and other equity-based arrangements are not regarded as horizontal linkages since, in this case, the firms share ties of ownership.

Table 2.2, adapted from the World Investment Report 2001, gives a general idea of the kind of linkages MNC subsidiaries create. Both vertical and horizontal linkages (UNCTAD, 2001:131) are shown, and the Table also distinguishes between spillovers and linkages.

In the present study, only backward or supply linkages are reviewed, because they are the more significant for regional development (Dicken, 1992).

Table 2.2: Relationship between Foreign Affiliates And Local Enterprises and Organizations

Form	Relationship of foreign affiliate to local enterprise		
	Vertical		Horizontal (co-operation in production)
	Backward (sourcing)	Forward (distribution)	
"Pure" marker transaction	"Off-the-shelf" purchases	"Off-the-shelf" sales	
Short-term linkage	Once-for-all or intermittent purcharses (on contract)	Once-for-all or intermittent sales (on contract)	
Longer-term linkages	Longer-term (contractual) arrangement fot the procurement of inputs for further processing. Subcontracting of the production of final or intermediate products	Longer-term (contractual) relationship with local distributor or end-customer. Outsourcing from domestic firms to foreign affiliates	Joint projects with competing domestic firms
Equity relationship	Joint venture with suppliers. Establishment of new supplier-affiliate (by existing foreign affiliate)	Joint venture with distributor or end customer. Establishment of new distribution affiliate (by existing foreign affiliate)	Horizontal joint venture. Establishment of new affiliate (by existing foreign affiliate) for the production of the same goods and services as it produces
"Spillover"	Demonstration effects in unrelated firms Spillover on processes (incl. technology) Spillover on product design Spillover on formal and on tacit skills (shop-floor and managerial) Effects due to mobility of trained human resources Enterprise spin-offs Competition effects		

Source: Adapted from UNCTAD 2001: 131

Definition of Backward Linkages

The term 'backward linkages' has been defined in various ways. Lall (1980:204) defined backward linkages as "the direct relationships established by firms in complementary activities which are external to 'pure' market transactions (i.e. anonymous buyers and sellers exchanging goods in discrete transactions at prices determined in competitive markets)." Backward linkages are also defined as "transactions that go beyond arm's length, one-off relations (as in buying standardized products off-the-shelf) and involve longer term relations between firms" (UNTCAD, 2001). The term is also used in a narrower sense to refer to "inter-firm relationships in which a company purchases goods and services as its production inputs on a regular basis from one or more other companies in the production chain" (Battat et al., 1996:4). However, the present study follows UNCTAD's definition, "transactions which go beyond arm's length, one-off relations."

By either definition, backward linkages represent all relations established with supplier firms, and they exist when MNC subsidiaries acquire goods or services from local suppliers. Among researchers and policy makers, discussion of backward linkages often uses terms such as 'procurement,' 'subcontracting,' and 'local sourcing' (outsourcing). The reason backward linkages are important for current studies are that they act as a channel by which MNC subsidiaries transfer their technology and knowledge. This creates spillovers by which local suppliers can acquire modern technologies as well as new management or organizational practices from MNC subsidiaries (Halbach, 1989; Supapol, 1995; Rasiah, 1995; IDE, 1994; Capannelli, 1997; Ariffin, 2000; Giroud, 2001, 2003; UNCTAD, 2001).

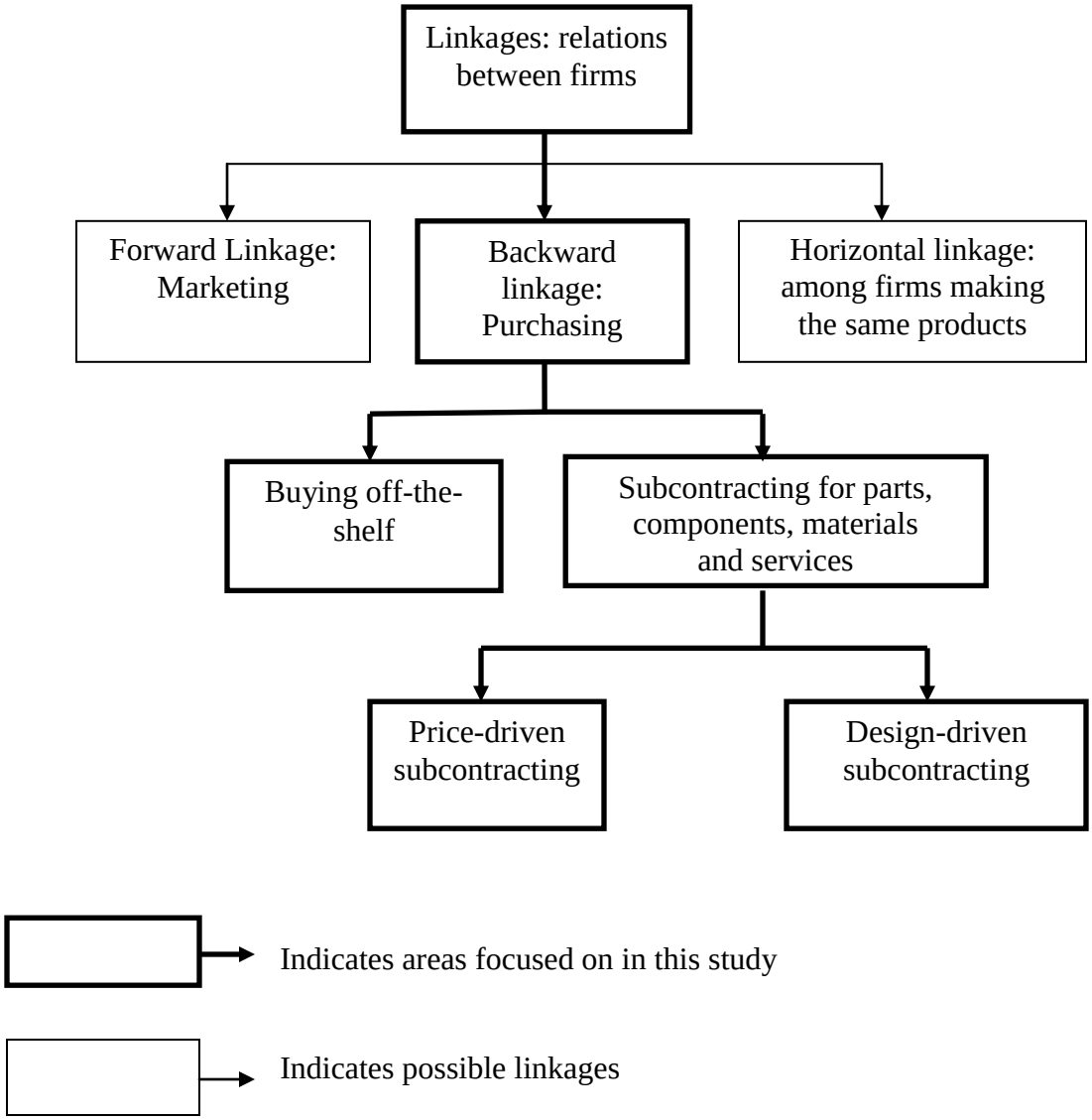
Figure 2.4 differentiates backward linkages from other inter-firm linkages and shows the different forms of backward linkages. In terms of MNC subsidiaries purchasing inputs,

firms may buy the products from the suppliers 'off-the-shelf' or they may enter into contracts with suppliers of specialized inputs. For the former, suppliers usually use relatively simple and standardized components; for the latter, they supply products custom-made to the subsidiaries' requirements. Subcontracting work of this kind requires regular and intensive inter-firm contact.

The more interactions there are between MNC subsidiaries and local suppliers, the stronger the inter-organizational linkages will be. In engineering work, for example, there will be many interactions between customers and suppliers in purchasing inputs (Ivarsson and Alvstam, 2009). A study by Ivarsson and Alvstam (2009) found linkages between MNC subsidiaries and local suppliers in the automobile industry. The petrochemical industry, of course, involves both engineering and scientific work.

As shown in Figure 2.4, subcontracting work can be either price-driven or design-driven, depending on the subsidiaries' corporate strategy. In price-driven subcontracting, the subsidiaries prepare specifications for the parts, components or services they need and send the specifications to a list of subcontractors, who then submit bids on the basis of price. On the other hand, design-driven subcontracting depends on frequent modifications of inputs at all stages of production. In this case, subcontracting is based on long-term consultative and networked relationships. While price competitiveness remains important in this kind of subcontracting, the supplier's ability to respond to the needs of the subsidiary will make the relationship between producer and supplier more stable, which in turn will encourage the supplier to make better planning and technological decisions. Thus the inter-firm linkages formed will encourage technology transfer, managerial training and sharing of market information (Battat et al., 1996).

Figure 2.4: Forms of Backward Linkage in the Study



Source: Adapted from Battat et al., 1996

Based on previous studies, backward linkages exist in almost all commercial activities. However, they are most common in manufacturing industries. The pioneering work on defining and outlining backward linkages or vertical inter-firm linkages between MNC subsidiaries and local suppliers was done by Lall (1980) in a case study involving subcontracting relationships in two leading truck manufacturers in India. That study found ten main categories of linkages in subcontracting relationships. A 1989 study by the International Labor Office (ILO), Axel J. Halbach's *Multinational Enterprises and Subcontracting in the Third World: A Study of Inter-Industrial Linkage* (quoted in Battat et al., 1996) suggested that industries where the prospects for backward linkages were the greatest included the automobile industry (requiring parts and components constituting 70 percent or more of final sale value); machinery and precision instruments involving primary assembly activities (50 percent or more); and the Electrical and Electronics industries (40 to 50 percent) (Battat et al., 1996). According to these studies, the food processing industry is also highly dependent on backward linkages for its agricultural inputs. However, industries that process raw materials, such as the metallurgical and petrochemical industries, rank among the lowest in backward linkages.

The low number of backward linkages attributed to resource-based industries has left a mixed impression as to whether developing countries should get involved in such activities. In his discussion of backward and forward integration in the development of resource-based industries, Auty (1987) argued that resource-rich countries should not aim to become involved in processing their natural resources. These countries should instead export them and allow developed countries to conduct the downstream activities. Auty also described resource-rich countries as suffering from the 'resource curse' syndrome.

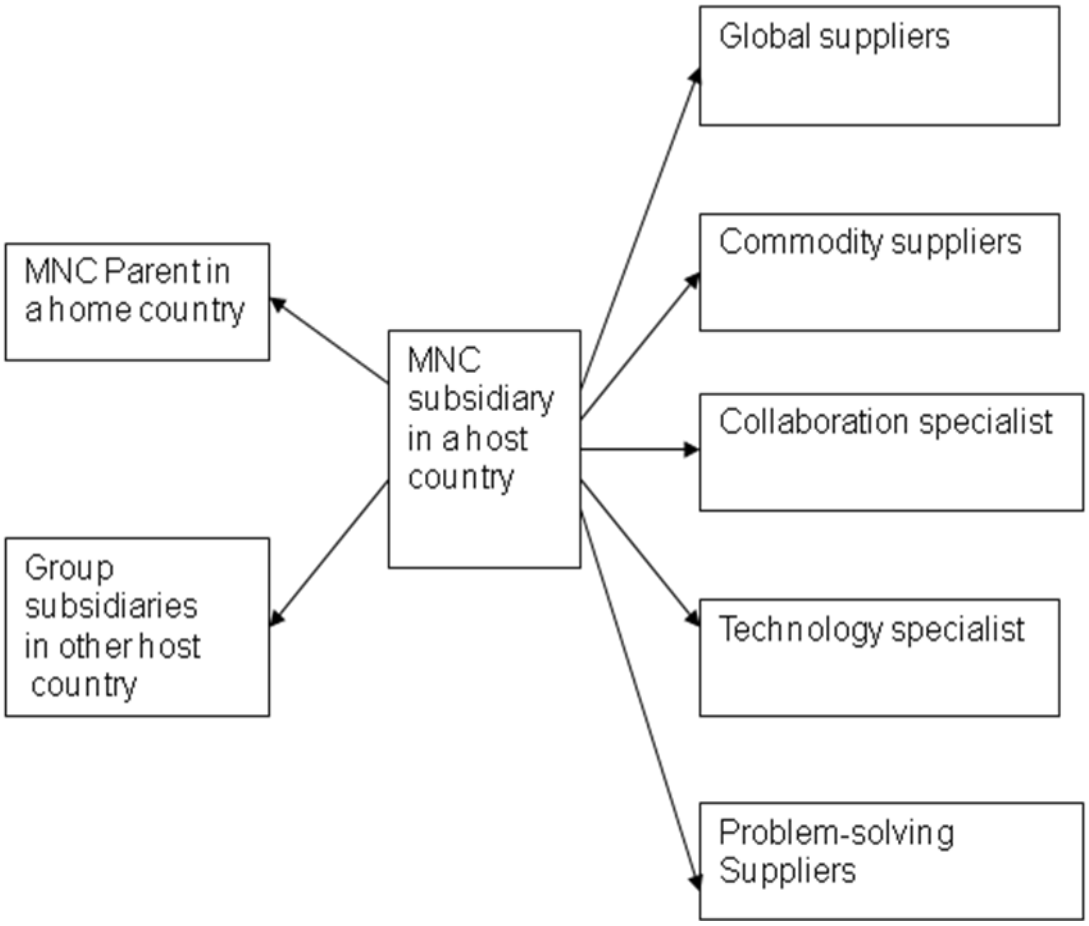
The exact field in which the industry-level study by Halbach (1989) found a low number of backward linkages is not known. Thus the present study seeks to ascertain which category has the most inter-firm collaboration leading to backward linkages. Figure 2.5 shows the inter-organizational linkages that are used in this study of backward linkages. It focuses on backward linkages between MNC subsidiaries and different types of local suppliers, namely global suppliers, commodity suppliers, collaboration specialists, technology specialists, and problem solving suppliers (UNCTAD, 2001; Pearce, 2001; and Kaufman et al., 2000). Global suppliers are omitted from the present study because in the Malaysian case, petrochemical suppliers needed to establish a company in the country in order to supply companies operating in the country.[i] However, if an MNC needs supplies that are not available on the local market, they are free to get them from abroad with the approval of the Malaysian Investment Development Authority (MIDA). So far, no subsidiaries have had any problems in getting their supplies.[ii] Commodity suppliers and problem solving suppliers (licensors) are also omitted from this study, since a pilot study found that the MNC subsidiaries reported no collaboration with these suppliers. As these suppliers are involved in mature technology, there is less need for subsidiaries to provide assistance to them (Supapol, 1995).

Based on Figure 2.5, the discussion now turns to the creation of vertical linkages (in this study, backward linkages) between MNC subsidiaries and local suppliers. As discussed above, MNC subsidiaries are willing to procure inputs from local suppliers in a host country because they are motivated to do so for cost reasons. In return, local suppliers are obliged to meet the subsidiaries' demand by supplying quality products or services and delivery. As the technological capability of local suppliers improves, this would lead to a wider range of collaborations (for this study, backward linkages) between the MNC

subsidiaries and the local suppliers. As a result of these interactions, upgrading of local suppliers can proceed.

The study is interested in examining the effects of these interactions between MNC subsidiaries and local suppliers, as well as the upgrades (if any) resulting from these interactions. The discussion now proceeds to the development of an analytical framework. There are actually three frameworks: firstly, a framework for the forms of backward linkages established between the MNC subsidiaries and the local suppliers; secondly, a framework for MNC subsidiaries' strategies and linkage; and lastly, a framework for the technological capabilities of local suppliers and their linkage effects.

Figure 2.5: Backward Linkages in the Petrochemical Industry



Source: Adopted from UNCTAD (2001), Pearce (2001) and Kaufman et al., (2000); derived from research

2.7 Development of an Analytical Framework: Forms of Backward Linkage

The literature on FDI suggests that the key firm-specific advantage of companies that invest in other countries is knowledge (Caves, 1996; Johnson, 1970). The creation and exploitation of this knowledge are the main reason for the growth and success of MNCs. MNCs go abroad to earn rents on that stock of knowledge. The existence of a technology gap between MNC subsidiaries and local firms in developing countries shows that there is scope for technological knowledge flows from the subsidiaries to local suppliers (Lall and Narula, 2004). As discussed above, subsidiary-supplier or buyer-supplier linkages are one type of informal mechanism by which such knowledge is diffused. This knowledge flow, termed backward linkage, has become a substantial channel for transferring technological knowledge and other capabilities to local suppliers (Giroud, 2003; UNCTAD, 2001). An important aspect of backward linkages for local suppliers and the host country in general is acquiring spillovers and gains through interactions with MNC subsidiaries (UNCTAD, 2001).

Lall and Narula (2004) agree that the development of local suppliers' capacities and capabilities is a key requirement, both in attracting FDI and in increasing spillovers from subsidiaries (Lall and Narula, 2004) – spillovers that lead to an upgraded technological level through the accumulation of technological capability on the part of local suppliers. As suggested by Lundvall (1988) and Von Hippel (1988,) this accumulation of knowledge takes place not only through local suppliers developing their internal capabilities, but also through learning by interaction with a wide variety of sources, such as external technology producers and MNC subsidiaries (Lundvall, 1988; and Kaufman et al., 2000).

Figure 2.4 shows that, depending on the suppliers' technological capability, local suppliers are involved in the process of manufacturing in terms of the sourcing of parts or

components, manufacturing, and providing services under sub-contracting arrangements or outsourcing (Battat et al., 1996; Corbett, 1997). In petrochemicals, rapid technological advancement and the ongoing process of globalization make it especially critical for local firms to be technologically capable if they wish to participate in the industry. As the petrochemical industry is capital intensive, big companies can find and choose suppliers from anywhere available to them, either domestically or externally (Cortes and Bocock, 1984). A subsidiary's motivation to engage in backward linkages with local suppliers is driven by the technological capabilities that the local suppliers have to offer (Lall and Narula, 2004). This is because MNC subsidiaries, like any other business entities, are looking for cost efficiency in procuring inputs in the host countries. Backward linkages help local suppliers play a crucial role in meeting subsidiaries' demands regarding quality and delivery (Handfield et al., 2000). A supplier's technological capability to meet these demands then contributes to the development of a wider range of backward linkages between subsidiaries and local firms. Such interactions further benefit local suppliers in terms of exposure to the subsidiary and the MNC group's high standard of manufacturing operations in the global market.

In order to meet the subsidiaries' demand through backward linkages, local suppliers need to be involved in technological learning (Kogut and Zander, 1996). Such learning is a prerequisite for them to ensure that the parts, components or products they supply will meet the subsidiaries' precise requirements. But for this to occur, the subsidiaries need to provide the necessary specifications to their local suppliers, and to transfer related technologies to the suppliers if the suppliers do not possess such technologies. These manufacturing technologies are in essence related to product and process know-how,

including proprietary knowledge, and to organizational and managerial know-how, as well as technical assistance of various kinds.

Just how much technology flows from MNC subsidiaries to local suppliers depends on the benefits that the subsidiaries consider it will bring to their own operations (UNCTAD, 2001; Iguchi, 2008). To evaluate the level of benefits realized, the level of technology acquired, and the level of capability absorbed, this study uses the criteria espoused by UNCTAD (2001:157) and Iguchi (2008) to examine the forms of linkages between subsidiaries and suppliers. It also measures how tacit assets such as technology, knowledge, and managerial skills flow from a subsidiary to linking local suppliers through backward linkages of different kinds. These qualities are measured using an index initiated in a study by Iguchi (2007).

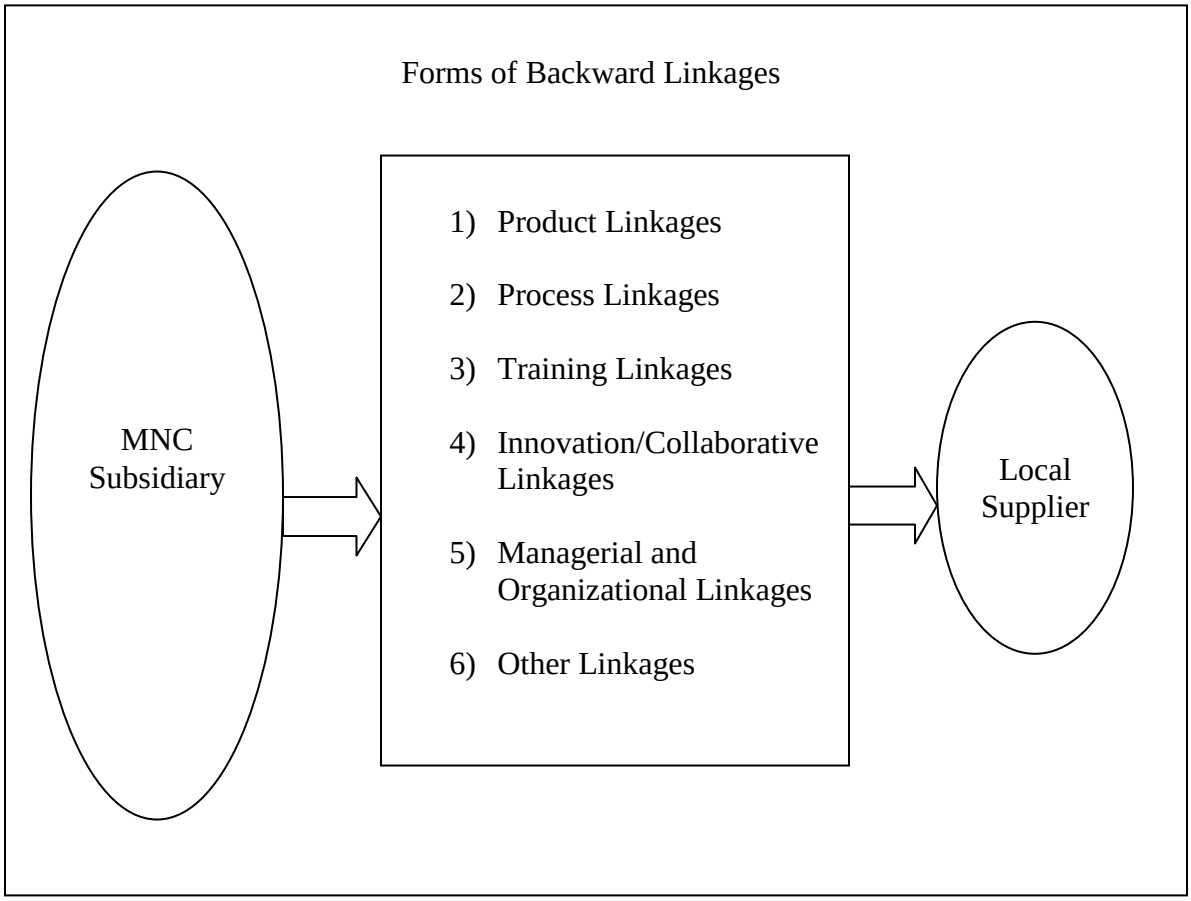
According to Table 2.2, backward linkages as defined by UNCTAD (2001:131) take several different forms, namely: i) pure market transactions, ii) short-term linkages, iii) long-term linkages. Long-term linkages are often preferred by local suppliers, as they are beneficial for their long-term goals. This study defines linkages as transactions that go beyond arm's length, one-off transactions and involve longer-term collaboration between the parties; and buyer-supplier relationships (UNCTAD, 2001). In the petrochemical industry (as in, for example, the oil and gas industry), this could include contractual arrangements for the procurement of inputs, as well as subcontracting of the production of intermediate or final products or services (Khanna, 1984; Crabtree, 1997; and Battat et al., 1996).

2.7.1 Analytical Framework of Forms of Backward Linkages

In order to evaluate the quality of backward linkages that are formed between subsidiaries and local suppliers and how these assets flow from a subsidiary to suppliers, possible forms of linkage are divided into six categories that a subsidiary can offer to its local supplier. According to UNCTAD (2001:157-162) and Iguchi (2008), these categories are: 1) Product technology-related, 2) Process technology-related, 3) Training, 4) Innovation/Collaborative, 5) Managerial and Organizational Linkages, and 6) Other. In each form of linkage, a subset of categories relating to flows of technology or knowledge can be derived, according to the areas of technology involved.

Figure 2.6 shows an analytical framework of forms of backward linkage. The details of each form of backward linkage are explained below (Lall, 1980; UNCTAD, 2001; Ernst et al., 1998).

Figure 2.6: Analytical Frameworks on Forms of Backward Linkages



Source: Compiled and modified from UNCTAD (2001), Lall (1980) and Ernst et al. (1998)

1) Product-Related Linkages

A product-related linkage is centered on: 1) proprietary knowledge flows to produce parts or components; 2) how subsidiaries provide product designs and technical specifications; 3) technical consultation or discussion; and 4) feedback on product performance. Table 2.3 provides a list of six potential product-related linkages.

Table 2.3: Potential Product-Related Linkages (five possible linkages)

1	1) Proprietary knowledge flows	
2	2) Product design and technical specification flows	
3	3) Provision of technical consultation on product characteristics or parameters flows	Visiting local suppliers
4		Inviting local suppliers
5	4) Feedback on local suppliers' performance	Formal and controlled feedbacks
6		Informal and less controlled feedbacks

2) Process-Related Linkages

Process-related linkages are collaborations by which subsidiaries give suppliers the required technology through a form of subcontracting or some other kind of link. Types of process-related linkages include: 1) provision of machinery; 2) provision of technical support on process-related activities; 3) visiting the supplier's facilities to support their process technology; and 4) provision of assistance to employees to set up their own firms. Table 2.4 provides a list of ten potential process-related linkages.

Table 2.4: Potential Process-Related Linkages (ten possible linkages)

1	1) Provision of machinery or equipment	
2	2) Provision of technical support	On manufacturing process
3		On quality control
4		On inspection and testing methods
5		On usage of process equipment
6	3) Visiting suppliers for support	Visit on factory layout
7		Visit on installing machinery
8		Visit on production planning
9		Visit on production problems
10	4) Attach company's engineers to local suppliers	

3) Training Linkages

In training linkages, subsidiaries play a significant role in helping local suppliers to train their human resources and upgrade their technological capability. These linkages can create knowledge flows through direct or indirect training by subsidiaries to upgrade or refine existing technology or to instruct local suppliers how to innovate on existing technology. Among the potential means of training-related linkages provided by subsidiaries are: 1) training offered by subsidiaries in the host countries, either direct, indirect or through a third party; 2) forming a special department for establishing linkages with the suppliers; and 3) forming special teams with suppliers. Table 2.5 provides a list of five potential training-related linkages.

Table 2.5: Potential Training-Related Linkages (five possible linkages)

1	1) Training of local supplier employees by MNC	Formal training
2		Informal training
3		Through third-party training
4	2) Forming a special department to liaise with suppliers	
5	3) Forming special teams for linkage with suppliers	

4) Innovation/Collaborative-Related Linkages

Some subsidiaries collaborate in product development with their local suppliers through the involvement of local research institutions and local universities. Innovative/collaborative linkages include 1) joint collaboration with local suppliers; 2) joint product development; 3) joint collaboration at the production stages; 4) joint collaboration at the research stage; and 5) support for product or process designing know-how. Table 2.6 provides a list of five potential innovation/collaborative-related linkages.

Table 2.6: Potential Innovation/Collaborative-Related Linkages (five possible linkages)

1	Joint collaboration with local suppliers
2	Joint product development
3	Joint collaboration at the production stages
4	Joint collaboration at the research stage
5	Support for product or process designing know-how

5) Managerial and Organizational-Related Linkages

Linkages at the managerial and organizational level occur after local suppliers have acquired sufficient technological capability. More often, subsidiaries assist local suppliers in adopting inventory management systems or using the system that the subsidiaries are using in their firms. Subsidiaries may also assist suppliers in designing and implementing quality assurance systems or total quality control systems so that they can maintain the quality standard required by subsidiaries. Subsidiaries also help suppliers by introducing new management practices, financial systems, purchasing systems and marketing know-how. Table 2.7 provides a list of seven potential managerial and organizational-related linkages.

Table 2.7: Potential Managerial and Organizational-Related Linkages (seven possible linkages)

1	Assisting with inventory management
2	Assisting with quality control
3	Assisting with obtaining ISO
4	Introducing new management practices
5	Introducing new financial systems
6	Introducing new purchasing systems
7	Introducing marketing know-how

6) Other Forms of Linkage

Besides the above linkages, which are formed by direct collaboration between MNC subsidiaries and local suppliers, there are other types of linkage that arise outside the official function of the parties – for example, the formation of clubs or informal associations for meetings – that help both parties in various ways in term of finance or training. Table 2.8 provides a list of five potential other forms of linkage.

Table 2.8: Potential Other Forms of Linkage (five possible linkages)

1	Funding of suppliers on training
2	Usage of host country's financial institutions
3	Participation in host country's vertical linkages
4	Joining suppliers' club or association
5	Joining meetings or activities organized by subsidiaries

2.7.2 Determinants of Backward Linkages

MNC subsidiaries are motivated to have backward linkages if they gain something from the collaboration. Thus the breadth of backward linkages formed will depend on subsidiaries' motivations and their strategies on product range, market scope and sourcing activities. Generally, subsidiaries that are targeting the local market employ lower technology than export-oriented subsidiaries due to lower quality requirements and technical specifications in the host developing countries (Iguchi, 2007). Furthermore, subsidiaries create more linkages when they use intermediate goods intensively and the home markets are relatively similar in terms of intermediate products (Rodriguez-Clare,

1996). This suggests that the level of backward linkages is intensified as the technological level of suppliers is upgraded.

As a result of liberalization, one way of reducing operating costs is to outsource non-core business activities (Corbett, 1997). MNCs have a strong interest in developing their supplier bases in host countries to enhance their competitiveness. Subsidiaries are willing to invest in building local capability when they expect this will yield a return on their investment. Thus, if the potential suppliers lack absorptive capacity or the host country's infrastructure is weak, subsidiaries may not be willing to form collaborations with the suppliers.

Traditionally, subsidiaries have kept their production internal. However, complex services and the production of simple and very capital-intensive products are outsourced as local suppliers' technological capabilities develop and the cost advantages of outsourcing become higher (Corbett, 1997).

If subsidiaries in host developing countries are involved in mature technology, there is less need for these subsidiaries to provide assistance to certain suppliers who are themselves involved in supplying mature technology (Supapol, 1995). Thus if subsidiaries enter into collaboration with their suppliers, the subsidiaries will decide what forms of backward linkages they will engage in. Their attention will focus on key suppliers who provide the subsidiaries with complex and strategically important inputs. The subsidiaries in return will give close interaction with the suppliers. Suppliers who are highly ranked in terms of their technological level will receive greater technical assistance. In this regard, the breadth or diversity of backward linkages can be categorized according to the area of technology the suppliers are involved in.

As the subsidiaries engage in more backward linkages with local suppliers, it is in the interest of the MNC subsidiaries to expand the number of suppliers that meet their requirements and to expand the breadth of linkages in terms of costs, quality, and timely delivery (Handfield et al., 2000). For some MNC subsidiaries, efforts to upgrade local suppliers are part of their corporate strategy and some even have a Supplier Development Program (Ivarsson and Alvstam, 2005, 2009).

Lall and Narula (2004) assume that the larger the gap is between the technological capability of MNC subsidiaries and that of local suppliers, the lower the breadth or diversity of linkages will be. However, in the petrochemical industry, which involves engineering industries, outsourcing plant maintenance services (for example) is high-risk if the local service provider cannot perform. In this sense, the extent of backward linkages between subsidiaries and their local suppliers is likely to be greater the more they are committed to long-term relationships, the greater the technical complementarities are, and the more specialized or custom-made the component, product, and services are (Ivarsson and Alvstam, 2009).

The extent of backward linkages is also influenced by the size of the subsidiary, the types of products it manufactures or procures, and the subsidiary's own strategy. A subsidiary's strategy, and hence the breadth of the backward linkages it creates in the petrochemical industry, can also be affected by varying types of ownership. The types of ownership in the petrochemical industry in Malaysia can be grouped as 100 percent foreign-owned, 100 percent local-owned, (this includes petrochemical firms owned by the national oil company, Petronas) and joint-venture companies (*Petronas Prospectus*, 1 November 2010). Studies have shown that linkages increase over time as skill levels grow, new

suppliers emerge and local content increases (Gorg and Ruane, 1998; Driffield and Noor, 1999; Scott-Kennel and Enderwick, 2001).

The extent of backward linkages is also affected by factors related to the host countries' levels of development, their institutions and organizations, and the technological capabilities of local suppliers. With the exception of the technological capabilities of local suppliers, however, these factors are not dealt with in this study.

2.8 Development of an Analytical Framework: MNC Subsidiaries' Strategies and Linkage Effects

2.8.1 Why Do Firms Enter Foreign Markets? A Review of FDI Theories

Hymer (1976) raised the question of why MNCs existed at all, given the penalties for operating in a foreign market. His theory of monopolistic advantage, whereby MNCs exist because they possess unique resources or firm-specific advantages (FSA), still remains persuasive. The principal belief of the theory of foreign direct investment is that the primary advantage that a firm brings to foreign markets is its possession of superior knowledge about technology, production, marketing or other activities (Arora and Fosturi, 2000). Therefore, a firm operating in a foreign country will seek to keep these unique advantages internal to itself in order to avoid the danger of losing the firm's unique competencies through expropriation by others.

In the wake of Hymer's monopolistic advantage theory, various other explanations and theories have been advanced as to why firms enter foreign markets. This segment reviews the literature on how knowledge determines the tendency of MNCs to expand. How this

technological knowledge is transferred to developing countries is described in more detail in the development of an analytical framework for local suppliers' technological capabilities. Before going to the detail, this study assumes that due to their possession of firm-specific advantage or knowledge, MNC subsidiaries are the ones that initiate linkage collaboration with local firms.

2.8.2 The Importance of Knowledge

Marshall (1890/1916) perceived knowledge as a "powerful engine of production," and Lundvall (1992) viewed knowledge as the most fundamental resource in contemporary economies. Contemporary studies in economics have portrayed knowledge as the driver of economic growth (Romer, 1990). Yet neo-classical economists assume knowledge to be an exogenous rather than an endogenous factor of production (Romer, 1990). The failure of the neo-classical model to explain economic growth stemming from technological advancement has prompted economists to shift the focus from a resource-based to a knowledge-based explanation of production.

The significance of knowledge in the theory of economic growth is that knowledge has the capacity to resolve uncertainty (Smith et al., 2002) due to the incompleteness of knowledge (Dosi and Egidi, 1991). Howells (2002:872) views knowledge as 'a dynamic framework or structure from which information can be stored, processed and understood.' From these perspectives, knowledge is conceptualized as a 'stock.' When seen in this light, it can be used to explain economic growth, since it is a commodity or a factor of production in its own right, capable of supplying countries with economic benefits. Knowledge takes at least four forms: 1) know-what (knowledge about facts); 2) know-why (knowledge about principles and laws), 3) know-who (information about who knows what and who knows

what to do); and 4) know-how (associated with the capability to do a particular task) (Lundvall and Johnson, 1994).

Following the importance placed on knowledge, there are four perspectives describing how knowledge determines the expansion tendencies of MNCs and how firms bring this knowledge to foreign countries.

The Public Goods Perspective

According to the public goods perspective or eclectic paradigm (also known as OLI) developed by Dunning (1988), knowledge is conceptualized as a public intermediate good owned by a firm that can be transferred at zero marginal cost to various units within an MNC (Johnson, 1970). Given the ease of transfer, a critical concern for the MNC is the potential for unintended transfer to, and expropriation of that knowledge by, competitors. The public goods perspective suggests that MNCs will internalize transactions in the external market because such transactions pose a significant risk of knowledge appropriation by competitors that would dissipate the MNCs' knowledge-based firm-specific advantage.

The public goods perspective of knowledge suggests that MNCs choose their markets and structures according to three factors – ownership advantage (O), or firm-specific advantages or competencies; locational advantages (L) inherent in particular geographic areas; and internalization advantages (I) derived from conducting transactions hierarchically rather than in the open market. In the OLI paradigm, ownership advantages are the key source of the MNC's competitiveness in foreign markets.

Firm-specific advantages arise from "privileged possession of intangible assets" and advantages from common governance of cross-border activities (Dunning, 1988:79). These O advantages have four characteristics: (i) the firm owns or can appropriate the assets or their services; (ii) the assets differ in productivity from comparable assets possessed by competing firms; (iii) they are mobile between national markets in which the MNC competes; and (iv) they may be depreciable or augmentable, but their lifespans are not short relative to the firm's investment horizon (Caves, 1996). The traditional view of firm-specific advantage suggests that the primary advantage an MNC brings to foreign markets is its possession of superior knowledge, i.e. its most important proprietary asset is knowledge or technology. Once the technology is produced, it generates income through sales of goods or services incorporating the technology.

Firm-specific advantages are seen as proprietary assets that the firm can use but may not necessarily be able to transfer to external parties. In order for the assets to be proprietary, either the firm must hold legal title to their use, or the assets cannot be easily copied or appropriated by other firms. This means that the benefits derivable from the use of firm-specific advantages remain the exclusive domain of the possessing firm. Because foreign markets offer the opportunity to earn additional rents over and above those in the home market, firm-specific advantages provide a rationale for expansion into foreign markets.

Protecting the knowledge advantages of the MNC from freeriding and opportunistic behavior by possible competitors is therefore a key to ensuring the long-run competitive advantage of the firm. The publicness of knowledge provides a rationale for the multinational's preference for wholly owned subsidiaries as the vehicle for transferring technology to foreign countries.

The Internalization Perspective

In the internalization perspective, the decision by the MNC to invest outside its home country rests on the costs of transferring knowledge to those distant locations. While this perspective recognizes the public-good aspect of knowledge, the focus in determining whether to expand is more on the weight of bureaucratic costs (the costs of hierarchical organization) relative to transaction costs (the costs of transacting through the market). MNCs will internalize divisions in host countries at that point where the costs of increased bureaucratization are just outweighed by the transaction costs associated with market contracting (Hennart, 1991; Buckley and Casson, 1976; Rugman, 1981).

Whereas the focus of the public-goods perspective is on the MNC's possession of unique knowledge, the internalization perspective is distinct in its concentration on the factors affecting the transfer of that knowledge (Buckley and Casson, 1976; Hennart, 1991; Rugman, 1981, 1986). Hood and Young (1979:56) suggest that, from the internalization perspective, "it is not the possession of a unique asset per se which gives a firm its advantage. Rather it is the process of internalizing that asset as opposed to selling it to a foreign producer which gives the MNC its unique advantage." Internalization decisions therefore rest on the relative weights of bureaucratic and transaction costs. The MNC internalizes these transactions as long as the costs of hierarchical organization are outweighed by the costs of knowledge transfer via the market mechanism.

The Technological Competence Perspective

The technological competence perspective also attaches primacy to knowledge in determining the expansion activities of MNCs (Cantwell, 1989, 1991). This perspective is different from the other two in that the importance of technological competence in determining an MNC's competitive advantage is stressed over knowledge transfer costs. In this framework, the MNC is not simply a mechanism through which costs are reduced but, rather, a vehicle through which knowledge is recombined (Schumpeter, 1934) to produce and subsequently exploit new and valuable innovations (Kogut and Zander, 1992, 1995). A firm's facility in accomplishing recombination and exploitation is unique to that firm. As such, that knowledge remains firm-specific or tacit.

Cantwell (1991:50) suggested that "technological competence… because it consists of those elements of a firm's technology which are distinctive, is never itself transferred through trade or copied exactly through spillovers to other firms." Technological competence, rather, is unique to each firm. It is tacit, being largely incomprehensible to competitors. This knowledge resides in the shared norms or routines of the firm's employees (Nelson and Winter, 1982) and the ability of those employees to reconfigure those routines (Kogut and Zander, 1992) to produce novel knowledge. Whereas patents of more codifiable knowledge may provide temporary firm-specific advantages to the firms – they can be bought, sold and used by others at a cost – tacit knowledge is much more difficult to imitate.

Infusion of the Three Perspectives on Knowledge:

The Knowledge-based View of the Firm Perspective

The increasing competitive importance of knowledge has led to the development of the knowledge-based view of the firm theory (Grant, 1996b; Kogut and Zander, 1992, 1996). This theory is a contemporary approach to strategic management and organizational design that has evolved over the last decade from the broader approach to strategy referred to as the resource-based view of the firm (Conner and Prahalad, 1996). This evolving perspective (which is the infusion of the previous theory on knowledge transfer, suggesting that the primary rationale for the firm's existence is to create, transfer and apply knowledge) is an extension of the resource-based view of the firm theory (DeCarolis and Deeds, 1999). The resource-based view explains performance differences by identifying unique, valuable and inimitable resources and capabilities. But the resource that ultimately leads to a sustainable competitive advantage is the firm's unique knowledge base (Barney, 1991; Grant, 1991; Peteraf, 1993).

The core assumptions of the knowledge-based view of the firm are: i) an organization's principal function is to create, integrate and apply knowledge; ii) sustainable competitive advantages and performance differences result when firms have unique knowledge bases based on the capability of managing different knowledge areas (Conner and Prahalad, 1996; Grant, 1996a, 1996b; and Nonaka, 1994). The guidelines for the knowledge-based view advise managers to develop a narrow set of core competencies and capabilities based on knowledge areas that the firm is uniquely qualified to expand and integrate (Grant, 1996b; Hamel and Prahalad, 1994; Leonard-Barton, 1995, Prahalad and Hamel, 1990).

Supporting knowledge areas should be obtained externally through benchmarking, outsourcing and partnerships.

In order to describe the uniqueness of knowledge in the knowledge-based view of the firm in the development of competitive advantage and value for the firm, we first look at the general dimensions of knowledge.

2.8.3 Dimensions of Knowledge

A critical contribution of the knowledge-based view of the firm is the recognition of two different types of knowledge: tacit knowledge and explicit knowledge (Grant, 1996a, 1996b; Nonaka, 1994). Knowledge can be classified as explicit if it can be transferred from one individual to another using some type of formal communication system. Thus, explicit knowledge must be articulable or codifiable. On the other hand, tacit knowledge is generally viewed as knowledge that cannot be formally communicated (Polanyi, 1966). Tacit knowledge is deeply rooted in one's own experience and 'mental model.' The distinction between explicit and tacit knowledge is important when we evaluate competitive differences between firms. Tacit knowledge is more valuable and more likely to lead to a sustainable competitive advantage than explicit knowledge, because it is much harder for competitors to imitate (Kogut and Zander, 1992; Winter, 1987; Zander and Kogut, 1995). Inimitability is further increased when the knowledge is complex and combined with other types of knowledge (Kogut and Zander, 1992). However, Kogut and Zander (1992) identified a critical dilemma concerning knowledge management: the same characteristics that make tacit knowledge hard for competitors to imitate also make it difficult to transfer within an organization, therefore delaying its application.

The tacit and explicit dimensions of knowledge can reside in an individual or in the collective organization. Spender (1996) incorporated these dimensions to develop a 2 by 2 matrix of organizational knowledge. The dimensions in his matrix are individual explicit (or conscious knowledge), individual tacit (automatic knowledge), collective explicit (objectified knowledge) and collective tacit (collective knowledge).

From the four perspectives of how knowledge determines the expansion of MNCs, the public goods perspective route of FDI through wholly owned subsidiaries (hierarchy) is seen as an MNC's preferred way of preventing dissipation of the potential rents from knowledge production. On the other hand, in more recent literature, i.e. in the technological-competence and knowledge-based-view-of-the-firm perspectives, it is the private characteristic of tacit knowledge within an MNC that leads it to choose wholly owned subsidiaries (hierarchy) over the market.

2.8.4 Defining MNCs

Dunning (1992a:3) defined an MNC as an enterprise that "engages in foreign direct investment (FDI) and owns or controls value-adding activities in more than one country." The reference to "value-adding entity" and "controls" in the definition acknowledges that in any host country the MNC parent company may have several subsidiaries that have roles given by the parent firm. According to conventional FDI theory, an MNC engaged in FDI must be strong in technological capability or resourceful in some intangible know-how. Saggi (2005) concurs: the basic principle in the theory of multinational firms states that "such firms rely heavily on intangible assets, such as superior technology and well-established brand names, to successfully compete with local firms that are better acquainted with the host-country environment" (Saggi, 2005:3).

In this study, the term 'MNC' is used to include all large corporations that are active with business activities and value chains in multiple countries. The "ownership" of MNCs (locals or foreigners) as technology supporters matters for industry development. This corresponds to the argument by Amsden (1989) that industry which experienced progress and spillover knowledge to the local economy was domestic-owned productive organizations, where the government had systematically intervened in the industries' production and market. This also corresponds to Chandler's (1977) hierarchical structural economic theory which argues that productive organizations and institutional arrangement would create conducive environment for innovation.

The study tries to look at how different types of ownership of MNCs affect the development of local suppliers, and to compare MNCs from developed countries with local MNCs or Third World multinationals (TW MNCs)[iii] in terms of linkage collaboration in the petrochemical industry (Wells, 1983). Since there are not many local MNCs in the petrochemical industry in Malaysia, local MNCs in this study include subsidiaries and former subsidiaries of large corporations. For simplicity's sake, all these local corporations are termed 'MNCs'.

2.8.5 Capabilities of MNCs

Empirical studies examining conventional FDI theory have shown that MNCs are generally large in size, superior in technology, or unique in their product lines (Caves, 1974). Weak firms have no place in the field of FDI. Some therefore see FDI as an expedition into unfamiliar and treacherous territory where only the strongest survive. In reality, however, as more firms go for international expansion, there are many international investors that are seemingly small and weak. Multinational firms originating from

developing countries have become a visible force in the world of FDI (Wells, 1983). Small and medium-sized enterprises (SMEs) have also played significant roles in outward investment (Buckley et al., 1988; Kohn, 1997). As explained earlier, conventional theory explains this phenomenon by attempting to identify firm-specific advantages unique to these seemingly small and weak firms. Possible advantages identified by researchers include superiority in small-scale production and flexibility in switching product lines (Wells, 1983). In the light of conventional theory, these advantages may be best exploited in a host country with a small domestic market, and hence are suitable for small-scale production or within an industrial structure embedded in institutions that can support a flexible production system, such as subcontracting networks.

Gomes-Casseres (1997) and Kohn (1997) identified a group of international investors that are small in size but strong in technological capability and dominant in certain niche markets. Dunning (2000a) concurs that small and medium firms are engaging in FDI and other forms of non-trade internationalization that were previously the domain of large corporations. In fact, multinationals from developing countries have been investing abroad based on their firm-specific advantages for a long time (Lecraw, 1993). These SMEs are relatively large compared to their peers in the specific segment of the market. To maintain their leadership in niche markets, they may venture overseas to exploit new markets, develop new products, and deepen their expertise. For this type of SME MNC, the conventional theory can interpret the motivation and mechanism of their FDI.

The internationalization behavior and strategies of small and medium firms on the foreign investments scene, can, however, be very different from those of large corporations. Thus, in examining the behavior and strategy of internationally active corporations, Bartlett and Ghoshal (1989) distinguished between forces for global integration and forces for local

responsiveness. They came up with four different types of parent firms, with the typology of multinational, global, international and transnational corporations. The distinctions between these types of parent firms have consequences for the management, values, configuration, control mechanisms, knowledge transfer, innovation and role of subsidiaries that enter foreign markets.

2.8.6 Strategies of MNCs

There are at least three broad issues of relevance when a firm decides to enter a foreign market (Madhok, 1997; and Hansen et al., 2009). Madhok (1997) gives two of them: 1) motivation, and 2) the firm's mode of entry. Hansen et al. (2009) add the third: intra-MNC coordination, or the firm's autonomy. The first issue, motivation, can itself be broken down into three reasons for entering a foreign market: 1) to exploit an advantage the firm possesses; 2) to strengthen an existing advantage; or 3) to develop a new normally related product. The second issue, the firm's mode of entry, is the means by which firms choose to participate in the particular product-market. A firm has several options for entry into foreign markets. These include exporting, licensing, franchising and direct investment (by joint ventures and wholly owned subsidiaries) (Root, 1994). The focus of this study is limited to the choice of entry mode in FDI, defined as investment that involves ownership and confers effective management control (Root, 1994). Other forms of international expansion, including exporting, licensing and other non-equity alliances, do not constitute FDI, but licensing is included in the present discussion so as to make comparisons in the mode of entry to the petrochemical industry between Malaysia, which uses FDI, and Japan and Korea, which use licensing.

The third issue, intra-MNC coordination (parent-subsidiary control or autonomy), refers generally to the role of an MNC subsidiary in a host country. According to Birkinshaw and Hood (1998), a subsidiary's role in a host country is affected by the corporate strategy of its parent company, with the role the subsidiary plays depending on the autonomy it receives from its parent firm.

Thus in the development of the framework of this study, we will examine why firms decide to enter foreign markets by looking at 1) the subsidiaries' motives and 2) their entry modes, focusing on greenfield investments, mergers and acquisitions, and joint ventures, and 3) their autonomy (Kogut and Singh, 1988; Hennart and Park, 1993; Hennart and Reddy, 1997).

The discussions below constitute the three factors in MNC strategy that influence an MNC parent to foster linkages with local suppliers: motive or strategic intent, entry mode and intra-MNC coordination or autonomy. The effects of linkage collaborations flow directly form these three factors, which are explained in detail below.

i) MNC Motives/Strategic Intent

According to Dunning (2000a), there are four main motives for FDI investment: 1) seeking natural resources; 2) seeking new markets; 3) efficiency seeking, or restructuring existing foreign production; and 4) seeking new strategic assets. Initially, the entry of MNCs into developing countries was mainly motivated by the desire to exploit their natural resources and abundant labor supply (Hertner and Jones, 1986; Wilkins, 1998). However, as these countries embarked on strategies for economic development in the 1960s, FDI was increasingly directed towards access to local markets; it was undertaken to avoid host-

country trade barriers and to exploit their growing market potential. This market-seeking motive was partially controlled by host-country governments, which used import-substitution industrialization strategies to develop linkages between MNCs and local suppliers.

Because of the high price of global oil in the early 1980s, MNCs became interested in gaining access to the oil, gas and petrochemical industries in developing countries because of the cost advantages they were able to offer. As a result, MNCs transferred some of their home market production to developing countries. The purpose of such investments was to create global efficiencies (Dunning, 1992b and 2000). However, studies in the 1980s warned that if countries rich in natural resources invested heavily in natural resources, it could lead to 'Dutch Disease.' That is, by embarking on developing resource-based industries, especially in oil and gas, they could end up becoming 'enclave' economies (Auty, 1987 and Singer, 1950).

The move by MNCs from market-seeking to the third category of motive, efficiency-seeking, had repercussions in regard to the content of linkages that could be forged between MNC subsidiaries and local firms. As noted by UNCTAD (2001), market-seeking investors may foster many more local linkages than efficiency-seeking investors. Efficiency-seeking investors may foster fewer linkages with local firms due to competition with global firms or suppliers. But linkages out of the efficiency-seeking motive may still have deep effects on local partners and can develop an effective local supply industry, or 'developmental enterprises' (Altenburg, 2000).

In the fourth category of motives, MNCs seek new strategic assets in order to remain relevant globally. In this way, MNCs in developing countries have moved towards

globally integrated production systems and networks through a highly complex intra-firm division of labor (Evans, 1998; Cypher and Dietz, 2004).

When foreign investors operate in host countries, their main motive for doing so is either to gain local market access or to establish an export platform for their products (Hansen et al., 2009). Local market-seeking investments may be undertaken either to sustain or to protect an existing market, or to exploit and promote new markets. In contrast, export-platform investments aim to exploit low cost-factor conditions or the availability of large talent pools in order to service a regional or global market. In a dynamic situation, a market-seeking venture may develop export activities based on its experiences with local sourcing. Conversely, an initially export-oriented FDI venture may uncover local market opportunities and re-orientate its activities toward servicing local markets (Hansen et al., 2009).

ii) Mode of Entry of MNCs/Entry Mode strategy

Choosing an appropriate mode of entry into a foreign market is a key strategic decision faced by internationalizing firms, as it entails substantial commitment of resources, in terms of both time and money (Anderson and Gatignon, 1986; Root, 1987). An MNC's choice of entry mode is bound up with its core competency contributions, its control over its subsidiaries, parent-subsidiary relations, and its vulnerability to external changes in a host country (Gomes-Casseres, 1990; Hill et al., 1990; Root, 1994). By choosing an entry mode that fits its internal capabilities, strategic goals, and environmental contingencies, an MNC can also prevent exposure of distinctive technology and boost the economic rents it earns from tacit knowledge (Gatignon and Anderson, 1988; Woodcock et al., 1994).

The various modes of entry offer alternative routes to a firm for transferring resources from the home country to the host country (Anderson and Gatignon, 1986; Hennart, 1982; Hill et al., 1990). The firm must choose from the variety of modes on offer. For non-FDI, the modes include exports and licensing. For FDI, they include greenfield investments or wholly owned subsidiaries; acquisitions and mergers; and different types of joint venture. There are also other non-FDI modes of entry, such as franchising, management contracts, turnkey contracts, subcontracting or associations, and consortiums. All of these lie in a grey area between arm's-length exports and wholly or majority-owned foreign subsidiaries (Hennart, 1989).

Each mode of entry offers specific benefits and risks (Hill, 2003). Acquisitions offer the fastest means of building a sizable presence in a foreign market, yet are fraught with the risk of paying too much; of inability to assess the value of acquired assets fully; and of post-acquisition challenges, including cross-cultural integration. Greenfield investments offer the greatest control over the local affiliate, yet often also require the greatest contribution of know-how. Joint ventures are a way of drawing on the resources of a local partner and of minimizing risk, but they also raise thorny issues of how to manage a partner whose interests may diverge over time from one's own.

In licensing, a licensor grants the rights to intangible property to another entity (the licensee) for a specific period in return for a royalty fee. As the licensee provides the capital for the operation, the licensor has reduced risk. In countries where there are barriers to investment, licensing offers a would-be investor an indirect route to exploit local know-how (intangible assets) for financial gain. However, there are drawbacks to licensing, including the fact that the licensor has no direct control over the operation. Should the licensor seek strategic coordination across operations, it will have limited scope

to achieve it, as the licensee has to maximize its own profit. Furthermore, a company that licenses its assets runs the risk of losing its competitive advantage. For all these reasons, a great deal of research has aimed to explain how and when a firm chooses to enter a foreign market by merger and acquisition (M&A), by greenfield investment (either through a wholly owned subsidiary or through a joint venture), or by licensing.

This study focuses only on the FDI mode of entry. When undertaking foreign investments, firms face two basic decisions: whether to own all or part of the investment, and whether to set up a new investment from scratch or to acquire an existing entity. Full ownership may be achieved either through a greenfield investment, which denotes setting up a new plant or other establishment from scratch, or through acquisition, which denotes the purchase of a controlling interest in a local firm. Kogut (1991) defined partial ownership, or a joint venture, as the pooling of assets of two or more firms in a common and separate organization. Joint ventures may at times be the only entry mode allowed by a host government, but in many instances they are also the preferred mode, as they allow a firm to limit its initial risk and later to expand the investment or terminate it, depending on the joint venture's performance or other strategic considerations.

The choice of entry mode has several implications for MNCs, as well as for the host country (Svensson, 1998:201). Greenfield investments are more inclined to import intermediate goods from the home country than are acquired firms. This indicates relatively large technology transfers from parent firms to the new ventures. Furthermore, a greenfield venture is commonly expected to create more job opportunities in the host country than an acquisition, both directly in the new production plant and indirectly through subcontractors and sales networks. In addition, a greenfield investment adds a new manufacturing unit, meaning that the industry's capacity and competition are

increased in the market. By contrast, acquired firms are characterized by their own corporate culture and connections with local subcontractors, and will not always be integrated with the parent. In this case, knowledge transfer may go in either direction. Sometimes, acquiring an already existing firm may involve the acquisition of the whole distribution chain as well.

Host countries expect to accrue benefits from inflows of FDI, especially in terms of transfer of technology and access to more competitive product markets (Mattoo et al., 2004). Even so, it is in their interest to impose certain restrictions on FDI. The most common policy restrictions are those on the number of foreign firms allowed and the extent of foreign ownership allowed. Restrictions on the choice of foreign entry mode have extensively been discussed (Fagre and Wells, 1982, Kobrin, 1988, and Contractor, 1990). The literature suggests that international firms tend to choose joint ventures over wholly owned subsidiaries (WOS) when investing in restrictive countries. For example, Kobrin (1988) found that about 76 percent of United States MNCs chose joint ventures when investing in such countries.

In terms of the effects of different entry modes on forming linkages, Hansen and Schaumburg-Müller (2006:19) argue "that joint ventures will have larger upgrading effects than fully owned subsidiaries, as the local joint venture partner will acquire technology and knowledge from the daily face-to-face interaction with the TNC. On the other hand… fully owned subsidiaries will receive more advanced technology and knowledge than the joint venture, as there is less danger of diffusion of proprietary technology and knowledge." Therefore fully-owned subsidiaries would have a smaller upgrading effect, considering that most of the new technology and knowledge is received from subsidiaries' home countries and so there is less incentive for firms to have linkage collaborations with

local firms. In either case, as the theory of MNCs indicates, foreign firms will only go to host countries where they can successfully compete with local firms due to their possession of superior knowledge or technology (Saggi, 2005:14).

Some host countries prefer allowing wholly owned subsidiaries to operate rather than have MNCs make acquisitions. A study by Mattoo et al. (2004) suggests that when a foreign firm faces a high cost of technology transfer, it will generally prefer direct entry to acquisition. The reason is that a high cost of technology transfer is associated with a high acquisition price. Since the cost of acquisition is high, the international firm will enjoy a smaller cost advantage over domestic firms. But host governments prefer acquisition of local firms by international firms when the cost of technology transfer is high, because the international firms will bring large technology transfers from their parent firms. Moreover, the host government will get a relatively higher price for domestic firms acquired by the international firms.

Conversely, if the cost of technology transfer is low, the host government would prefer direct entry to acquisition. Direct entry would not only foster a more competitive domestic market, but would also encourage greater technology transfer because of the international firm's strategic interest in bringing in newer technology. However, international firms would prefer to acquire existing firms, because when the cost of technology transfer is low, the acquisition price is also low. Through acquisition, an international firm commands greater market power. In this situation, a host country may impose restrictions on foreign equity in domestic firms – restrictions that foreign firms will probably find irksome, so that they go instead for direct entry. The study by Mattoo et al. (2004) recommends that this policy intervention to induce a different mode of entry is best used in oligopolistic markets – for instance, in the petrochemical industry, which is considered oligopolistic.

iii) Intra-MNC Coordination/Autonomy

When a firm enters a foreign market, it will form a subsidiary or an affiliate firm. The traditional view of the role of subsidiaries is to adapt products developed in their home countries to local customer tastes or needs and to adapt processes to locally available resources and production conditions. This type of subsidiary is dependent on the competence of the subsidiary parent and its role is called 'competence exploiting' (Cantwell and Mudambi, 2005). However, after long experience operating in host countries, and with increased specialization of subsidiary units made possible through reduced tariffs and facilitated by efficient communication and transportation, MNC subsidiaries often realize that their parent companies are not the sole source of competitive advantage for the MNC group. Increasing attention is being given to subsidiaries that look at other avenues to increase their competitive advantage. Such subsidiaries are called 'competence-creating' subsidiaries (Cantwell and Mudambi, 2005). In such subsidiaries, activities once carried out inside the firm may be outsourced. Hence, MNC parents are decentralizing in order to reduce costs and take advantage of local skills to produce efficient and specialized firms or plants in the host countries. Established MNC subsidiaries are focusing on ways to configure and coordinate their value-adding activities globally to achieve economies of scale and scope (Porter, 1986).

For competence-creating subsidiaries, Birkinshaw and Hood (1998) introduce the concept of a subsidiary charter. The charter is a shared understanding between the subsidiary and the parent firm regarding the scope of a subsidiary's responsibilities in terms of markets served, products manufactured, technologies held, and functional areas to be covered. With the charter, the subsidiary is given a certain level of decision-making autonomy.

However, the MNC parent's strategy affects the subsidiary's charter, and this decides whether the subsidiary will evolve towards competence-creating status. A competence-creating subsidiary needs to look at the capabilities of the subsidiary before it can obtain autonomy through the parent. Therefore, subsidiary roles in a host country are affected by the corporate strategy of its parent firm (Birkinshaw and Hood, 1998).

Even though MNC corporate strategy acts as one of the most important factors affecting the decentralization of activities of subsidiaries, environmental factors such as customers, competitors, suppliers and government policies can also influence the activities they undertake. This means that each subsidiary is operating under different conditions, to which the subsidiary has to adapt to remain effective.

In summary, as Birkinshaw and Hood (1998) suggested, there are three determinants of subsidiary evolution. They are: 1) head-office assignment; 2) subsidiary choice, which gives the subsidiary management the power to define the role of the subsidiary; and 3) local environment determinism, in which the subsidiary responds to the constraints and opportunities it faces in the local market. These three mechanisms in fact interact to determine the subsidiary's role at any given point in time. Thus it is assumed that as each subsidiary tends to emerge as a competence-seeking subsidiary (Dunning, 1996), this subsidiary will change its strategy or its location in the host country, as long as economic opportunities warrant doing so. Therefore there is no linear trajectory shift from one type of strategy to another.

2.9 Development of an Analytical Framework: Technological Capabilities of Local Suppliers

2.9.1 How is Knowledge Acquired by Local Suppliers?

As discussed in the section on the development of an analytical framework on MNC subsidiaries, the principal beliefs of the theory of foreign direct investment are that the primary advantage a firm brings to foreign markets is its possession of superior knowledge about technology, production, marketing or other activities (Arora and Fosturi, 2000), and that the firm operating in a foreign country will seek to keep these unique advantages internal so as to avoid the danger of losing its unique competencies through expropriation by others. Before we go into the detail of knowledge transfer, this study assumes that MNC subsidiaries are (owing to their possession of firm-specific advantage or knowledge) the ones that initiate linkage collaborations with local firms. This segment reviews the literature of how technological knowledge is acquired by local firms or firms.

Contemporary theory on multinationals states that MNCs enter foreign countries in order to create value from their existing pool of resources as they compete in the uncertain, dynamic and volatile global market. Local firms in host countries on the other hand must be able to identify, create and continuously manage knowledge in order to generate value by using their knowledge stock to build on sustainable competitive advantages (Nonaka, 1994). The ability to develop, maintain or exploit competitive advantages therefore depends on the ability to create, diffuse and utilize knowledge throughout the firm (Drucker, 1999). When a firm has acquired the technological knowledge, it will have the capacity to be technologically competent.

The following sections describe the mechanisms of how firms acquire technological knowledge.

2.9.2 Technology and Technological Knowledge

Technology can be defined as "a systematic body of knowledge about how natural and artificial things function and interact" (Itami and Numagami, 1992:119). Pack and Westphal (1986:104) used a broad definition of technology that includes its technical component as well as organizational and institutional components. Cantwell and Janne (1999) on the other hand defined technology as the corporate capability to use technical knowledge effectively in production. From these definitions, it can be stated that technology at the firm level of analysis represents the capacity for a firm to create and advance the pool of industrial skills and knowledge within its own organization. The firm should also be able to absorb, adapt and advance existing knowledge and skills. The creation of technology relies on the firm's capacity to absorb new knowledge as inputs for its production in order to generate new capabilities for the firm. These discussions have led to a systematic body of knowledge on technology, which knowledge-based views of the firm theory dub 'technological knowledge' (Nonaka, 1994; Spander, 1996).

As described in the perspective of knowledge above, the knowledge-based view of the firm theory recognizes two different types of technological knowledge: tacit and explicit knowledge (Nonaka, 1994; Spander, 1996). As explained earlier, explicit knowledge is codifiable, while tacit knowledge is generally viewed as knowledge that cannot be formally communicated (Polanyi, 1966). These two types of technological knowledge can be further divided into individual explicit (individual skills pertaining to a particular technology that can be codified), individual tacit (individual skills pertaining to a particular

technology that is personal), collective explicit (standard operating procedures), or collective tacit (an organization's routines and culture regarding technology). Each of these technological knowledge dimensions can be the source of competitive advantage and value creation (Spender, 1996). However, the dimensions that include a tacit component demonstrate the greatest potential for creating competitive advantages and firm value. Technological knowledge that is difficult to articulate, codify and explain is also difficult to imitate. Such tacit technological knowledge is firm-specific in that other firms may find it difficult to understand and use. Furthermore, technological knowledge that is not only tacit, but resides in the collective organization, can increase the difficulty of imitation by competitors.

Spender (1996:52) furthermore argues that "collective knowledge is the most secure and strategically significant kind of organizational knowledge." Thus, collective tacit technological knowledge is an important source of competitive advantage and value creation. As stated previously, knowledge is a critical outcome of individual and collective (i.e. organizational) learning. This being the case, the competitive success of local firms is influenced by each firm's ability to engage in technological learning in order to improve its knowledge base in areas where it must be competitive (i.e. technological advances based on competitively superior technological knowledge and the management of that knowledge). The need to engage in technological learning calls for the firm to create and cultivate internal path dependent relationships that generate the type and amounts of learning that create valuable technological knowledge.

Basically, firms gain access to technological knowledge, or formulate it themselves, through two primary avenues: 1) internal technological knowledge and 2) external technological knowledge.

2.9.3 Internal Technological Knowledge

Internal technological knowledge is generated as individuals and groups experiment across multiple projects, including those involving research and development, manufacturing and marketing activities. Resulting from these experiments are unique and idiosyncratic insights about technological knowledge and its commercial application. Kogut and Zander (1996, 1992) have argued that a firm is a social community specializing in creating and transferring knowledge. They suggest that the advantage of the firm over the market lies in creating and transferring knowledge. Similarly, Nonaka (1994) suggests that firms create knowledge through socialization, combination, externalization and internalization processes. A primary internal source of technological knowledge creation is the firm's research and development program and capacity (Hoskisson and Hitt, 1988). Another important internal source of technological knowledge is innovation resulting from internal projects. March (1991) stated that exploration, which entails searching for and experimenting with new alternatives, is critical for an organization's survival.

2.9.4 External Technological Knowledge

The knowledge-based view of the firm also makes a distinction between the internal creation of knowledge and knowledge acquisition. Bierly and Chakrabarti (1996) and Leonard-Barton (1995) defined knowledge acquisition as the search for, identification of, and absorption of, external knowledge. But the processes involved in acquiring knowledge from an external source may be different, depending on whether the knowledge is tacit and explicit. External technological knowledge is knowledge gained and absorbed from sources outside the firm's boundaries. A source used increasingly for this purpose is inter-

firm arrangements or collaborations (Gulati, 1999). As tacit knowledge is more difficult to identify, understand and transfer into the organization, more direct help will be needed from the holders of the specialized knowledge through more frequent interactions and richer communication (Kale et al., 2000; Mowery et al., 1996). On the other hand, acquisition of explicit knowledge is a relatively straightforward, simple process, since the knowledge can be written down in research papers, manuals and books, or can easily be articulated in direct communications or at technical conferences.

Cohen and Levinthal (1990) argued that a firm's 'absorptive capacity' is important in knowledge acquisition. Absorptive capacity refers to the firm's ability to recognize the value of new, internal information, to assimilate it, and to apply it to commercial ends. The ability to recognize, exploit and utilize external knowledge depends on the firm's level of related prior knowledge. Thus, prior learning influences a firm's absorptive capacity. Additionally, to exploit the knowledge gained, it must be diffused to other units inside the organization.

Firms often participate in multiple external networks and collaborate in multiple ways with other firms (Gulati, 1999). Potential forms of collaboration include but are not limited to nonequity strategic alliances, equity strategic alliances and joint ventures (Hitt et al., 1999). The traditional reasons for collaborative efforts emphasized reducing risk and uncertainty. More recently, however, learning has become an important motive behind collaborative efforts (Hitt et al. (1999), Hamel, 1991; Levitas et al., 1997). Kogut (1988) explained the rationale behind such 'learning alliances' by suggesting that firms can be thought of as knowledge-based, and that joint ventures can be regarded as mechanisms for transferring tacit knowledge. Hitt et al. (1999) found that both parties to a strategic alliance often select a partner on the basis of potential skills and competencies that can be learned through

collaborative efforts. Such alliances, which transfer organizationally embedded tacit knowledge, are one of the few forms of collaboration that are conducive to the transfer of external tacit knowledge.

In addition to learning alliances, inter-organizational networks are a major source of technological knowledge. Mohrman and Von Glinow (1990) suggested that many innovations originate outside the company and even outside the industry that eventually commercializes them. Liebeskind et al. (1996) found that social networks helped new firms obtain new technological knowledge, as well as increasing the scope of their technological learning.

Another form of external technological knowledge transfer is collaboration between firms and universities. Santoro and Gopalakrishnan (2001) examine the institutionalization of knowledge-transfer activities in collaborative ventures between industrial firms and university research centers. Interestingly, the results show that knowledge-transfer activities are facilitated when industrial firms have more mechanistic structures, have cultures that are more stable and direction-oriented, and when the firm is more trusting of its university research center partner. Some of these characteristics (e.g. mechanistic structure, direction-oriented culture) may not be conducive to internal development of technological knowledge and innovation. Santoro and Gopalakrishnan conclude that while organic structures facilitate *creating* innovation, mechanistic structures may be superior for *implementing* it. Furthermore, a stable and direction-oriented culture imbues members with a common purpose and thereby reduces internal conflicts. They suggest that innovation creation and implementation create tensions in firms' cultures that must be managed effectively.

This study focuses more on acquiring external technological knowledge. However, it is important for a firm that is seeking to create competitive advantage and value to draw on both internal and external sources of organizational learning.

2.9.5 Developing Technological Knowledge through Technological Learning

As the above discussion suggests, learning and knowledge are inseparable competitive dimensions. The discussion now elaborates on the importance of technological learning as the path for local firms to develop technological knowledge, a path that can then lead to the firms' acquiring technological capabilities.

Firms accumulate technological capability through technological learning (Malerba, 1992). As a result of this learning, they are able to build their technological knowledge about products and processes in manufacturing (Lundvall et al., 2002; Malerba, 1992). Learning also helps develop, deploy and improve the skills of the workers and continually transform knowledge assets in order to foster higher orders of operation (Lundvall et al., 2002; Malerba, 1992). Carayannis (1999:142) defined technological learning as "the process by which a technology-driven firm creates, renews, and upgrades its latent and enacted capabilities based on its stock of explicit and tacit resources." Dodgson (1991:110) defined technological learning as "the ways firms build and supplement their knowledge-bases about technologies, products and processes, and develop and improve the use of the broad skills of their workforces."

Firms operating in technological fields often operate in complex, dynamic and risky competitive conditions. As Mohrman and Von Glinow (1990:264) put it, "the technological environment can simultaneously create new opportunities for entry, bankrupt

existing companies, and render obsolete entire product lines and manufacturing and design processes overnight." A rapid rate of technological learning is therefore important in building technological knowledge. Recent evidence showing that technological learning contributes to the success of new ventures competing in global markets highlights the importance of such learning (Zahra et al., 2000). Technological learning helps a firm to develop its technological knowledge stock and to use that stock to create value.

2.9.6 Local Suppliers Acquiring Technological Capability

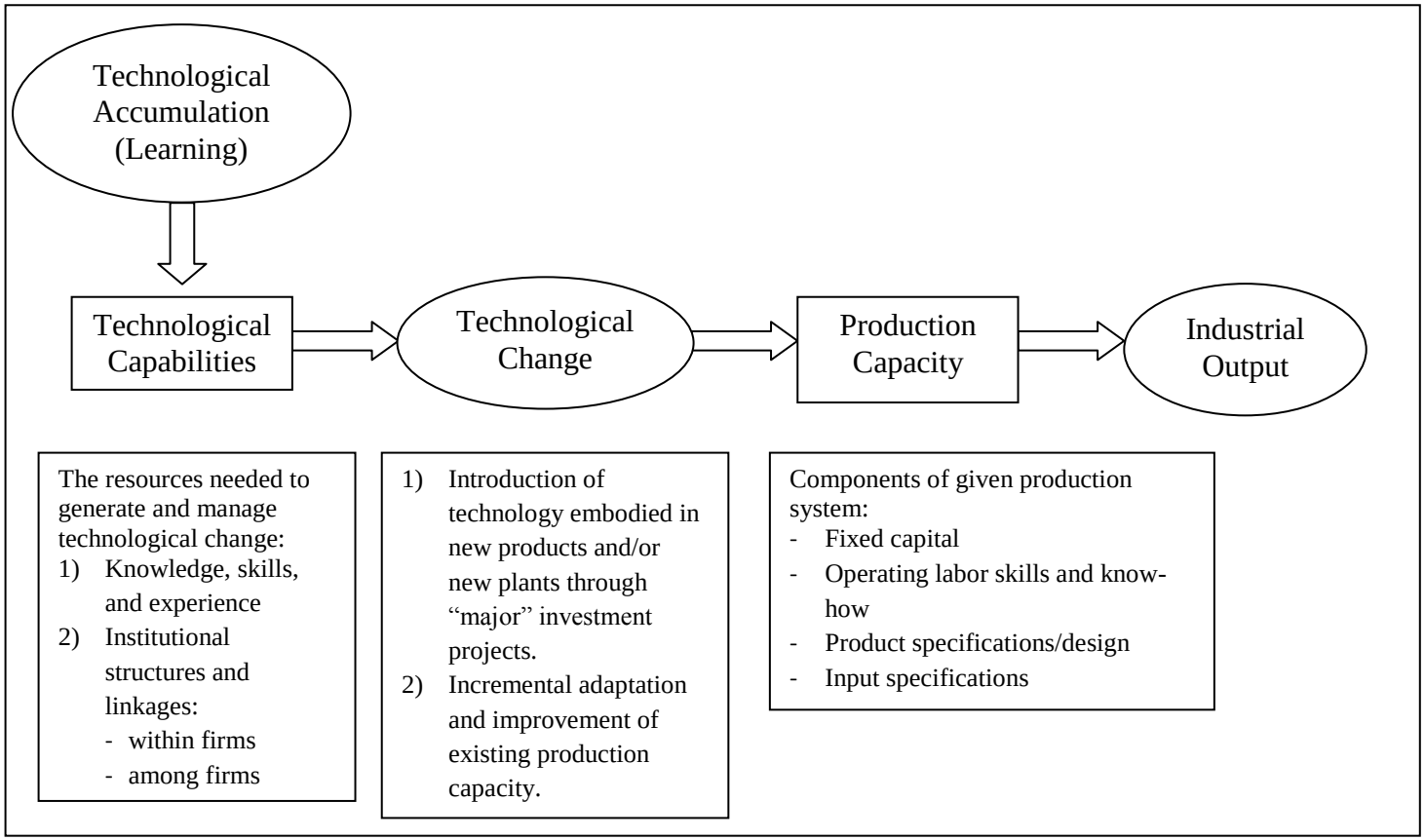
Technological capability is the knowledge, skills and experience required by firms to produce, innovate and organize marketing functions (Lall and Wignaraja, 1998). Accumulating technological capabilities to generate technical change is important for developing countries' competitiveness and economic growth (Bell and Pavitt, 1995). The development of the capacities and capabilities of local firms is one key to attracting FDI and increasing technological spillovers from MNCs (Lall and Narula, 2004).

According to Bell and Pavitt (1993, 1995), accumulating the technological capabilities to generate technological changes is necessary for competitiveness in developing countries. But, as shown in Figure 2.7, Bell and Pavitt make an important distinction between two stocks of resources: production capacity and technological capabilities. The Figure shows how production capacity incorporates the resources used to produce industrial goods at given levels of efficiency and given input combinations. This includes fixed capital or equipment that embodies technology, operating labor skills and know-how, product and input specifications, and the organizational methods and systems used in production (Bell and Pavitt, 1993:163). Technological capabilities, on the other hand, consist of the

resources needed to generate technical change (Bell and Pavitt, 1993: 163). These include knowledge and experience, skills, and institutional structures and linkages.

For industrialized countries, technological capabilities and production capacity are loosely linked, but for developing countries, they are not necessarily complete or linked in any way (Bell and Pavitt, 1993). Bell and Pavitt emphasize that the distinction between production capacity and technological capabilities is made due to the dynamics of industrialization. Thus it is important to know which resources must be present in order to generate and manage the dynamism. Figure 2.7 also emphasizes two processes: technical change and technological learning (accumulation) (Bell and Pavitt, 1993: 163). Technical change encompasses any way in which new technology is incorporated into the production capacity of firms, while technological learning refers to any process by which the resources for generating and managing technical change (technological capabilities) is strengthened.

Figure 2.7: Technological Accumulation: Basic Concepts and Terms



Source: Adapted from Bell and Pavitt (1995:55)

2.9.7 Development of Local Suppliers Typology

In the MNC typology discussion above, we have already considered the roles that MNCs (customers) play in the technology transfer scenario. The following discussion explains why technology suppliers need intervention to help improve their technological capabilities. It also examines how customers (MNCs) work with their suppliers through co-development of products or processes and through supplier development.

2.9.8 The Need for Technological Development of Technology Suppliers

To examine the extent to which local suppliers' technological capabilities or technological knowledge have been upgraded, we need to define the different levels of technological capabilities of the local suppliers. Manufacturing industry has been moving away from vertically integrated companies (with design, development, manufacturing, and assembly performed in-house) toward a supply network of many companies performing different functions. This stems partly from a strategy to outsource non-core activities (Prahalad and Hamel, 1990; Corbett, 1997).

This study uses the typology developed by Kaufman et al. (2000), which divides small and medium-sized manufacturing suppliers (see Figure 2.8) into four quadrants. Amongst these four, the technology specialists' suppliers and the problem-solving suppliers are likely to be the most critical in terms of their technological contribution to the end product. Regardless of the size of such firms, it is crucial for their customers that they maintain and develop their technological capabilities. These suppliers of strategic technology are likely to be those dubbed 'black box suppliers' by Clark and Fujimoto (1991), or simply 'subcontractors' (Hines, 1994).

In order to examine how far MNCs have helped local suppliers build up their technological capabilities, and to understand the formation of a supply network of companies performing different functions, the typology refined by Kaufman et al. (2000) provides a useful guide. However, this typology was developed based on data from large original equipment manufacturers (OEMs) in the study of auto manufacturers. Kaufman et al. used the study of Clark and Fujimoto (1991) in the auto industry whereby the latter observed that automotive OEMs divided purchased component parts (and their manufacturers) into three categories: black box parts, detail-controlled parts and supplier-proprietary parts. Using Clark and Fujimoto's study, Kaufman et al. adopted frameworks from strategic management and operations strategy literature to explore the relationships among collaboration, technology, and innovations in small and medium-sized manufacturers. Statistical analysis of the responses of 200 New Hampshire manufacturing companies in four SIC code industries (fabricated metals, industrial equipment, electrical and electronic equipment, and instruments) led to the development of a strategic supplier typology that is useful in explaining the differences in the composition and performance of various types of suppliers (Kaufman et al., 2000).

Figure 2.8: Typology of Small and Medium-sized Manufacturing Suppliers

	COLLABORATION Low	High
Low TECHNOLOGY	I Commodity Supplier • Spot market supplier • Low cost, low price priorities • Little or no differentiation	II Collaboration Specialist • Detail-controlled parts supplier • Uses a close network in each industry • Can be in many industries to maintain customer product information
High	IV Technology Specialist • Proprietary parts supplier • Innovation in product technology used to produce high barriers to entry • First mover advantages • Uses design capabilities for competitive advantage	III Problem-Solving Supplier • Black box supplier • High differentiation • Cost less important • Small runs, high process and labor flexibility

Source: Kaufmann et al. (2000)

The typology of Kaufman et al. divides along two dimensions: technology and collaboration (see Figure 2.8). By dividing these dimensions into high and low categories, the typology creates four distinct supplier strategies:

Quadrant I, Commodity Supplier, defines firms that use standardized technologies and relate to customers through standard market contracts. Commodity supplier firms compete successfully on the basis of low cost. Usually investments in advanced technologies and managerial practices cannot be fully recovered. Neither customers nor suppliers are dependent because switching costs are low. In the petrochemical industry, this supplier can be considered as supplying the feedstock, such as naphtha and gas and the raw materials inputs.

Quadrant II is the Collaboration Specialist. Firms in this category use standardized technologies (general assets and skills) to make parts which meet customer specifications and delivery schedules. These firms develop enhanced collaborative techniques to fulfill current customer needs and to anticipate future ones. Since the products produced remain under the customers' detailed (design) control, suppliers in this quadrant invest few resources to innovate in product and process technology. This avoids becoming dependent on a few customers. Customers find these suppliers attractive because they reduce internal monitoring (administrative) costs.

Quadrant III is Problem Solvers. This term describes firms that employ both advanced technologies and collaborative methods to promote innovation in product design and manufacture. Firms in this quadrant compete primarily on their ability continuously to acquire and evolve new ways to solve process and product problems. Clark and Fujimoto

(1991) called this type of firm 'black box suppliers.' Their customers reduce monitoring costs and avoid expensive investments in specific skills and assets.

Quadrant IV is Technology Specialists. Engineering-driven firms fall into this quadrant. Firms in this quadrant emphasize technology and develop weak relationships with customers. They invest heavily in firm-specific skills and assets for producing proprietary products and strive to produce products of the highest quality and performance that will attract customers and reduce their reliance on a few customers. Customers benefit from relationships with these suppliers by acquiring exceptional or even unique parts without making major, costly investments.

For the purpose of this study, the researcher uses the following terminology to describe the four types of supplier in Figure 2.8: 1) the commodity supplier is termed 'raw material suppliers'; 2) the collaboration specialist is termed 'basic suppliers'; 3) problem solvers are termed 'licensor'; and 4) technology specialists are 'advanced engineering suppliers.'

2.9.9 Supplier Development

Krause and Handfield (1999: 233) provide a summary of the small body of recent literature concerning supplier development (SD) programs, or what is termed in Malaysia the Vendor Development Program (VDP). The literature distinguishes between SD, which is simply a process to select appropriate new suppliers to meet a firm's requirements, and programs that involve active intervention to upgrade existing suppliers' capabilities (Hahn et al., 1990; Watt and Hahn, 1993). Based on the literature, a wide variety of SD activities are undertaken by firms (Krause, 1997). However, the main emphasis of SD literature is on active intervention by customers (Krause, 1997; Krause and Handfield, 1999). In this

study, the term 'VDP' is used to describe active intervention in existing suppliers by customers.

Another distinction is made between strategic and reactive approaches to selecting suppliers for development (Krause et al., 1998). Customers use SD either reactively to deal with poor supplier performance, or strategically to enhance the long-term capability of the supply base. Studies reveal that firms are more interested in improving the products purchased than in improving their suppliers' capabilities. This demonstrates a short-term focus by the customers on improving the product in order to reduce the delivered cost, rather than on looking at the process- and systems-related capabilities that can facilitate future improvements and cost reductions by the suppliers (Watts and Hahn, 1993).

It should be emphasized that improving suppliers' technological capabilities obviously requires a long-term focus. SD activities such as improvements in quality, cost, and delivery performance, have been well explored in the literature (Krause and Hanfield, 1999). However, these do not greatly influence technological capability. The other SD processes, such as the transfer of management best practice, are treated by Bessant et al. (1999) in their study of supply chain learning. There are various areas and types of SD used by customers to upgrade local suppliers' capabilities.

2.9.10 Supplier Development to Improve Technological Capabilities

In SD literature, the need to improve technological capabilities of suppliers has been identified (Hahn et el., 1990; and Morgan, 1993). Improving quality, cost, and delivery (QCD) performances clearly remains the top goal of SD (Krause and Handfield, 1999; and Watts and Hahn, 1993). Other SD areas include improving supplier technical capability

and increasing supplier product development capability (Krause and Handfield, 1999). In the US, customers permitted access to their new technologies as part of their SD effort (Krause and Handfield, 1999).

Globally, technological capability has been linked to SD as part of a vision of 'integrative development' (i.e., development aimed at achieving a globally aligned supplier network). This includes the integration of suppliers in new product and process development and considers issues such as outsourcing design, sharing technology roadmaps, and supplier co-location. Very few firms have made any inroads at this advanced level of supply base management (Krause and Handfield, 1999).

2.9.11 Capabilities of Local Suppliers

Local firms can have various capabilities that make them attractive to MNCs, and these capabilities determine whether these local firms would benefit from linkages with MNCs. They include, for instance, technological capabilities (R&D capacity and engineering skills), human resource base capabilities (skills, training and effectiveness of labor force), and other capabilities related to factors such as ownership structure, size and industry.

The size of the firm in particular may be an important factor. Large firms often have a dominant position in local markets. They may have privileged access to authorities, perhaps because they are under state ownership or because they play a key role in the local economy. For the same reasons, however, large firms may be inefficient. Conversely, SMEs may have a large number of advantages, such as flexibility and entrepreneurial talent. However, they may also lack many of the capabilities needed to work effectively with foreign firms. These SMEs are typically latecomer firms with very brief experience

of operating in competitive markets and they often have limited access to human and financial resources. Financial constraints, for example, may make it more difficult for small firms to advance their technological capability than it is for larger firms, which are able to fund R&D and technical specialists. This allows larger firms to spread risk across a portfolio of projects, and they can also access external specialist networks more easily. Small firms have fewer employees available to engage in external networks and are unlikely to undertake speculative R&D (Rothwell and Dodgson, 1991). Since their MNC customers are always looking to minimize cost, small firms too are under pressure to cut costs (Sako, 1994). This leaves little space for small suppliers to do much beyond fulfilling immediate orders and winning the next contract. Even though small firms are associated with innovation advantages, such as responsiveness, lack of bureaucracy in decision-making, and ease of internal communication (Rothwell and Dodgson, 1991), these assets do not help the small firms with long-term planning or developing new technologies.

Another factor shaping linkages is related to the source of the local firm's advantage. Altenburg (2000:20) argues that developing countries' firms can be divided into three categories, depending on their competitive advantages:

1) Low-cost, low organizational capabilities suppliers, typical for industries where entry barriers are low (e.g. apparel);
2) Low-cost, advanced organization suppliers, typical for industries where demands on quality and organization are high but where the cost advantage is still essential (e.g. electronics and automotive); and
3) Innovative suppliers, typical for industries where entry barriers are high (e.g. machinery production).

Spillover and diffusion effects are less likely to occur in cases where a local firm's advantage is based solely on low wages or low environmental, health and safety standards. However, in cases where the linkage is based on more dynamic capabilities, such as innovative ability, specialized skills or other non-factor cost capabilities, the linkage is more likely to be mutually beneficial (Altenburg, 2000).

A related issue is whether the local firm has a capacity to take in the knowledge and technology of the foreign partner and transform it into an advantage. This is sometimes labeled as 'absorptive capacity,' defined as the ability of local firms to recognize, assimilate and apply external knowledge. Numerous factors, such as financial solidity of the firm, its size, its organization, its technology, its managerial vision and its human resources, are determinants of absorptive capacity (Narula, 2004).

Finally, the structure, content and effects of linkages depend on the bargaining capacity of the local firm. If the local firm is highly dependent on the foreign firm, "the bargaining position of the suppliers is extremely weak and the risk is high that suppliers will engage in ruinous competition" (Altenburg, 2000:10). Local firms may have different abilities to mobilize resources when bargaining with foreign firms, but support from the government, industry associations or international organizations can contribute to improving their bargaining position (Lauridsen, 2004). State-owned enterprises are often particularly well-positioned to secure such support.

2.9.12 Strategies of Local Firms

In considering whether local firms take the opportunity to collaborate with MNC subsidiaries and formulate a strategy to upgrade and learn, Hansen and Schaumburg-Müller (2006:21) ask firms in developing countries to:

1) redefine which markets the firms want to serve, either end-consumer markets or the business-to-business market. Hansen and Schaumburg-Müller feel that developing countries' firms are more inclined towards end-consumers in their domestic market. This is not good, as the market is inevitably limited. Instead, they recommend that these firms take up a strategy to be suppliers of goods and services to MNCs.

2) redefine whether to concentrate on a domestic market-oriented or export-oriented strategy. A domestic market strategy is constrained as protective barriers are removed and as market sizes limit the potential for growth. Even though it is difficult for developing countries' firms to penetrate export markets due to MNCs controlling a large portion of world trade and to trade barriers in developed economies, linking up to MNCs may help them overcome these obstacles.

3) local firms have to compete on the basis of costs. In this regard the strategies of local suppliers can be based on factor-cost advantages with sophisticated organizations, or on unique, highly specialized skills.

In the case of petrochemical industry which is engineering-dominated industry, there seems to be significant potential for local suppliers to upgrade their technological competence. Studies done by Ivarsson and Alvstam (2009) shows that Swedish engineering MNCs will help in the upgrading of local suppliers in emerging markets. The studies also show that local suppliers aiming at exports are provided with more

technological assistance from MNC subsidiaries than those aiming solely at the domestic market. Therefore being part of the global value chain has a positive impact on supplier upgrading.

2.10 Presentation of Hypothesis: Research Questions and Hypotheses

2.10.1 Analytical Frameworks and Hypotheses for MNC Subsidiaries

This study is interested in the nature of MNC subsidiaries' corporate strategy, in terms of the degree of autonomy subsidiaries enjoy as they take up roles that are more or less independent of the parent firm. The study uses subsidiary typology defined according to ownership structure. Based on the discussion above, it can be deduced that joint-venture firms and wholly owned firms have different ownership structures, and as a result their corporate strategies also differ. In this study, however, we are interested to compare MNCs from developed countries and producer firms from host countries (TWMNCs) in terms of the strength of their linkage collaborations with local suppliers. Therefore the types of MNC subsidiaries that are relevant in this study are: 1) greenfield investments; 2) mergers and acquisitions; 3) joint ventures. The greenfield investments and mergers-and-acquisitions types of MNC subsidiaries, being either wholly owned foreign firms (WFO) or wholly owned local firms (WLO), are considered as wholly owned firms in this study. Thus the study examines three types of MNC ownership: WFO, JV and WLO.

Analysis of Factors affecting Backward Linkages: provided by different subsidiary typology

Research Question 1:

In host developing countries, backward linkages depend on subsidiaries' motivations and their strategies. If subsidiaries are targeting the local market, they generally purchase more local content than export-oriented subsidiaries because of lower quality requirements and technical specifications (Reuber et al., 1973; Altenburg, 2000). MNC subsidiaries are likely to be integrated with local suppliers where they source relatively simple inputs (Ganiatsos, 2000; Carillo, 2001). The first research question on the relationship between different types of subsidiaries (wholly owned local firms, joint ventures, and wholly owned foreign firms) and the technological development of local suppliers is:

How do different types of MNC ownership structure affect the development of local suppliers?

To answer this question, the research looks at the strategies of MNC subsidiaries or producers:

Hypothesis related to FDI motives

As discussed above, several studies have shown that the tendency for subsidiaries to form backward linkages is affected by the motives MNCs have for investing in the host

developing country. Local market-seeking investors are more inclined to develop many local linkages because high-quality inputs are less critical. On the other hand, investors looking for exports from the host country tend to create relatively few linkages with local firms, since the demand for quality in intermediate inputs to the end products is high (Tavares and Young, 2006; UNCTAD, 2000). Hence, we put forward the following hypothesis:

Hypothesis 1. In developing countries, local market-seeking MNC subsidiaries have higher interactions of backward linkages with local supplier firms than do export-oriented MNC subsidiaries.

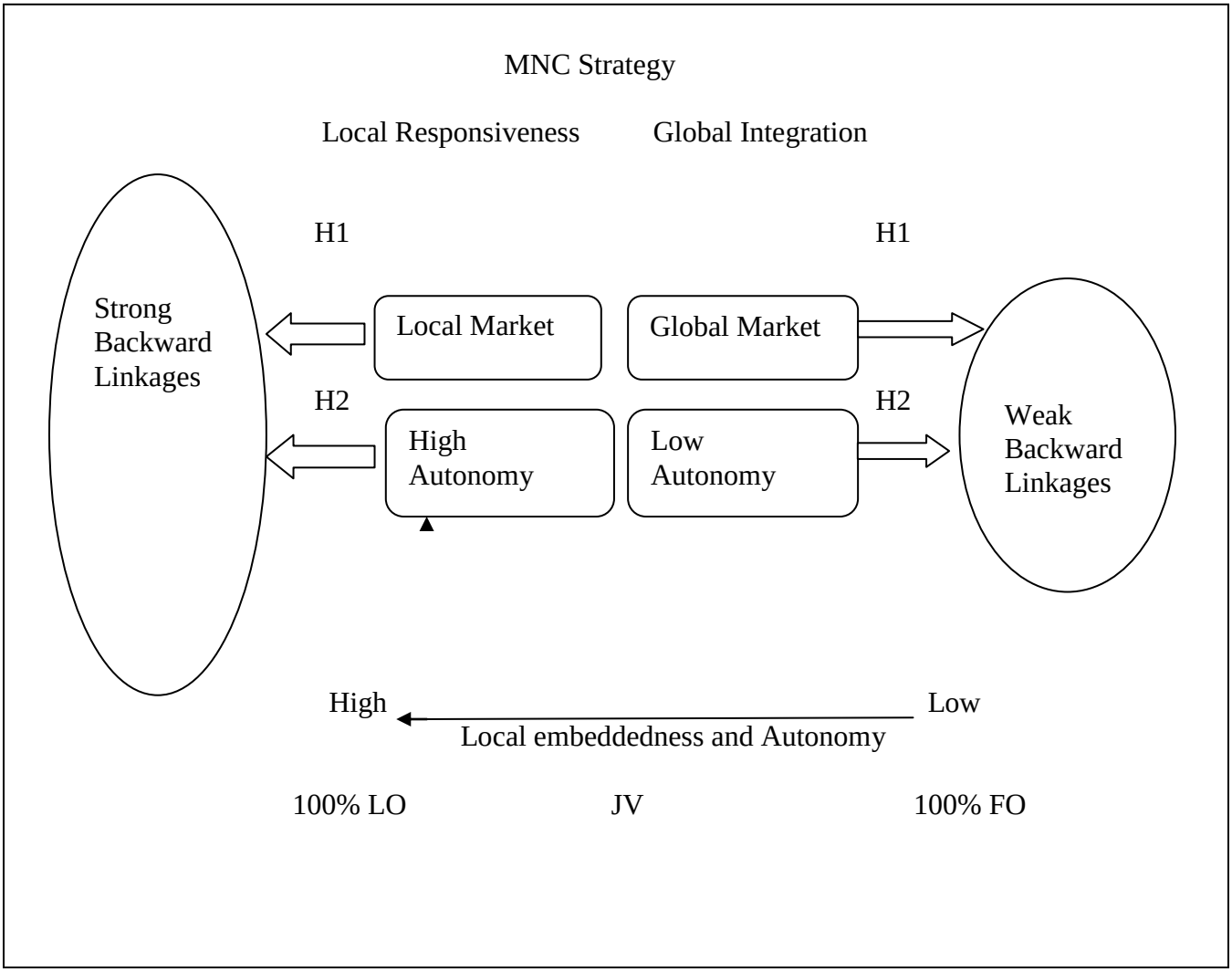
Hypothesis related to intra-MNC coordination (autonomy)

From the discussions above, several authors have argued that the formation of linkage collaborations is affected by the degree of autonomy that parent MNCs allow their subsidiaries. A high level of autonomy would lead to broad local linkages, while a low level of autonomy would lead to narrower local linkages. Tavares and Young (2006) put forward a similar hypothesis in regard to linkage effects and the autonomy given by parent firms to subsidiaries. Hence, we put forward the following hypothesis:

Hypothesis 2. In developing countries, loosely coordinated MNC subsidiaries create higher interactions of backward linkages with local supplier firms than do tightly coordinated MNC subsidiaries.

Based on the strategies of MNCs in forming subsidiaries in the host country, Figure 2.9 shows analytical frameworks in examining the relationship between MNC strategies and local linkage effects. It shows the study's analytical framework in analyzing for the MNC strategy: MNC strategies pursuing local responsiveness and high autonomy are positively related to strong backward linkages (left-hand side), whereas MNC strategies pursuing global integration and low autonomy are related to weak backward linkages (right-hand side).

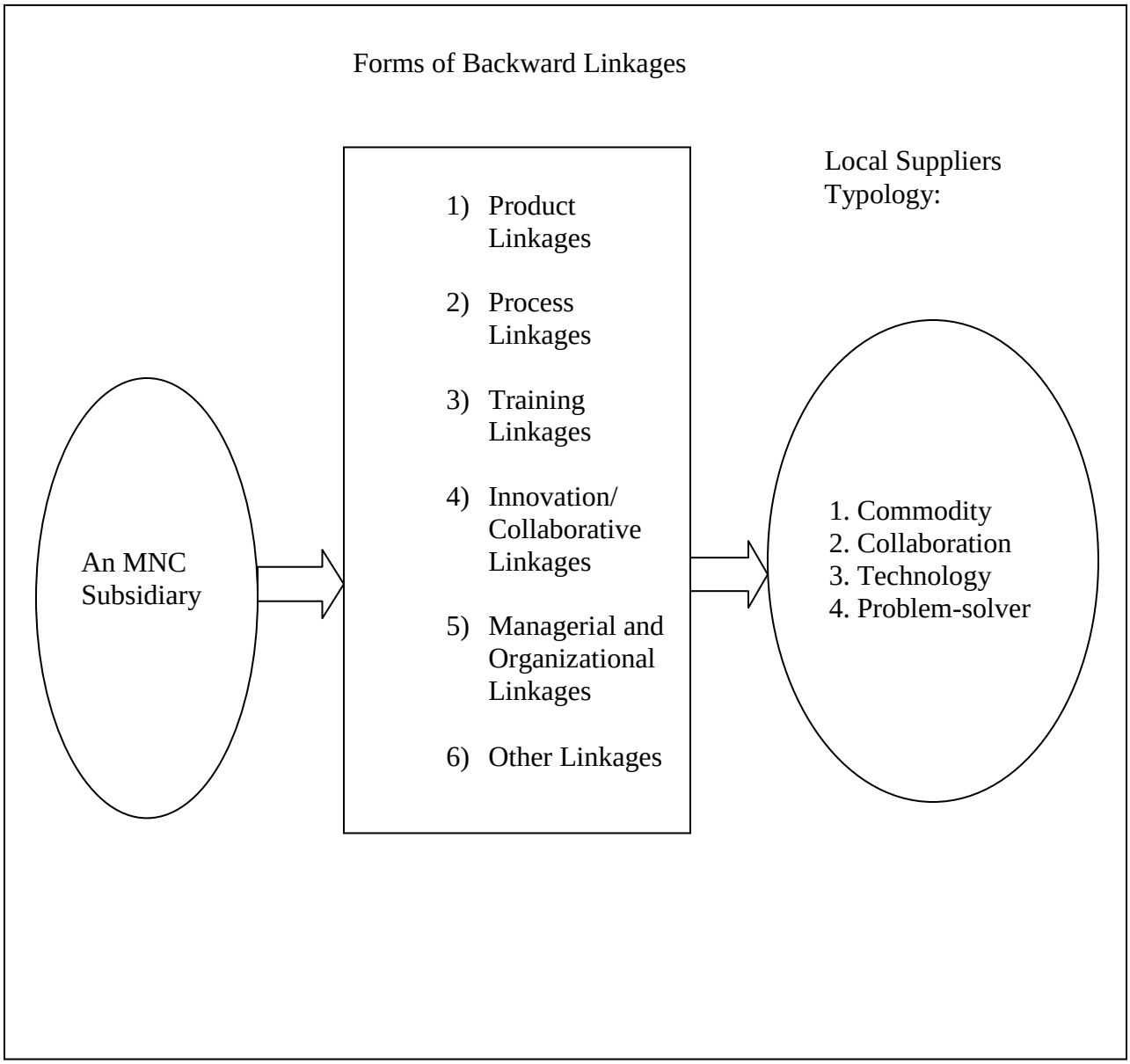
Figure 2.9: Analytical Frameworks for Analyzing the MNC Strategy



2.10.2 Analytical Frameworks and Hypotheses for Local Suppliers

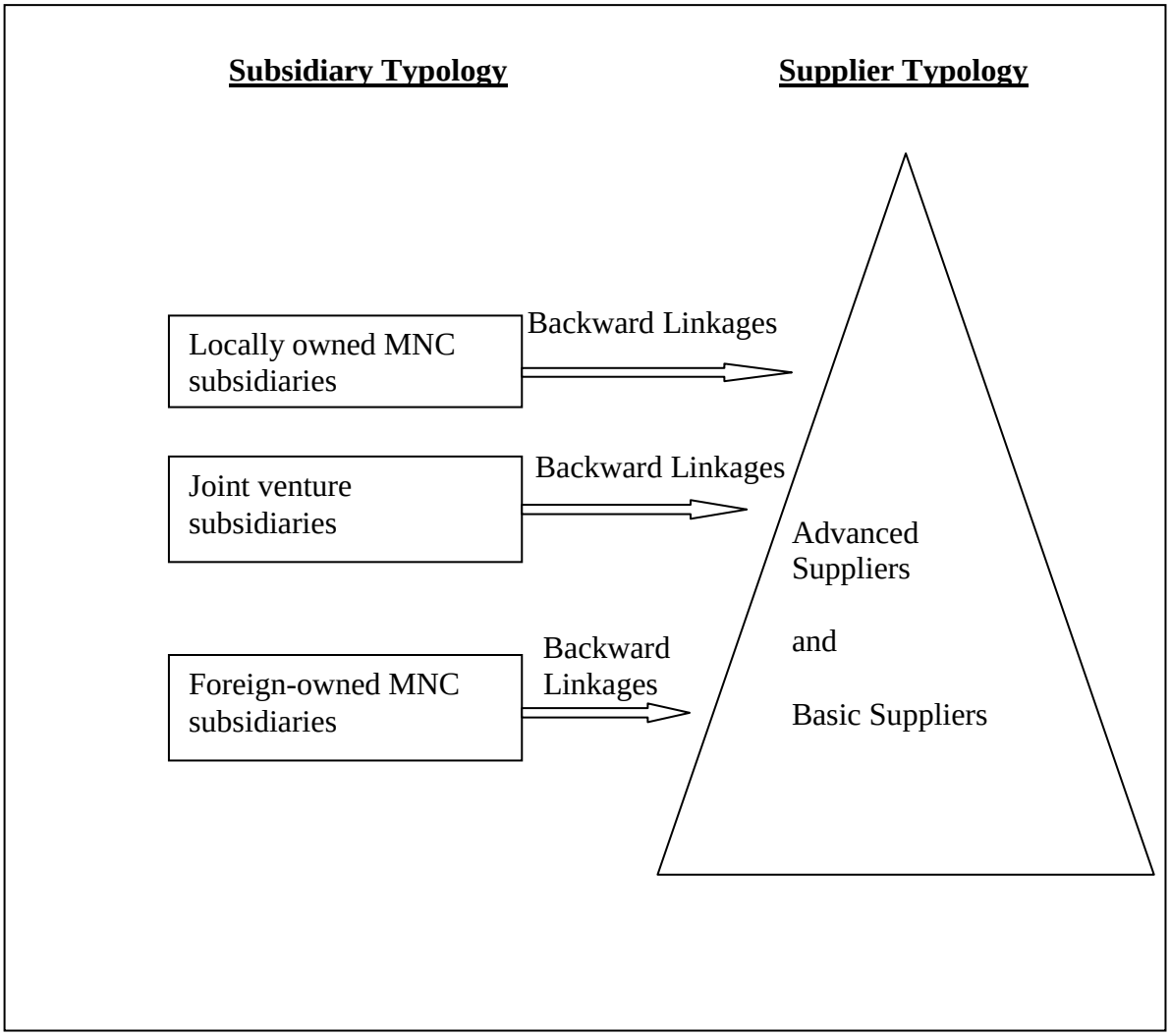
The above discussions of what makes local firms form linkages with MNC subsidiaries show that various factors influence whether, and to what extent, MNC subsidiaries form linkages with local firms. As a result of these inter-organizational linkages, technology or knowledge is transferred which then creates spillovers to the host countries. Several researchers have done studies on backward linkages and the spillovers that may be produced (Ariffin, 2000; Giroud, 2000; and UNCTAD, 2001). Following the typology developed based on Kaufman et al. (2000), the analytical framework in the present study of backward linkages between types of local suppliers and MNCs is presented as in Figure 2.10 below:

Figure 2.10: Analytical Frameworks on Forms of Backward Linkages and Typology of Local Suppliers



While subsidiary typology and supplier typology are presented separately in Section 2.8 and Section 2.9, they are in fact mutually integrated through backward linkages. The possible linkages between different subsidiary typology and local supplier typology are shown in Figure 2.11.

Figure 2.11: Possible linkages between MNC subsidiary typology and local supplier typology



Based on these studies, the second research question is presented as follows:

Research Question 2:

The second research question is based on the relationship between the capabilities of the local firms and the number of different forms of backward linkages local firms can establish as a result of their inter-firm relations with MNC subsidiaries. Thus our research question on the effects of different forms of backward linkages to local suppliers' technological capabilities is:

Do local suppliers' technological capabilities affect the forms of backward linkages (such as product, process, innovation, training, and management linkages) established between the two entities?

Research Question 2 is directly linked to the following hypothesis:

As discussed, based on the knowledge-based view of the firm theory, local suppliers' technological capabilities are affected by both internal and external technological knowledge. In this research question the hypothesis is based on: 1) backward linkages factors (external learning factors); and 2) suppliers' internal (learning) factors.

Hypothesis related to technological capability: backward linkages factors

Hypothesis 3. In developing countries, the breadth of backward linkages is affected by local suppliers' technological capability level.

Hypothesis related to technological capability: suppliers' internal factors

Hypothesis 4. In developing countries, local suppliers' technological capability is affected by the internal factors of local suppliers.

From these two hypotheses, if we find the supplier's external factors are not affecting the technological capabilities of local suppliers, then it can be justified that internal factors are affecting the technological capabilities of suppliers. Conversely, if the supplier's internal factors are not affecting the technological capabilities of local suppliers, then it can be justified that external factors are affecting technological capabilities of suppliers.

Research Question 3:

The upgrading of the technological capabilities of local firms does not take place in a simple way, and local firms do not innovate in isolation. External actors with which local firms interact are crucial in the process of technological learning, especially in firms where entry barriers are high, such as innovative suppliers in the petrochemical industry, where machinery production and engineering are involved. Local firms may vary in their ability to mobilize resources when bargaining with foreign firms, so support from the

government, industry associations or international organizations can contribute to improving their bargaining position (Lauridsen, 2004). Often, state-owned enterprises may be particularly well-positioned to secure such support (Lauridsen, 2004).

The focus of this study is the petrochemical industry in Malaysia and the National Oil Company (NOC), Petronas. As an NOC, Petronas has been entrusted with managing the nation's oil resources, and it has been the 'anchor company' at the forefront of designing MNC linkage policies under the Vendor Development Program (VDP). Its successful linkage formation between MNCs and local firms is seen as a cost-effective and viable way of fostering the economic development of the country (Lauridsen, 2004) and, of particular interest to this study, of the petrochemical industry. Thus the research question on the extent of the role taken by MNC subsidiaries and Petronas in supporting the upgrading of local suppliers' technological capabilities is:

Research Question 3:

i) *How do backward linkages promote the upgrading of local suppliers' technological capabilities?*
ii) *To what extent and in which ways does an MNC provide its local suppliers with technological assistance as part of a regular and ongoing business relationship?*

In order to answer the three research questions identified in this chapter, this study examines the following themes: 1) MNCs' corporate strategies as regards their subsidiaries' motivations and autonomy; 2) the local suppliers' technological capabilities; and 3) organizations or institutions that affect the upgrading of local suppliers'

technological capabilities. To answer these research questions, the study uses descriptive statistics (Chapter 5) and quantitative and qualitative analysis (Chapter 6).

2.11 Conclusion

The chapter reviews the relevant literatures for analysis of inter-organizational linkages between MNC subsidiaries and local suppliers. It provides the background of the subsidiary typology and the supplier typology. It also discusses the local suppliers' technological capabilities and technological learning, which are central to productivity growth and crucial to product and process improvement.

The accumulation of knowledge takes place not only by developing and employing local suppliers' internal capabilities, but also through learning by interacting with a wide variety of sources. Therefore backward linkages, which are one form of vertical linkages, can become substantial channels for transferring knowledge, technology and other capabilities to local suppliers and for spillover effects to take place in the economy. Thus backward linkages lead to an upgraded technological level through an accumulation of technological capabilities by local suppliers. The backward linkages index is proposed to measure the extent of inter-firm interaction and the mutual effects of backward linkages between MNC subsidiaries and their local suppliers.

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[i] Based on the interview with LOP.
[ii] Based on the interview with JVGP.
[iii] An increasing number of Third World MNCs are coming up as a result of globalization.