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**“The Links between International Production
and Innovation: a Double Network Approach”**

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The links between international production and innovation:

A double network approach

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The links between international production and innovation

Abstract

This paper examines the changing role of multinationals in the global generation, adoption and transfer of innovation. It is argued that the combination of traditional asset exploiting objectives with increasing asset seeking activities entails a transition of multinationals towards a *double network structure*. On the one hand multinationals are more and more characterised by the interconnection of a large number of internal units that are deeply involved in the company's use, generation and absorption of knowledge. On the other hand, units belonging to the internal network tend to develop external networks with other firms and institutions that are located outside the boundaries of the multinational firm, in order to increase the potential for use, generation and absorption of knowledge. Extending the analysis to a more general level, it is suggested that each of the external actors with which multinationals are interconnected across countries are themselves involved in extensive webs of relationships with other firms and institutions. By becoming embedded in different local contexts, multinational firms act as *bridging institutions* connecting a number of geographically dispersed economic and innovation systems. As a result, they are conditioned by, and contribute to, the evolution of different contexts in which they operate.

1.1. Introduction

An extensive literature has long highlighted the strong interconnections between innovation and multinational activities. Seminal contributions by Hymer (1960) and Dunning (1970) have emphasised that the possession of a superior technology is one of the fundamental factors generating the distinctive business advantages of multinational firms (MNFs). Vernon (1966) placed innovation at centre stage as the most important dynamic force underlying the international expansion of business. More recently, Caves (1996) argued that "the affinities between R&D and the multinational enterprise are numerous", and observed that the extent of R&D spending constitutes an excellent predictor of multinational activity in an industry. A number of studies have also called attention to the fundamental role of MNFs as producers and disseminators of knowledge and technological innovations across national borders (Teece 1977, Cantwell 1989, Narula 2003). A shift has emerged in this literature from early emphasis on the "transfer of MNFs' technology" to the host

countries towards a more comprehensive view of the links between internationalisation and innovation, wherein attention is given to the process of “global knowledge creation and exchange”. This changing perspective implies consideration of different aspects, including the nature of FDI decisions, the international dispersion of innovative activities, international learning and technology sourcing strategies, and intra-firm knowledge transmission across national borders.

This paper will adopt this broad perspective and analyse the two-way link between innovation and internationalisation. On the one hand innovation is a key engine of internationalisation as it largely contributes to make it profitable to compete in foreign markets. On the other hand, internationalisation creates important innovation opportunities. In this context, multinationals play a key role in the international exploitation and generation of innovative advantages. A crucial distinction in this respect is between international operations aimed at utilising pre-existing advantages of MNFs (asset exploiting FDIs) and those aimed at gaining access to local sources of knowledge and competitiveness (asset seeking FDIs). It is argued that (a) technological and institutional factors have contributed to increasing the intensity and geographic spread of asset seeking strategies; and (b) the latter largely overlap and co-exist with asset exploiting in most circumstances. This evolution has important implications for the organisation of innovative activities of MNFs. In particular, the combination of traditional asset exploiting objectives with increasing asset seeking activities entails a transition of multinationals towards a *double network structure*. On the one hand MNFs are more and more characterised by the interconnection of a large number of internal units that are deeply involved in the company’s use, generation and absorption of knowledge. On the other hand, units belonging to the internal network tend to develop external networks with other firms and institutions that are located outside the boundaries of the MNF, in order to increase the potential for use, generation and absorption of knowledge. The development of external networks is thus largely complementary to the growth of multinationals through internal networks. Extending the analysis to a more general level, one can observe that each of the external actors with which MNFs are interconnected across countries are themselves involved in extensive webs of relationships with other firms and institutions. In other words, by becoming embedded in different local contexts, MNFs act as *bridging institutions* connecting a number of geographically dispersed economic and innovation systems. As a result, they are

conditioned by, and contribute to, the evolution of different contexts in which they operate.

Section 1.2 provides a general view of the links between international production and innovations. Section 1.3 addresses the distinction between asset exploiting and asset seeking FDI as key strategies for the global generation, diffusion and utilisation of knowledge. Section 1.4 highlights some evolutionary forces underlying this increasing importance of asset seeking FDI. In Section 1.5 we examine the tendency of MNCs to adopt a double network structure as a means to combine asset exploiting and asset seeking strategies. Section 1.6 examines the organisational implications of the evolution of MNCs towards a double-network structure. Section 1.7 extends the analysis to a more general level and examines the role played by the MNC as a bridging institution, connecting geographically dispersed economic and innovation systems. Section 1.9 concludes.

1.2. Technology and internationalisation

How do innovation and technology relate to internationalisation processes? One way to look at this link is to focus on the so called globalisation of technology and innovation. Archibugi and Michie (1995) have proposed a useful taxonomy identifying three different aspects of this ongoing process. The first aspect is the *international commercialisation of technology*. Key indicators of these activities are international trade flows, especially of high technology products, and cross border patenting, both of which reflect the global utilisation of knowledge. These activities certainly involve multinational enterprises but also national firms, institutions and individuals which are able to extract economic value from innovative activities carried out where they are established. The second aspect refers to *international technical and scientific collaborations*. These involve national and multinational firms, universities, research centers, as well as individual researchers active in these institutions. The third aspect is the *global generation of innovation*, i.e. R&D, product and process innovation taking place in labs and plants located abroad. This involves exclusively multinationals, which are by definition the only institutions setting up value added activities in more than one country. The most important indicator of this aspect of the globalisation of technology is R&D expenditure abroad as a share of total R&D of

MNFs. There is rather clear evidence that all three aspects of the globalisation of innovation have been increasing over the past decades (Archibugi and Iammarino 2002, Narula and Zanfei 2005)¹

However, by focusing on the globalisation of technology and innovation, one can capture only part of the links between technology and internationalisation. In fact, it is not merely a matter of how dispersed technological activities are across national borders. The issue we want to raise here is that technology and innovation co-evolve with international production as a whole. In other words, all cross border activities of firms, no matter how innovative they are (hence including those with no innovative content at all), will have some direct or indirect connection with R&D and innovation either at home, or abroad or in both locations.

In a nutshell, we shall recall here three key features of this co-evolution. First, innovative activities are among the most important determinants of advantages which make international operations profitable. Firms with high R&D spending are likely to open up new paths of profitable innovation to be exploited in different markets, and not only in the home market. They will be able to reduce costs below those of their rivals or to rapidly introduce new products, thus expanding their international market shares (Cantwell 1989, Cantwell and Sanna Randaccio 1993). By the same token, international expansion allows to spread the fixed costs of innovation over larger volumes of sales. Each firm expanding in foreign markets thus takes advantage not only from economies of scales in production, but also in R&D and knowledge creation (Mansfield, Romeo and Wagner 1979, Petit and Sanna Randaccio, 2000). Moreover, by extending the market for new products and processes, internationalisation creates the conditions for a more extensive division of labour among firm-units involved in the generation and use of knowledge. From this

¹ The share of high-tech products (including electrical and electronic equipment, aerospace products, precision instruments, fine chemicals and pharmaceuticals) in world exports rose from 8% in 1976 to 23% in 2000 (Unctad 2002 p.146-7). The average annual growth rate of patents obtained by national inventors in foreign countries rose from 0.9% in 1970-1980 to 13.3% in 1984-1994 (Archibugi and Iammarino 2002). Foreign-owned inventions, accounted for about 14.7% of patents applied for in OECD countries over the 1999-2001 period (Oecd, 2005). The number of international technology collaborations recorded by the Merit-CATI database has almost doubled from 339 to 602 in the 1991-2001 period, with a growing dominance of non-equity partnerships, including supply agreements and strategic technical alliances, whose share has grown from 78% to 91% of total cooperative ventures (Unctad 2005, Hagedoorn 2002). MNFs steadily increased their R&D spending abroad from 15% of their total R&D budget in 1995 to 22% in 2001 (Roberts 2001). More details and discussion on the globalisation of technology can be found in Castellani and Zanfei (2006, Ch2).

perspective, innovation is a fundamental engine for internationalisation which, in turn, creates the incentives for more intense and efficient innovative efforts (Caves 1996).

Second, the two way link between internationalisation and innovation is not only a matter of incentives, but also of learning from foreign contexts. International operations may be a means to interact with, and gain access to, foreign sources of knowledge which (together with other advantages obtained through internationalisation, e.g. a higher bargaining power vis a vis labour force and other stake holders) help increase firms' competitiveness (Dunning and Narula 1995, Zanfei 2000, Frost 2001). Access to foreign sources of knowledge is guided by, and filtered through, knowledge assets which are already available within the firm. Hence, firms need some distinctive advantages (competencies) not only to gain access to, and compete in, foreign markets, but also as a means to absorb local knowledge (Cantwell 2000, Cantwell and Narula 2001). The more they invest to accumulate advantages, the greater their absorptive capacity, and the more likely they will further expand their knowledge basis.

Third, to the extent that firms undertake FDI strategies oriented to gain access to local assets there may be important implications for the analysis of spillovers accruing to local firms as well. Different forces are at work here. On the one hand, asset seeking FDIs are attracted by the existence of domestic firms endowed with some valuable and complementary skills and competencies. When this is the case, local firms are also likely to have the absorptive capacity which enables them to gain access to foreign firms' assets, if these are valuable and complementary. In other words, asset seeking strategies and the generation of spillovers to local economies can be mutually interdependent on one another. Moreover, this interdependence is likely to be self-reinforcing: the more foreign firms set up asset seeking activities in local markets, the more they will be available to transfer knowledge to indigenous firms and institutions. And viceversa: the more local firms are willing to access knowledge from foreign sources, the more they will be ready to transfer knowledge back on a reciprocity basis.

On the other hand, multinationals may well be in a position of relative weakness in the specific technological field in which the investment takes place, and use asset seeking strategies to overcome this fragility. If this is the case, local firms cannot easily have access to valuable complementary competencies of the MNF. The latter may behave as a free rider and "run away with the technology" as soon as it

gains access to it (Coombs et al. 2005). In sum, asset seeking FDI will not necessarily generate (mutual) spillovers. It is the interaction between the motivation of FDI and the structural characteristics of both foreign and domestic firms that determines the direction and intensity of spillovers. Foreign firms must have something to “learn” and something to “teach”, and the same applies to domestic firms (see Castellani and Zanfei 2006, Part III). Furthermore, knowledge flows from MNCs towards local firms (and viceversa) need to be organised, and this requires a serious commitment of the parties involved and a favourable environment, particularly for the creation of durable and effective linkages between MNCs and local firms and institutions. This opens, *inter alia*, a wide area of possible interventions for public policy in the crucial areas of intellectual property rights, competition, FDI promotion, selection and “after care”.

1.3. Using ownership advantages and creating them: asset exploiting and asset seeking FDI

A consolidated view in the literature is that firms need to be endowed with some distinctive advantages to be able to compete in foreign markets. This view is based on the idea, put forth by Hymer (1960), that international operations are associated with some extra-costs and risks relative to doing business in national markets. These comprise costs of communication and acquisition of information in a context of less favourable treatment given to foreign companies by the host governments and the costs and risks of exchange rate fluctuations. Such extra costs and risks imply what Hymer called the “liability of foreignness”, something that local counterparts do not suffer as they are already active in the host market. The existence of a specific advantage explains why, in spite of these extra-costs, a firm can decide to do business abroad and expect to compete successfully against local counterparts. This idea has been thereafter elaborated and subsumed in a number of contributions in the literature on FDI and multinational firms. Among other streams of literature, trade theoretic approaches have relied on this view and emphasised that firms exhibiting higher productivity premia will be better off at overcoming the sunk costs

of operating foreign affiliates. Hence, the more firms are productive, the deeper their engagement in international markets (Helpman, Melitz and Yeaple, 2004).

Where do ownership advantages – and productivity premia – come from? One key idea emerged in the literature is that these advantages are at least partially endogenous to international production. This is consistent with Hymer's insight that market imperfections generate the ex ante advantages of multinational firms; but it is the (endogenous) choice to internationalise that generates new market power and reinforces market imperfections. A number of contributions have thereafter elaborated on this view and examined how ownership advantages interact with international production more explicitly. First, it is now widely acknowledged that globalisation has been increasing its intensity and geographic reach, and this contributes to changing the very nature of ownership advantages. The point is that it would be limiting and misleading to maintain that ownership advantages are necessary to overcome merely the costs and risks of doing business abroad. In fact the only firms not sustaining such costs and risks are local uni-national firms. While juxtaposing internationalised firms to purely domestic firms was an acceptable approximation of the real world in the early phases of multinational expansion when Hymer was writing, it is not so anymore. Specific advantages are more and more needed to compete against other MNFs (or even parts of other multinationals) in the international markets they serve. They must all bear the costs and risks of doing business internationally, but they each require some distinctive edge vis-a-vis one another (Cantwell and Narula 2001).

Second, several works have examined the origins of ownership advantages leading firms to undertake their FDI decisions. Dunning (1977) has partially incorporated this issue in his eclectic paradigm by singling out country, sector, and firm specific factors underlying ownership advantages of multinationals. Moreover, he highlighted how ownership advantages interact with what he calls *locational advantages*, which reflect the attractiveness of a given host economy; and with *internalisation advantages*, which depend on market imperfections and failures. Other authors stress that firms intentionally invest to accumulate knowledge as a means of increasing their competitiveness relative to their rivals in the final product market. By reducing unit costs below those of others in the same industry, firms with higher technological capabilities (hence exhibiting some distinctive advantages) may both increase their margins and reduce prices, thus expanding their international market

shares (Cantwell 1989, Cantwell and Sanna Randaccio 1993). The choice of internationalisation modes also interacts with the nature of knowledge developed by firms. As a large fraction of this knowledge is tacit, its exploitation and use tends to require robust organisational devices and the creation of internal networks within firms, especially when technology is applied in different and (culturally and institutionally) distant markets (Cantwell 1989, Kogut and Zander 1993, Vaccà and Zanfei 1995).

Third, a growing albeit less established literature has emphasised that internationalisation, and particularly production and R&D investments abroad, can be a fundamental means of gaining access to complementary knowledge sources. In other words, while some foreign investment decisions are aimed at exploiting some prior advantages, other multinational strategies may well pursue the objective of gaining access to further assets that are complementary to firms' already existing advantages. Consistently with this view, Dunning (1993) distinguishes four different FDI strategies: resource seeking, market seeking, efficiency seeking, and asset seeking. The first three can be grouped into the broader category of "asset exploiting" FDIs, as they represent different modes of extracting economic value from advantages firms are already endowed with. When firms pursue resource seeking or efficiency seeking objectives, their specific assets are combined with low cost production factors available locally. In the case of market seeking FDIs, multinationals are attracted by the perspective of exploiting their ownership advantages on a larger scale. By contrast, "asset seeking" investments are primarily aimed at gaining access to specific competencies which reinforce firms' ability to compete in foreign markets².

Although the asset exploiting vs. asset seeking juxtaposition applies to all kind of FDIs, it has been used particularly with reference to the internationalisation of R&D. Asset exploiting R&D investment abroad occur when firms wish to improve the way in which existing assets are utilised (Dunning and Narula 1995). That is, firms may seek to promote the use of their technological assets in conjunction with, or in response to, specific foreign locational conditions. This has been dubbed also as home-base exploiting (HBE) activity (Kuemmerle 1999). Locational conditions may

² These definitions are not clear-cut. There are important overlappings and grey areas. Take for instance the case of R&D FDIs in Asian countries documented in recent years (Unctad 2005). These investments appear to be attracted by the possibility of gaining access to qualified human capital at a significantly lower cost than it would be possible in advanced countries. Would that be resource seeking, efficiency seeking or asset seeking?

require some modifications to the product or processes in order to make them more appropriate to local conditions. In such activities, the technological advantages of the firm primarily reflect those of the home country. Such FDIs lead to a duplication of the MNF's home base activities. In fact, under these circumstances, operations carried out in the host location *substitute* for the ones the firm may have wished, *ceteris paribus*, to undertake at home (Zander 1999), but can be undertaken more efficiently elsewhere. Asset-exploiting strategies thus correspond by and large to the traditional view of the organisation of innovative activities. Referring mainly to the US based multinationals, Vernon (1966), Kindleberger (1969), Stopford and Wells (1972) theorised a quasi-colonial relationship between the parent company and foreign subsidiaries, wherein the latter replicated the former's activities abroad, with strategic decisions - including R&D and innovation strategies - being rigidly centralised in the home country. In particular, Vernon emphasised that co-ordinating international innovative activities would be too costly, due to the difficulties of collecting and controlling relevant information across national borders. Host countries and foreign subsidiaries would then play a role almost exclusively in the adoption and diffusion of centrally-created technology.

In the case of asset-seeking FDIs (Dunning and Narula 1995) or home-base augmenting (HBA) investments (Kuemmerle 1999), firms aim to improve their existing assets, or to acquire (and internalise) or create completely new assets through foreign-located activities³. Once again, this may be particularly, albeit not only, the case of investments for the creation of R&D facilities. In fact, access to complementary technology assets available locally may well occur through learning at the plant level which might either be embodied into improved goods and processes, into blueprints such as user manuals or codified practices, or into routines and tacit competencies (Zanfei, 2000). The assumption in such cases is that the foreign site provides access to *complementary* location-specific advantages that are not as easily available in the firm's primary or 'home' base. In many cases the location advantages

³ Although the HBE-HBA terminology has become widely used in the literature, it is worth observing that this classification scheme is less accurate, and holds to a very traditional view of the MNF as centred in a dominant home-base. In fact, by emphasising the role of home bases, the HBA-HBE jargon cannot be easily made consistent with the possibility that firms are evolving towards network structures. As internationalisation proceeds, the importance of a single home is reduced, and the number of countries wherein the firm ends up being based increases. We take the view that being accurate is more important than being fashionable, and avoids using the HBE-HBA terminology except where necessary to give precise account of existing literature.

sought are associated with the presence of other firms endowed with high quality technological skills and competencies (Cantwell and Iammarino 2003). The investing firm may seek to acquire access to the technological assets of other firms through different channels. These include spillovers (in which case the firm seeks benefits that derive from economies of agglomeration), direct acquisition (by means of M&As), through R&D alliances and, less frequently, arms-length transactions.

There are several reasons why such asset-augmenting activities would be hard to achieve through arms-length transactions. Some of these reasons are associated with the nature of technology. When the knowledge relevant for innovative activities is located in a certain geographical area and it is “sticky”, foreign affiliates engage in asset-augmenting activities in these areas in order to benefit from the external economies and knowledge spillovers generated by the concentration of production and innovation activities in specific regional or national clusters. The tacit nature of technology implies that even where knowledge is available through markets (as technology markets generally tend to be under-developed), it still needs to be modified to be efficiently integrated within the acquiring firm’s portfolio of competencies. In addition, the tacit nature of knowledge associated with production and innovation activity in these sectors implies that “physical” or geographical proximity is important for transmitting it (Blanc and Sierra, 1999). While the marginal cost of transmitting codified knowledge across geographic space does not depend on distance, the marginal cost of transmitting tacit knowledge increases with distance. This leads to the clustering of innovation activities, in particular at the early stage of an industry life cycle where tacit knowledge plays an important role (Audretsch and Feldman, 1996).

The discussion on asset-exploiting vs. asset-seeking activities thus bears important similarities to the debate on the local nature of technological spillovers in the economics literature (e.g. Jaffe, Henderson and Trajtenberg, 1993). If knowledge spillovers are indeed localized, one may expect that local knowledge bases tend to differ with regard to focus and quality. The only efficient way for a firm to tap into a local knowledge base would then be to be physically present in such a local environment, which is indeed what we have defined as asset-augmenting activities⁴.

⁴ Asset-seeking (or asset-augmenting) motives and technology sourcing have been partially incorporated in formal models of the FDI decision. In particular, Fosfuri and Motta (1999) and Siotis (1999) show that a technological laggard may choose to enter a foreign market by FDI because there

In sum, asset-exploiting activities are primarily associated with demand-driven innovative activities, with the internalisation of technological spillovers as a secondary issue, while asset-augmenting activities are primarily undertaken with the intention to acquire and internalise technological spillovers that are host location-specific. Broadly speaking, the former represent an extension of R&D work undertaken at home, whereas the latter represent a diversification into new scientific and technological problems, issues or areas.

Empirical studies have traditionally focused on asset exploiting activities of multinationals. This is the case of pioneering studies by Safarian (1966), Mansfield, Teece and Romeo (1979), Lall (1979), and Warrant (1991) which (more or less) implicitly assumed that the internationalisation of R&D is mainly aimed at adapting technologies for selling in host markets. Hence, international R&D activities was by and large considered as demand driven.

The evidence on asset seeking activities of multinationals is more recent and still rather inconclusive. However, several studies do provide some empirical support to three important statements. First, multinationals are often, and increasingly so, attracted into areas where local firms exhibit some Revealed Technology Advantage⁵, i.e. where MNFs have something to learn from indigenous sources of knowledge (Miller (1994), Odagiri and Yasuda (1996 p.1074), Florida (1997), Le Bas and Sierra (2002)). This might be interpreted as a signal that MNFs pursue asset augmenting objectives, although the actual implementation of such objectives is different matter. Second, MNFs do source relevant knowledge from host economies, at least when they are located in some technologically advanced geographical areas. This is particularly the case of the US and several EU regions wherein foreign firms appear to cite patents (i.e. codified knowledge) generated locally at least as frequently as they cite patents obtained by their parent companies (Almeida (1996), Frost (2001), Cantwell and Noonan (2002), Singh (2004), Criscuolo, Narula and Verspagen (2005)). Third, there is growing evidence also of R&D FDI in Less Developed Countries and Newly

are positive spillover effects associated with locational proximity to a technological leader in the foreign country. Where the beneficial knowledge spillover effect is sufficiently strong, Fosfuri and Motta show that it may even pay the laggard firm to run its foreign subsidiary at a loss to incorporate the benefits of advanced technology in all the markets in which it operates. In a dynamic framework, it has been shown that the presence of localized spillovers might not only affect the FDI decision, but also the amount of R&D carried out by multinational firms (Petit, Sanna Randaccio and Sestini, 2005).

⁵ Denoting as P_{ij} the number of patents granted in technological field j to firm (or country) i , the RTA index is calculated as follows: $RTA_{ij} = (P_{ij} / \sum_i P_{ij}) / (\sum_j P_{ij} / \sum_{ij} P_{ij})$. An $RTA > 1$ signals a relative advantage of the country (firm).

Industrialising Countries, especially in Asian regions, which are apparently attracted by the possibility of gaining access to highly qualified human capital⁶. Puga and Trefler (2005) have stressed that MNFs' R&D investments in some Asian countries is motivated by the decision to involve qualified suppliers in innovation, thus sharing the costs of technology development while minimising technical incompatibilities between product design and inputs manufactured locally. Unctad (2005) reports of a number of case histories of foreign R&D investments in Asia where state-of-the-art product development services are supplied by local labs, particularly in the case of India, China, Malaysia and Taiwan in electronics and pharmaceuticals industries. This observation leads to conclude that: "the dividing line between the kind of R&D that is suited for expansion in developing countries and that in which is best kept at home - or in developed as opposed to developing countries - has become blurred" (Unctad 2005 p.140). It thus appears that MNFs locate R&D in these countries to rapidly gain access to low cost pools of cutting-edge skills and technology, combining asset seeking with resource seeking and efficiency seeking objectives. Under these circumstances, the fact that lower wages are being paid for human capital available locally might simply increase the attractiveness of LDCs as a location for high quality R&D and even technology sourcing activities.

1.4. Understanding the evolution of strategies and structure of MNFs

In the previous section we have discussed the distinction between asset exploiting and asset seeking activities of MNFs and we have recalled some findings from empirical studies supporting the idea that asset augmenting internationalisation is relevant and has gained momentum over the past two decades. In this section we focus on a more general discussion on the dynamic factors underlying this trend. (Zanfei, 2000). There seems to be a wide agreement on the very general statement that changes in the "competitive environment" are the main determinants of the alleged evolution of international activities. More specifically, reference is made to the

⁶ In 1994-2002, the share of total R&D abroad by majority owned foreign affiliates of US MNFs has grown from 7.6% to 13.5% in LDCs and from 3.4% to 10% in Developing Asia (Moris 2005). Recent surveys on FDI projects involving R&D indicate a further increase of developing destinations. Of the 1,773 FDI projects in R&D worldwide for which information has been collected by OCO Consulting in 2002-2004, the majority (1,095) were undertaken in LDCs, with developing Asia and Oceania accounting for nearly a half of the world total (861 projects) (Unctad 2005).

quicken pace and widening scope of technical change and to the globalisation of markets.

1.4.1. Technical change, global markets and asset seeking FDI

To discuss the role of these dynamic factors in the evolution of multinational firms, one may refer back to Dunning (1995). He focused on some general trends in the fields of technology and of demand. With reference to technological factors, he highlighted at least five sets of evolutionary pressures affecting the strategy and structure of MNCs (Dunning 1995 p.468). First, technical change has raised the fixed costs of a wide range of manufacturing and service activities; second, it has increased the interdependencies between distinctive technologies that may need to be used jointly to supply a particular product; third, it has enhanced the importance of multi-purpose, flexible technologies, such as microelectronics, information processing and transmission, and biotechnology; fourth, it has often determined a reduction of product life cycles; and fifth, partially as a result of the previous changes, it has forced firms to upgrade their core competencies and improve their competitive advantages.

As far as trends on the “demand side” are concerned, Dunning (1995 p.468) emphasised the increasing variety of markets MNCs are forced to deal with, as a factor that is further spurring firms to increase their ability to compete dynamically. However, his interpretation of the so called “globalisation of markets” is not shared by all scholars. Discussing this aspect is at least partially beyond the scope of this work. Suffice here to notice that a number of contributions have emphasised an opposite view. According to this interpretation, a process of homogenisation of markets would be actually taking place, as a result of imitation, cultural cross-fertilisation and contamination, favoured *inter alia* by progress in communication technologies. This view, submitted in the late 1970s and early 1980s by Vernon (1979) and by Levitt (1983), has received attention in part of the business literature (Porter 1986, and Martinez and Jarrillo 1989), and has been more recently resumed in the less academic debate on the social consequences of globalisation (see Kaldor et al. 2003 for a review) .

Neither position appears to be supported by convincing and conclusive evidence. However, for the purpose of the present analysis, it is important to observe that the more local contexts are different, the higher the likelihood that there are valuable complementary assets to be accessed and utilised locally. In other words,

asset seeking FDI's can be a response to high and increasing diversity of local contexts.

Considering local contexts as sources of competencies and of technological opportunities, and less as constraints to the action of multinational enterprises, marks a fundamental departure from the conventional approach to international business. Hedlund (1986 pp.20-21) caught the essence of this new way of theorising the role of local contexts: "The main idea is that the foundations of competitive advantage no longer reside in any one country, but in many. New ideas and products may come up in many different countries and later be exploited on a global scale". Later, Kogut (1989 p.388) expressed a similar, complementary view: "What is distinctive in the international context, besides larger market size, is the variance in country environments and the ability to profit through the system-wide management of this variance"⁷.

From this perspective, the view proposed by Dunning (1995) can be fully appreciated and enriched if we take the "value of diversity" into the appropriate account. He submitted that the *combination* of the technical determinants recalled above, with the differentiation of demand induced by globalisation, would increasingly force firms to be more dynamically competitive, and cause firms - and particularly large hierarchies - to reconsider both the scope and the organisation of their value added activities (Dunning 1995 p.468-470). In the light of the previous discussion, we should add that demand diversity is only part of the variety MNFs have to deal with. Local contexts can be considered as differentiated and evolving sets of cultural values, institutions and norms that influence the behaviour of economic agents and their ultimate performances⁸. It is this ever increasing variety, and not only demand diversity, that -- combining and interacting with technical change -- pressures for MNFs to adopt asset seeking strategies.

⁷ Ietto-Gillies (2002) stresses that also other advantages may derive from multinationalisation, including a higher bargaining power vis a vis labour force and institutions at home and in other countries where the firm is active. However, we are interested here in host economies as key sources of complementary knowledge.

⁸ This is consistent with a view of institutions as interacting with both economic and technical change (Freeman and Perez 1988, North 1990). There is also some correspondence here between our line of argument and the one developed by other authors who emphasise that historically determined networks of personal and social relationships among economic agents influence the organisation of their transactions. Some scholars name these networks of personal and social relationships with the term *embeddedness* (Granovetter 1985; Forsgren and Johanson 1992; Andersson and Forsgren 1996, 2005). Similarly, multinational growth is being analysed as an important case of internationalisation whose patterns are largely influenced by local institutional and social factors (Vaccà 1996).

1.4.2. The changing nature of technology and the role of local contexts

Our understanding of MNF evolution could be significantly improved if we examined in greater details the interactions between technical change, on the one hand, and the variety and evolution of local contexts, on the other. One way to proceed is to briefly consider, first, some of the emerging changes in the nature of scientific and technological progress that are affecting a wide number of industries; and then the impact of these changes on the role of local contexts. We shall thereafter draw some implications for international business in general. The more specific implications on the internal and external organisation of MNFs are discussed in sections 1.5 and 1.6.

Let us start with scientific and technological factors. Arora and Gambardella (1994) have emphasised that a number of scientific advances over the past thirty years together with the remarkable evolution occurred in the field of instrumentation, particularly computers and communication devices, induced a significant increase in the availability and use of what they call "general and abstract knowledge". Following their definition, we can identify "abstract" knowledge with the ability to represent phenomena in terms of a limited number of "essential elements", making abstraction from the specific context in which such phenomena were originally observed; and "general" knowledge with the ability to relate the outcome of a particular experiment to the outcomes of other experiments that may be distant from a historical, geographical or even logical point of view. New (computer based) experimentation technologies enable researchers to test theories more rapidly and effectively, and even to prove theories that could not be tested with old instruments. Scientific advances improving the theoretical understanding of problems make it possible to formalise concepts and ideas, so that relevant information can be processed with new instrumentation⁹. The wider and wider pool of generic knowledge that is becoming available within and across firm boundaries increasingly requires that firms gain

⁹ Examples of how the availability of cheap computational power may extend the application and the development of theoretical knowledge (and vice-versa) can be drawn from the fields of biotechnology, new materials, airplane production and testing (Arora and Gambardella 1994 p.525-527). For instance, a recently developed theorem using the principle of energy minimisation reduced the number of alternative molecular structures of a given protein chain in a way that information is processable by supercomputers. This made it possible to speed up the process of exploration of given molecular structures and of their interactions with other molecules.

timely access to "contextual" knowledge, that is information on specific applications environments and user needs. Moreover, as the costs of knowledge codification fall, and the potential for applications of knowledge expands, the division of innovative labour in the generation and in the utilisation of technologies also increases (Arora et al. 2001).

This line of argument brings us to the second step of our analysis: the changing nature of scientific and technological progress enhances the role of local contexts as a source of economic value for the innovating firms. In other words, it is context-specific knowledge that makes the difference and determines the competitive advantage of firms. Context-specific knowledge is highly complementary to the development of general and abstract knowledge. Two reasons can be proposed here. First, general and abstract knowledge is "sterile" from an economic point of view, if considered in isolation from contextual knowledge. In fact, companies with a high general and abstract knowledge endowment, but with no contact with contextual knowledge, are not able to evaluate actual user needs and expectations, and will then encounter very limited commercialisation opportunities. This will undermine the very possibility of funding R&D efforts and the generation of knowledge itself. Second, generic knowledge basis can be further expanded through the contact with context-specific information. Application experience may highlight puzzles and problems to be solved, thus stimulating research at all levels, and eventually generating new generic knowledge (Rosenberg 1969). Furthermore, localised, context specific experience conducted at the level of both manufacturers and users can eventually be de-contextualised and enrich generic knowledge as well (Becattini e Rullani 1993).

The described trends have fundamental implications for international business. First, advances in information processing and communication technologies increase the incentives for firms to codify knowledge and lower the cost of exchanging information between different and distant nodes of a MNF's internal network (Santangelo 2002). This is the most commonly considered aspect in economics and business literature. Second, developments in the theoretical understanding of phenomena together with computational progress increase the rapidity and effectiveness of the process through which knowledge can be de-contextualised,

codified and transferred to different sites where it has to be employed¹⁰. As a result of this process, local knowledge can be de-contextualised to enter the cycle of generation of new economic value (Becattini and Rullani 1993). In the case of transnational companies, this implies that subsidiaries can specialise in specific knowledge creation activities, contribute their own bits of knowledge to the network, and gain access to other specialised inputs at a lower cost and with greater potential advantages than in the past. Research and development phases can be separated and assigned to distinct and geographically distant units within the MNF or to foreign external units with complementary competencies (Criscuolo 2004). Third, the growing possibilities offered by science and technology to generalise, codify and transfer knowledge, make it more and more necessary for firms to gain access to local resources and competencies, wherever these may be available, and to absorb the stimuli deriving from local applications experiences (Tunisini and Zanfei 1998).

The dynamic factors we have considered thus appear to increase the importance of asset seeking FDI. However, this does not imply that these substitute the more traditional asset exploiting activities. There are at least two basic reasons why asset seeking and asset exploiting activities can be expected to co-exist. On the one hand, to the extent that asset seeking investments are undertaken, new technological opportunities are opened and explored. The exploitation of these opportunities will require complementary assets which are not necessarily available locally. This will call for further FDI which are asset exploiting in nature. The reverse also applies: MNFs carrying out asset exploiting activities may get in touch with local learning opportunities and knowledge sources which can be accessed by means by further (asset seeking) investment. This recalls the combination of resource-seeking and asset seeking FDI in Asian countries which we mentioned earlier in this Paper (section 1.3). On the other hand, whenever products are multi-technology-based, one firm may be marginally ahead in one technology, and its competitor in another. This will imply that the same firm might be oriented to exploit superior technology in one area, while undergoing exploratory strategies to augment competencies in another (Criscuolo, Narula and Verspagen, 2005). This is another

¹⁰ We are not suggesting that all knowledge can (cost effectively) be generalised and codified. The argument is that the described changes are making it possible to *expand* the area of knowledge that can be, and actually is, generalised and codified.

reason why firms often engage in both asset-augmenting and asset-exploiting activities simultaneously.

1.5. Multinationals, innovation, and the double network structure

We have argued that there are important dynamic forces leading to an increase of asset seeking activities. The combination of these strategies with more traditional asset exploiting FDIs entails a transition of MNFs towards a *double network structure*. This view of the evolution of MNFs emphasises a fundamental change in the internal networks of knowledge creation and transfer within the MNF, combined with a growing recourse to external networks of inter-firm alliances (Zanfei, 2000). On the one hand, MNFs are more and more characterised by the *internal networks* of units (affiliates and business centers) that are deeply involved in the creation and use of knowledge. The traditional organisational model, based on the vertical, unidirectional transfer of knowledge from the center to the periphery, is being gradually replaced. Enterprises and business units belonging to the multinational group and located in different countries are not only able to passively adapt knowledge generated elsewhere. They are also able to generate and circulate new information, and are more and more tied to one another by means of cultural relationships (based on common values, norms of conduct and languages), rather than hierarchical linkages. On the other hand, enterprises and units belonging to the internal network tend to develop *external networks*, with other firms and institutions that are located outside the boundaries of the MNF, in order to increase the potential for use and generation of knowledge. These co-operative relations do not only involve the central units of the MNF, but they more and more concern the decentralised units as well, which increasingly use such networks to gain access to local sources of knowledge and applications abilities.

How does the development of internal networks favour (or prevent) the setting up of external networks? More specifically, how do internal networking strategies affect the likelihood that external networks are used to enhance asset seeking activities, and vice-versa?

Different streams of literature provide useful insights to answer these questions, and show that internal networks can influence external networks either by

reducing uncertainty or by creating economic and technological opportunities (see Castellani and Zanfei 2004 for a review).

One such stream of literature relies upon the transaction cost approach and has emphasised the role of *multinational experience* in reducing the uncertainty stemming from the variety and volatility of international markets, of technological opportunities and of institutional conditions. As multinational experience is, by and large, a function of the extension, geographic spread and duration of firms' presence in different countries, we shall simply use this term as a synonym of *internal networking*. The idea put forth in this literature is that the development of a network of subsidiaries yields greater knowledge on foreign environments. In other words it will reduce a specific type of uncertainty, often referred to as "external uncertainty" which is largely exogenous to the behaviour of individual firms. The important implication is that such a reduction of uncertainty will diminish the returns associated with cooperation as a mode of market entry and information gathering (Gomes-Casseres 1989). Under these circumstances, the advantages from external networking (e.g. lower sunk costs, shorter set-up and shut-down time) are likely to be outbalanced by transaction costs and organisational problems (shirking and conflicts).

Other contributions emphasise the impact of internal networking on another type of uncertainty, namely *behavioural (internal) uncertainty*, having an opposite effect on external networking. As suggested by Robertson and Gatignon (1998 p.520), behavioural uncertainty concerns the difficulty of observing and measuring the adherence of contracting parties to the contractual arrangements and the difficulty of measuring the performance of these parties. This kind of uncertainty is critical for opportunism to arise in the absence of control mechanisms. The inexperienced firm might not be in a position to accurately assess the performance (outputs) of economic agents active in foreign markets, thus it might resort to monitor their efforts (inputs) by extending hierarchical control (Erramilli, 1991; Anderson and Gatignon, 1986). Experience created by an extensive web of foreign subsidiaries may reduce internal uncertainty and lower the desirability of hierarchical control mechanisms by two means. First, by increasing mutual trust between MNFs and local counterparts¹¹.

¹¹ A relationship is characterised by mutual trust when each of the parties involved in it chooses to refrain from opportunism (hence they are *trustworthy*), and believes that the others will do the same

Experienced firms are likely to have a history of relations with local firms and institutions, through which they get acquainted with one another, share goals and competencies, and become less inclined to adopt opportunistic behaviour (Zucker 1986, Lyons and Mehta 1997). This can be envisaged as a learning by cooperating process: mutual trust is an immaterial asset which is generated through the interaction, and creates a business environment which is conducive to further collaboration with the same partner(s) (Bureth, Wolff and Zanfei, 1997, Andersson et al. 2005). Second, multinational experience reduces the risk of opportunistic behaviour of foreign counterparts (hence diminishing internal uncertainty) by increasing outside options and the credibility of retaliation strategies. In a different analytical context, Kogut (1989) points out that having other ties increases the stability of collaborative ventures because it allows one party to retaliate in case a partner behaves opportunistically, either by punishing the same partner in different transactions; or by resorting to different partners to accomplish the same tasks. In a similar vein, we shall suggest that MNFs with extensive internal networks in foreign markets will have greater opportunities to retaliate in case a local party deviates from a contractual agreement, therefore reducing the risk that such opportunistic behaviour occurs¹².

A final strand of literature pays a closer attention to the role of multinational experience/internal networking in favouring asset seeking strategies and dynamic efficiency¹³. In particular, several contributions focusing on the evolution of high technology industries, highlight the need to explore and rapidly exploit new opportunities, either new businesses or new technological developments. From this point of view, strategic alliances appear to be appropriate means to search for and utilise new ideas, stimuli, and bits of knowledge. In other words they represent "an

(hence they are *trusting*). See Lyons and Mehta (1997), Burchell and Wilkinson (1997) for extensive reviews of the literature on this concept.

¹² By increasing the feasibility of retaliation in case of contractual breach, multinational experience increases the *trustworthiness* of foreign partners, i.e. their availability to refrain from defection given the credible threat of being sanctioned thereafter. This would be consistent with the notion of *calculative trust* (Dasgupta 1988, Kreps 1990, Williamson 1993). However, multinational experience does not ensure that calculative trust is also *mutual*. In fact the described impact is unidirectional, and the local counterparts cannot be expected to become more *trusting* towards the MNF whenever this becomes more experienced.

¹³ One may incidentally observe that the lack of attention for these issues is admittedly a limit of approaches based on transaction cost economics. According to Williamson himself, transaction cost literature "has been less responsive in dynamic, evolutionary respects" (Williamson 1993 p.337). See also Williamson (1988) for earlier considerations on the weaknesses of transaction cost approaches in dealing with these aspects of economic analysis.

attractive organisational form for an environment characterised by rapid innovation and geographical organisational dispersion in the sources of know how" (Teece, 1992 p.20). The need for a timely and effective knowledge access may spur firms to choose strategic alliances even when short term, static (transaction and organisational) cost minimisation would point to different forms of linkages. Consistently with a more general view of complementarity between internal and external competence accumulation (Cohen and Levinthal, 1989; Rosenberg, 1990; Arora and Gambardella 1994), multinational experience – which is associated to the expansion of firms' internal network of foreign subsidiaries over time - can be identified as a fundamental asset that helps increase a firm's *exploration potential*, i.e. its possibility to search for and absorb external knowledge (Cantwell 1995, Castellani and Zanfei 2002, 2004). This view appears to be consistent with a number of studies which highlight the mutually reinforcing nature of intra-firm and inter-firm networks, through which generic as well as applications and market oriented knowledge assets can be searched for and accessed¹⁴. The relevant implication for our purposes is that multinational experience/internal networking can be expected to expand the exploration potential and hence lead to a greater recourse to international collaborative ventures.

To summarise, part of the existing literature suggests that multinational experience/internal networking will reduce external uncertainty and will thus have a *negative impact* on collaborative linkages (as opposed to hierarchical control modes). By contrast, other contributions highlight that internal networking can have a *positive* effect on external networks, when internal uncertainty (and opportunism) is reduced. As we have shown, this can occur if multinationals, by expanding their presence in foreign markets, either reinforce their relationships with local partners based on (mutual) trust; or use their internal networks as a means to credibly retaliate against partners which deviate from contractual agreements. Finally, works stressing dynamic efficiency considerations lead to the conclusion that internal networking will increase firms' exploration potential and hence favour the recourse to external networks of international collaborations rather than hierarchical linkages.

¹⁴ Evidence on the complementarity between intra-firm networks and inter-firm collaborative ventures can be drawn from various studies on high technology industries. See Arora and Gambardella (1990)

In the light of the previous discussion, it thus appears that the actual impact of internal networking on external networks is at least partially an empirical issue. The interpretive ambivalence we have highlighted calls for a more detailed analysis of the characteristics of MNFs' internal networks of subsidiaries and of their impact on external networks. The idea is that multinational experience – identified by firms' internal web of foreign subsidiaries - should be considered a multifaceted concept. Different characteristics of internal networks can be expected to have a distinct effect on the key determinants of linkage creation we have focused on above: uncertainty and exploration potential. These characteristics include the number, geographic spread and length of establishment of foreign affiliates in local economies (Castellani and Zanfei 2006 ch.2 and 4).

The point to be stressed here is a more general one. Our arguments for the growing recourse of MNFs to asset seeking FDIs, as reported in section 1.4, suggests that dynamic complementarities between internal and external networks are likely to become more and more important too. In other words, assets seeking activities proceed hand in hand with the evolution of MNFs towards a double network structure. In fact, the expansion of firms' internal network of foreign subsidiaries may create the conditions for a more effective exploratory activity in foreign locations and increase the possibility to search for, and absorb, external knowledge. This augments the expected payoff from the development of external networks, and increases the likelihood that asset seeking objectives are pursued.

1.6. Organising the international generation and use of knowledge

In the previous sections, we have argued that, especially in industries characterised by a high dynamic competition, MNFs should be moving towards a *double network structure*, by expanding both their internal networks of subsidiaries and their external networks of collaborations with local partners. This raises a number of organisational issues. In fact, the creation, transfer and exploitation of technological assets within the MNF requires a division of labour among semi-autonomous units located in different countries. These units should in turn be able to engage in external networking and have the incentive to circulate knowledge and

and Yamin and Otto (2004) for biotechnology, Malerba and Torrisi (1992) and Torrisi (1998) for software, Steinmueller (1992) and Ernst (2005) for semiconductor industry.

assets acquired locally at the global corporate level (Zanfei 2000, Criscuolo, Narula and Verspagen 2005). In other words, foreign affiliates need to be endowed with sufficient degrees of autonomy, in order to be in a position to absorb external knowledge; but these autonomous units may lack the incentives to make such knowledge available to the rest of the MNF and to adopt technologies produced elsewhere in the MNF (Blanc and Sierra 1999). This calls for an organisational structure which allows autonomy, though maintaining internal cohesion. In the following, we shall address the three issues separately. First, why should the degree of decentralised units' autonomy increase within MNFs organised as a *double network*? Second, what are the consequences of such autonomy for the degree of knowledge transfer within the MNF? Third, how can a MNF ensure internal cohesion among autonomous units?

1.6.1. The autonomy of units within the MNF

To the extent that local contexts are a fundamental source of opportunities and competitive assets for MNFs, centralising information and strategic decisions is more and more likely to be *ineffective* for several reasons. First, the increasing variety and variability of challenges stemming from local contexts augments information asymmetries between headquarters and subsidiaries. This will reduce the possibility for headquarters to effectively control the subsidiaries' on-going operations. Such a view is consistent with agency theory, in which the headquarters (principal) are expected to try and secure that the subsidiary (agent) behaves in accordance to the former's goals. Within this framework an increase in information asymmetry will entail a shift from direct control to output control: the principal (parent company) will more effectively evaluate the final performances of the agents (subsidiaries), allowing them a greater discretionary power in the process leading to a given output (O'Donnell, 2000)

Second, the more MNFs get involved into external networks with local counterparts, the lower will be the headquarters' command over their decentralised units. As Forsgren and Johanson (1992 p.27) have put it: "The wish for freedom in the subsidiaries cannot be explained solely by a general desire for autonomy; it probably also stems from the demand of actors in the industrial network, e.g. local authorities and trade unions". Moreover, subsidiaries involved in collaborative linkages are also likely to improve their economic and innovative performances (Andersson and

Forsgren 1996), hence increasing their bargaining power within the internal network (Mudambi and Navarra 2004). This will *inter alia* increase their ability to negotiate higher autonomy in a number of decision making areas.

Third, centralising decision making is also highly ineffective in markets characterised by intense dynamic competition because it would negatively impact on the number and variety of learning patterns. Florida (1997 p.87) submits that that when foreign R&D plants are subject to complex reporting and central control, there may be negative consequences on both the affiliates' innovative performances and on their ability to recruit and attract high-quality scientific and technical human capital. Moreover, centralising decision making will reduce the firm's ability to understand local business environment and hence to develop close relationships with local counterparts, hence further diminishing its innovation potential (Andersson, Bjorkman and Forsgren 2005).

Allowing greater autonomy to subsidiaries would instead create greater incentives for the subsidiary to take profitable initiatives at the local and global levels (Birkinshaw 1997). It would also create an incentive structure that is more conducive to creativity and innovation among local workers and managers (Bartlett and Ghoshal 1989), and would be more attractive for qualified researchers (Criscuolo 2004). Moreover, it will increase the possibility for local firms to establish enduring and tight relationships with local counterparts, and ultimately to knowledge absorption and creation (Andersson, Bjorkman and Forsgren 2005, Birkinshaw et al 2005). *Inter alia*, a higher autonomy of units belonging to the internal network will favour the firm's ability to explore a wider range of collaborative patterns with local partners.

To summarise, the affiliates' autonomy is by and large shaped by the characteristics of the environment in which the MNF is active: the larger the variety of challenges and opportunities offered by local contexts, and the higher the intensity of competition based on innovation, the greater will be the need for autonomy within the MNF's organisation. Autonomy will also be higher the larger and the more binding are external networks with local counterparts. However, subsidiaries' autonomy enables them to explore a wider number of collaborative patterns. One can thus expect that autonomy be, *coeteris paribus*, a cumulative process wherein external networking plays an important reinforcing role.

1.6.2. Knowledge circulation within MNFs

As we have just highlighted, autonomy guarantees that affiliates are fully integrated into local contexts and are enabled to maximise learning and accumulation of application-specific knowledge. However, autonomy can constrain the circulation of knowledge within MNFs, thus dramatically reducing the advantages of specialisation and undermining the process of knowledge accumulation as well. There are two such constraints to knowledge circulation:

- *Constraints on the adoption of new technology by foreign affiliates.* Subsidiaries with a large autonomy may not be willing to utilise knowledge that is available within the multinational group. This reluctance to adopt knowledge may be due to a number of reasons. New technology originating elsewhere within the MNF may turn out to be incompatible with technological choices autonomously made by the decentralised unit, deriving from previous adoption of different standards, or of research programs implying a pre-determined sequence of innovative steps (Arthur 1988). Cultural resistance can also play a role, as a result of a limited ability to evaluate technological alternatives, or of institutional factors (nationalistic orientation of local decision makers, lack of trust, “Not Invented Here” syndrome). Furthermore, foreign affiliates are often forced by host country governments to source at least part of their inputs and technology locally, thus reducing the rate of adoption of knowledge from parent companies. Finally, not all foreign affiliates possess the “absorptive capacity” – most often associated with firm size and human capital endowment – needed to adopt technology from parent companies, and from other parts of the MNF (Teece 1977, Cantwell 1995, Gupta and Govindarajan 2000). The non adoption of knowledge can be a problem for the MNF for at least two reasons. First, it may put a brake on rationalisation efforts - e.g. inducing subsidiaries to “re-invent the wheel”, or impeding the diffusion within the multinational network of a new, more efficient standard - and worsen compatibility problems within the network. Second, by refusing to adopt technology available within the MNF, the reluctant subsidiary does not contribute to the exploitation of knowledge economies of scale at the network level, thus reducing the incentives of other parties to invest in the generation and codification of specialised knowledge.

- *Obstacles to the transfer of knowledge from affiliates to other units of the firm.*
Autonomy of subsidiaries may also put a brake on their willingness and capability to contribute their own knowledge to the network. We have already observed that some of the subsidiaries' strategic moves may be constrained by the need to obey to local rules, or to decisions that are jointly taken with external parties. For example, some of the results of these cooperative ventures may be subject to contractual constraints which do not allow subsidiaries to freely circulate knowledge within the MNF. Furthermore, to the extent that foreign affiliates access external knowledge they can bargain with the headquarters the transfer of such assets, in order to maintain their autonomy and strategic mandates. This process is likely to produce a sub-optimal disclosure or degree of knowledge transfer within the MNF. In other words, the process of reverse technology transfer may not be working properly (Criscuolo, 2004). Among other consequences, autonomy may thus end up increasing, rather than reducing, the cultural and organisational distance between the headquarters and affiliates, which is considered a fundamental source of communication problems (Buckley and Carter 2004). Besides, subsidiaries will be less willing to transfer knowledge if their local markets are large, implying that their incentive to pursue knowledge economies of scales through the network will not be so compelling. Autonomy may also generate problems with the actual access to knowledge available in the network. If a subsidiary does not contribute knowledge to the network, it may suffer retaliation from other parties belonging to the MNF, which might either deny access to their own knowledge or refuse to adopt knowledge when and if circulated in the network.

1.6.3. *The internal cohesion of MNFs*

The arguments developed in the previous section suggest that decentralisation of decision making needs to be complemented with a close attention to the factors favouring internal cohesion of MNFs and balancing out centrifugal forces. The risks attached to autonomy without integration have been effectively summarised by Ghoshal and Bartlett (1995 p148): "In the absence of ... an integration process, decentralised entrepreneurship may lead to some temporary performance improvement as existing slack is harnessed, but long term development of new

capabilities or businesses is seriously impeded". Hakanson and Nobel (2001) argue that the degree of integration between a subsidiary and the rest of the company is the primary predictor of knowledge transfer from the subsidiary to the headquarters or to another subsidiary. Moreover, they submit that the highest reverse technology transfer (from periphery to the center of the MNF) should be found when subsidiaries are both highly embedded in the local environment and highly integrated.

While there is a wide agreement on the need to ensure integration to favour internal cohesion, there is much lower convergence on whether it should be attained by means of hierarchical control or via more informal means, such as the rotation of personnel and the sharing of cultural values and of “strategic visions” (Young and Tavares 2004). On the one hand, Gupta and Govindarajan (2000) posit that centralisation encourages flows from headquarters to subsidiary. On the other hand, Egelhoff et al. (2003) point out that centralisation might well favour knowledge transfers from headquarters towards subsidiaries, but it would not imply as strong flows from subsidiaries towards headquarters, nor between subsidiaries. This calls for innovative coordination modes that ensure an acceptable degree of cohesion, while safeguarding the autonomy and creativity of MNF units (see Martinez and Jarrillo 1989, and Zanfei 2000 for a review of the literature on this issue). First, there seems to be some convergence on the idea that decentralisation processes within MNFs are likely to be associated with the adoption of “subtle” and informal coordination mechanisms (Hedlund 1986, Egelhoff 1984, Hedlund and Rolander 1990). Second, the role of headquarters is subject to fundamental changes: central offices are gradually abandoning their traditional function as centers of control and are more and more involved in setting the rules of the game, monitoring competencies and organising resources for the joint exploration and exploitation of technological opportunities by MNF units (Dunning 1993, Cantwell 2001).

There are however some centripetal forces at work, independent of administrative mechanisms adopted. A wide literature on MNF internal organisation has shown that affiliate autonomy is severely constrained by a system of interdependencies in terms of knowledge, technology, products, markets (cf. Dunning 1993, Ch.8 for an extensive review of these cohesion mechanisms). We here suggest that, as a result of the evolutionary process examined in section 1.5, additional incentives come into action, stimulating affiliates to co-operate with one another and to transfer knowledge within the MNF.

Increasing centripetal effects are partly the result of growing competitive pressures. Coping with globalising markets and evolving technology implies that each unit will be induced to collaborate with the headquarters and other units to solve problems that neither the headquarters nor subsidiaries can individually solve (Evans 1992 p.92). This is only part of the story. A powerful incentive to co-operate within the network is the expectation to take advantage from potential *economies of scale in the generation of knowledge*, due to the large variety of alternative uses of knowledge itself that are accessible through the transnational network (Grandinetti and Rullani 1996). It is worth noting that units active in small sized markets have greater incentives to contribute to the internal network, than subsidiaries with large markets (Zanfei 2000). In fact, subsidiaries with small markets would never attain economies of scale in the accumulation of context-specific capabilities, if they could not generalise it and transfer at least part of their knowledge through the network (whereas subsidiaries with larger markets could attain greater returns on their investments thanks to their local sales).

1.7. Multinationals as bridging institutions

The evolution of MNF towards a *double network structure* entails that they increasingly act as *bridging institutions* connecting a number of geographically dispersed economic and innovation systems. In fact, each of the external actors with which MNFs are interconnected across countries are themselves involved in extensive webs of relationships with other firms and institutions. Therefore, MNFs are embedded in sectoral, regional and national contexts whose characteristics and evolution affect, and are influenced by, their behaviour and performances. From this perspective, multinationals are not the quasi-colonial institutions exporting technological and organisational standards from the home to the host country, as described by Vernon (1966, 1971) and Stopford and Wells (1972). Instead, they can play a role in leveraging upon each system's peculiarities, through a process of search, recombination and exploitation of assets. Admittedly, MNFs are likely to impact on the economic environment where they operate, but not in the unidirectional way that was described in the classic contributions of the 1960s and early 1970s. To the extent that MNFs increasingly act as bridging institutions, they are more and more exposed

to the inertial constraints and to the pressures for change characterising each of the economic and innovative systems which they connect.

On the one hand, there are some system-wide inertial forces which may put a brake on the MNF's deployment of global asset exploiting and asset seeking strategies. Differences in natural factor endowments, in the organisation and specialisation of industries, in the national stocks of knowledge, and in national economic and political institutions seem to create important impediments to the cross-border integration of innovation systems (Foray 1995, Noisi and Bellon 1996, Gregersen and Johnson 1997). Developing linkages with external networks of local counterparts may be expensive and time consuming, as compared with the low costs of maintaining the integration with the innovation system in the home location (Narula 2003, Carlsson 2003). Linkages with firms and institutions are both formal and informal, and may take years to create and sustain. Government funding institutions, suppliers, university professors, private research teams, informal networks of like-minded researchers take considerable effort to create, and once developed, have a low marginal cost of maintaining. Even where the host location is potentially superior to the home location - and where previous experience exists in terms of other value adding activities - the high costs of becoming familiar with, and integrating into, a new location may be prohibitive. This cost constraint is particularly binding in the case of R&D FDI decisions (Narula and Zanfei 2005). Firms are constrained by resource limitations, and by the need to reach some minimum threshold size of R&D activities in every distinct location. As such, to maintain more than one facility with a threshold level of researchers means that the new (host) location must offer significantly superior spillover opportunities accruing to the MNF. In other words, the host location must provide access to complementary resources that are simply not available anywhere else, and which cannot be acquired by less risky means and more efficiently. The high costs associated with integrating into the host location's systems of innovation - in contrast to the low marginal cost of maintaining its embeddedness in its home location's innovation system - may thus increase the fixed costs firms have to overcome in order to expand internationally.

On the other hand, some of the constraints at work at the home system level may also act as key inducing mechanisms for firms to internationalise their own activities, including R&D facilities. Institutional bottlenecks and resource shortages can be expected to stimulate a creative reaction, inducing firms to look for market or

technological opportunities abroad. The role of FDIs as a creative response to resource scarcities has been emphasised by Franko (1976) in the case of European firms, and by Ozawa (1979) with reference to Japanese multinationals. The impact of institutional characteristics and constraints as a determinant of the internationalisation of innovative activities has been examined by Zanfei (1993) with reference to the US telecommunications industry, by Mowery (1988) for the US aircraft industry, and by Lam (1997) for the Japanese and UK electronics industry. See Castellani and Zanfei (2006, ch4) for a more extensive discussion of internationalisation processes induced by economic and institutional constraints.

Narula (2003) provides a stimulating analysis of the ambivalent role of the inertia of innovation systems and of how firms may be influenced in their internationalisation decisions. He observes that national innovation systems and industrial and technological specialisation of countries change only very gradually, and – especially in newer, rapidly evolving sectors - much slower than the technological needs of firms. In other words, there may be *systemic* inertia. When innovation systems cannot respond to a technological discontinuity, or a radical innovation that has occurred elsewhere, there is a mismatch between what home locations can provide and what firms require, this gives rise to a sub-optimal lock-in. Firms are induced to respond to this inertia, but their response is itself conditioned by their own resource endowments and by their degree of embeddedness in the home innovation system. Using Hirschman's terminology, Narula (2003) suggests that firms will choose among three different possible options: exit, voice and loyalty. They may venture abroad and seek to internalise aspects of other countries' innovation systems, thereby utilising an 'exit' strategy. Of course, firms rarely exit completely, preferring often to maintain both domestic and foreign presence simultaneously. There are costs associated with an exit strategy, reflecting the characteristics and constraints of their innovation systems of origin and the costs of integrating into a foreign innovation system, as mentioned earlier. Firms may minimise these costs by importing the technology they need from abroad if a market for it exists, or through a cooperative strategy with a local firm if tacit components of knowledge prevail. Firms could also follow a second alternative. They can use a 'voice' strategy aimed at modifying the home-country innovation system. For instance, establishing a collective R&D facility, or by political lobbying. Firms are inclined towards voice strategies, because it may have lower costs than exit. But voice strategies also have costs, and may not be

realistic for SMEs, which have limited resources and political clout. Such firms usually cannot afford an ‘exit’ strategy either. They will end up utilising a third alternative, a ‘loyalty’ strategy, relying instead on institutions to evolve, or seeking to free-ride on the voice strategy of industry collectives, or larger firms.

The discussion above highlights that multinationals will significantly differ according to the characteristics and evolution of their system of origin, to the response they are able to give to constraints and stimuli deriving from it, and to the opportunities they will capture through their contacts with foreign innovation systems. Relative to less internationalised firms, MNFs will be in a position to gain access to a larger variety of stimuli and opportunities generated by the different innovation systems (of origin and destination) in which they are active. They will also have a greater possibility to contribute to the evolution of their own system of origin, and of the foreign systems in which they are active. Their actual impact on the recipient economy will depend *inter alia* on the level of economic development of both the home and the host countries, and particularly on the strengths and weaknesses of firms and institutions characterising the national innovation systems of origin and destination¹⁵. It will also depend on the strengths and weaknesses of other countries in which the MNF is active, whose characteristics can be absorbed and transmitted to each of the systems it connects.

Furthermore, as they increase their degree of internationalisation, multinationals will be able to respond to constraints and stimuli stemming from their own systems of origin and of destination using a wider variety of alternative strategies. Referring back to Hirschman’s taxonomy used by Narula, MNFs will have the possibility of spanning from exit, to voice and loyalty in each of the contexts in which they are active. Moreover, they will be able to reinforce voice strategies by using the credible threat of exiting at a lower cost than most local counterparts. The larger the number of innovation systems they are bridging, and the more these systems have technological stimuli and opportunities to offer, the wider the span and quality of assets they can gain access to; and the greater will be the spillovers which will potentially accrue to host economies as well. MNFs will thus differ significantly

¹⁵ A weak manufacturing industry coupled with underdeveloped infrastructures and institutional setting in the host country, which is often the case of LDCs, may be detrimental even in the presence of innovative multinationals originating from highly developed economic and innovation system: “There will be little or no impact on developing countries that lack the basic production and adaptive capabilities needed for new product development” Unctad (2005 p.180).

in terms of the number and quality of economic and innovation systems they connect, and they will deal with heterogeneous firms and institutions in each of the countries in which they do business. From this perspective, the extent to which knowledge advantages will actually accrue to MNEs and to host economies will largely depend on the interactions between heterogeneous agents.

1.8. Concluding remarks

This paper has provided a general framework for the analysis of the links between innovation and international production. We have suggested that there are a number of ways of looking at these links, the most popular of which is to focus on the globalisation of technology. The latter view captures only part of the issue. In fact, innovation has a much more pervasive role in internationalisation processes. On the one hand, it is one of the most important engines of international production. On the other hand, international operations may result into technological opportunities and into the access of new sources of knowledge. Having adopted this broader view of the innovation-internationalisation links, we discussed the increasingly used distinction between asset exploiting and asset seeking international activities. We have provided arguments and evidence to support the increasing importance of the latter, i.e. strategies aiming to augment firms' technological advantages. We have also suggested that the growing recourse to asset seeking strategies, combined with more traditional asset exploiting activities, goes hand in hand with the transition of MNEs towards what we dubbed as a *double network structure*. Focussing on the changing organisation of innovative activities across national borders, we have submitted that multinational firms have growing incentives to expand both their internal networks of subsidiaries and research centers, and their external networks of relationships with local firms and institutions. In fact, the two networks play a crucial and complementary role in the generation and use of knowledge, and hence in determining the evolution of competitive advantages of multinationals. Internal networks are needed to take roots in local contexts, learn about local institutions and knowledge sources, and increase the capacity of firms to explore and use technological opportunities. External networks are the vehicles through which such exploration potentials can be fully utilised to gain access to complementary assets, especially in industries characterised by a high degree of dynamic competition. To the extent that

multinationals increase their embeddedness in different local contexts by means of both internal and external networks, they accentuate their natural role as *bridging institutions*: MNFs increasingly connect geographically dispersed innovation systems, being conditioned by, and contributing to, their characteristics and evolution. Using this conceptualisation we are enabled to extend our view to a more general level. In fact, asset seeking strategies can be interpreted as a process through which MNFs, expanding their internal and external networks, are not only able to rely on complementary assets supplied by firms and institutions directly interacting with them. They can also indirectly take advantage of the competencies which their local counterparts are able to draw from, by means of their own local and international relationships.

From this perspective, one can thus envisage a cumulative relationship between international production and innovation, wherein MNFs contribute to connecting, contaminating and cross-fertilising different innovation systems. By so doing, multinationals will themselves gain access to largely distinct competitive assets. Therefore, MNFS will create intra-industry diversity both directly, through their own, distinctive contribution to innovation and economic performances of the economies in which they active; and indirectly, through spillover effects.

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