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Patterns of Multinationals' Technological Strategies in Emerging Economies: Evidences from Brazil and India

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Patterns of multinationals' technological strategies in emerging economies: evidences from Brazil and India[*]

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Abstract

A key factor behind a country's ability to attract knowledge-based foreign Investment is an institutional context oriented towards innovation. The development of such a context is not an easy task though: it requires not only an advanced domestic knowledge base, but also a policy and a management framework that can integrate local and foreign assets in the host-country innovation system. This is a challenging task for emerging economies, especially given that they have increasingly experienced erosion of their locale-specific technological advantages after liberalization of their economies. Hence there is a strong need to re-design strategies for catch-up, oriented towards combining interests of local and foreign business. This paper aims to contribute to the design of such new strategies by identifying Innovation Practices (IPs) of Multinational Enterprises (MNEs) affiliates in Brazil and India. Multivariate analysis techniques applied in more than 1000 manufacturing foreign-owned firms in Brazil and India shows significant differences in knowledge-based assets-seeking strategies by MNE affiliates, which reflect a heterogeneity of IPs in MNE affiliates across-countries. The results suggest MNEs have different levels of involvement with local innovation systems in Brazil and India. Such heterogeneity in assets-seeking MNEs behaviour combined with different country-specific competencies in attracting more-knowledge intensive foreign investments have created different opportunities for these countries to be inserted in the global value-chain.

Keywords: multinationals, learning economy, assets-seeking strategies, knowledge management, innovation capacity, technological capabilities, emerging economies

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INTRODUCTION

Multinational Enterprises (MNEs) – the main engines of innovation in the world economy – have traditionally tended to confine their technological activities in their home countries, located in the 'triad' - United States, Europe and Japan (PATEL and PAVITT, 1992, 1998; PAPANASTASSIOU and PEARCE, 1999; KUMAR, 2001). In such countries, they intermingled their firm specific assets – such as finance, technology and human capital, with location specific immobile and 'less fluid' assets, like host country infra-structure and tacit knowledge to create innovation capabilities. (LALL, 2002)

Prior to the mid-1970s, one of the reasons stated by MNEs for not internationalizing R&D beyond the triad was the difficulties involved with the supervision and control (MANSFIELD, 1974), possible scale economies in R&D (CAVES, 1996) and higher appropriability of R&D efforts at home (GRANSTRAND et al 1993, KUROKAWA et al, 2007). However rapid technological change and growing inter-relatedness between formerly disparate technologies (CANTWELL and PISCITELLO, 2000) coupled with a greater market orientation in firm level R&D have tilted companies to consider a more decentralized pattern (DUNNING and NARULA, 2000).

Viewed from the supply side requirements, the ability to tap into pools of scientific laboratories and low cost research bases are key elements behind globalization of R&D (viz HOECHST, DUNNING 1988:128). By dividing finely their global value creating activities into optimum locations (BUCKLEY and GHAURI, 2004) – elsewhere called "the slicing and dicing of the global value chain" (RAMAMURTI, 2001) – MNEs are integrating their firm-specific advantages with host-country specific advantages to create innovation capabilities.[1]

[1] DAHLMAN (2007) has precisely summarized the main recent changes in MNE's organization structure. According to the author, "Production, distribution, and supply chains have become more integrated globally even as production has become more fragmented across countries." (p.61)

More recently however, new Information and Communication Technologies (ICT) have significantly increased the scope for global sourcing (BRENNER, 2007) of technologies even from developing countries, which are rapidly inserting themselves into the global innovation system (UNCTAD, 2005). MNEs have thus started locating some of their strategic R&D in some developing countries. High cost factors, shortage of R&D personnel in the most developed countries[2] and the increasing demand for talents (REDDY, 1994) are contributing to this trend. Last, but not the least, the recent allocation of R&D to emerging markets is facilitated by the availability of large cadres of research personnel at substantially lower wages and adequate infrastructure in these countries.[3]

A select group of emerging countries appear to be more successful in attracting more knowledge-intensive activities from MNEs (LALL and ALBADEJO, 2002). After China, Brazil and India have showed large potential in drawing R&D from overseas. In the case of Brazil, the main drivers of R&D internationalization seem to be the already significant amount of existing MNE affiliates established in the country since the beginning of its industrialization period,[4] and the large presence of skilled engineers in the most competitive industrial segments of the Brazilian economy, such as machinery, auto-parts, automobile and chemical industries. (GOMES et al, 2007) Furthermore, in comparison to their Brazilian congeners, MNEs affiliates in Brazil have demonstrated higher innovation performance and R&D efforts (MATESCO, 2000; QUADROS et al, 2001).

For **India** IT services and pharmaceuticals sectors have attracted much technology-intensive activities from MNEs (REDDY, 1997; RAY, 2005). The abundance of low-cost

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[2] The Science and Technology Agency in Japan estimated that by 2050 there will be a shortage of some 480,000 researchers in Japan. This will be about half of the estimated requirement for R&D personnel by that year (SWINBANKS, 1992, pp. 34).

[3] For example, GRANSTRADT (1992) estimated that costs of performing R&D in India are only about a tenth of that prevailing in the OECD. (p.10)

[4] According to the Brazilian Society of Transnational Corporations and Economic Development (SOBEET), more than 80% of the largest multinational companies in the Fortune 500 list have been operating in Brazil.

talented engineers and fluent English speaking programmers seems to be an essential local "centripetal force" (DUNNING and NARULA, 1995) to attract R&D from MNEs. In fact, the mass of skilled human resources in India is becoming even more valuable with the expansion of global offshoring/outsourcing networks.[5]

However not much is known about the unique knowledge creating inputs and practices adopted by MNE affiliates in emerging economies to exploit location specific innovation opportunities that exist there. Little is known about precisely how emerging countries compete with each other, as well as with developed countries in order to attract R&D investments by MNEs (RAY, 2005). Thus far, most of the extant literature has focused on MNEs in China and their role in transferring technology to their Chinese subsidiaries. In contrast, little information exists about what actual inflows of technology has been taking place in Brazil and India, or what role policymakers should be playing in stimulating foreign investment.

This is surprising, given that both Brazil and India have attracted large amounts of Foreign Direct Investment (FDI) specialy in their post-liberalization periods. Both countries have large markets, and both pursued an import substituting industrialization strategy prior to liberalization. Yet despite these similarities, there are many differences in their institutional contexts and national innovation systems. These differences spawn distinctive technological capabilities and industrial specializations in the two countries, which then determine their unique location-specific advantages. Such host country factors have significant impact on the MNE's ability to "internalize externalities" (DUNNING, 1993) of host bases and hence are likely to influence their investment decision.

This critical gap in the literature motivates us to ask some germane questions: what kind of innovation practices are emerging in the two countries; what knowledge resources are drawn from and brought into them, and how are these combined to create new technologies?

[5] According to WIR (2004), as much as 60% of offshored IT-enabled services take place within MNEs, which are increasingly providing services and creating links with highly capable local firms.

Finally, we also ask what are the different factors that explain convergence or divergence in IPs of MNE-affiliates across the two emerging countries?

In short, our research objective is to compare and contrast Innovation Practices (IPs) of MNE affiliates in Brazil and India so as to determine how these firms are building absorptive capacity by combining different streams of local and foreign knowledge. Identifying what factors shape knowledge linkages between MNEs' affiliates and national innovation systems or *which country specific assets are being endogenized with firm specific assets and why* is important especially for two reasons: first, this would have implications for policymakers in the two countries insofar as how they might calibrate incentive mechanisms and direct MNE's knowledge flows into higher value added activities (see LALL, 2002); and second, a more precise knowledge about the costs and benefits of different kinds of knowledge linkages between foreign and local suppliers in two specific emerging economies would enable MNEs in question to position themselves better in the transnational network of knowledge creation.

Above all, it provides new insights distinct from those obtained in developed countries where most studies have been conducted thus far – uncovering as yet unrealized phenomena. We believe our paper is a novel contribution in this sense and what is more, the richness of data we present makes the analysis particularly useful.

BACKGROUND

Foreign innovation systems give firms access to a wider range of solutions to technological problems to enhance their innovative capability (BARTHOLOMEW, 1997). MNE subsidiaries performing value adding activities embedded in the host countries' national innovation systems can tap into local fields of expertise, and provide a further source of new technology that can be utilized in MNEs' global operations (RUGMAN and

VERBEKE, 2001). According to DUNNING's OLI eclectic paradigm, MNEs are drawn to perform value adding activities in host countries to internalize the location specific spillovers and create new firm-specific advantages specific to that market or other foreign markets (DUNNING, 1998).

Technology-seeking FDI— which is motivated by a desire to source or seek external foreign knowledge (DUNNING and NARULA, 1995; KUMMERLE, 1999; LE BAS and SIERRA, 2002) – captures knowledge spillovers from firms and other institutions in host countries in which they invest. Nowhere is this more common in the R&D-intensive industries such as biotechnology, software and computers, which tend to be highly concentrated spatially. This is due in large measure to their nature of knowledge: often tacit and idiosyncratic, and difficult to transfer. Moreover, knowledge spillovers are mostly local and not international. Close geographic proximity and good connectivity with technology suppliers are required for successful spillovers to take place (CARLSSON, 2006). Such supply factors can vary substantially between country to country and the presence of additional contextual variables like industry factors, age and size of firms can also influence the nature of technological activities of MNEs (DUNNING, 1998).

It is therefore natural to expect IPs of MNEs will vary substantially across countries in line with differences in institutional and firm-specific variables.

Country factors guiding IPs of MNEs

Countries evolve differently in their trajectories of development and in their institutional framework and policy stance. Such differences are likely to shape dissimilar patterns of IPs responses from MNEs. Each developing country has "different natural factor endowments, path dependent effects of industrial organization and specialization, different national stocks of knowledge, different national economic and political institutions" (NIOSI and BELLON, 1996, p. 156).

Elsewhere PAVITT (1998) argues the national science base is socially constructed: it is influenced by the country's level of economic development and the composition of its economic and social activities. Thus, the main hypothesis behind this study is that host countries, in general, and emerging host-economies, in particular, are not passive entities in the process of FDI attraction and absorption of foreign technology. Even for late industrializing countries like India and Brazil, considered knowledge–users, rather than knowledge/technology-creators, MNEs have presented a diversity of strategies to access and create knowledge-based assets for innovation. Such heterogeneous innovation-oriented practices have created different levels of MNEs involvement with local productive and innovation systems.

It is plausible that such diversity occurs due to 'imperfections' related to knowledge absorption processes, which involves substantial costs, uncertainty and investments in learning capacity. (KATZ, 1985; LALL, 1992) Moreover, most part of the knowledge can not be replicated or transferred because of its tacit component, mostly emanate from **informal** Research and Development (R&D) activities of learning-by doing or learning-by interacting (BELL, 1985; JONHSON and LUDVALL, 2000) So, emerging economies have been essentially benefited from these **indirect mechanisms of learning and knowledge creation**, **specially involving embodied technology acquisition in the form of capital goods**. (STEWART, 1990)

Recent empirical studies have confirmed the existence of different kinds and levels of local technological capabilities in MNEs affiliates located in these emergent economies (FU and GONG, 2008; ARIFFIN and FIQUEIREDO, 2003; REDDY, 1997). Often the cost of some factors with similar or even superior quality is cheaper than MNEs specific array of assets. This motivates MNEs to insert such domestic advantages into the value chain for competency creating purposes. Besides the existence of local-specific strategic assets, another key-factor which encourages FDI and R&D-oriented FDI in particular is the industrial structure of the host-countries. In fact, industrial policy and economic architecture not only shapes technological capabilities in a given country, but also influences the connections of its local production and innovation systems with the global (multinational) value chain activities.

LALL (2004) distinguished four broad stances in industrial strategy. The first is autonomous (building technological capabilities indigenously while restricting FDI) as in Korea and Taiwan. The second is ‘strategic FDI dependent’ (relying heavily on FDI but using industrial policy extensively to induce it to deepen into advanced activities and linkages) as in Singapore. The third is ‘passive FDI dependent’ (FDI dependent but without industrial policy to deepen technological structure) as in Hong Kong. The fourth is ‘ISI restructuring’ (inducing domestic market oriented activities to restructure for export markets) as in China (ibdem, p 4). In the latter mode in particular, MNEs are guided by such restrictions like local content policy (content protection), phased indigenization programs, trade and tariff restrictions which compel them to substitute imports with local content.

India and **Brazil** started out with an autonomous policy of industrialization and still harbour a somewhat ambivalent attitude towards FDI. Indeed there are several restrictions continuing. Both countries are also evolving strong capabilities in some sectors such as chemicals and pharmaceuticals, heavy industries, and software and telecommunication that draw on their past investments in public research and training infrastructure consisting of svarious scientific and technological institutions.. For India in particular, these centers have built up substantial capabilities over the past 50 years due to government support (RAY, 2005).

Today much of the available advanced factors of innovation that MNEs are drawing on emerge from these local institutions and country factors. They have presented great potential to be mixed with MNEs' firm specific assets in order to create competitive advantage to cater to markets in Brazil and India as well as in other developing countries.

EMPIRICAL STUDY: IDENTIFYING IPs OF MNEs AFFILIATES IN BRAZIL AND INDIA

We argue that differences in MNE IPs between countries arise due to the nature of country and firm specific factors, and how both entities (country and MNE) have interacted with each other in the past in order to use, create and assimilate knowledge-based assets oriented to innovation. Such assets can be a) internally developed by the firm via learning by doing, internal R&D, training and hiring of skilled personal, management skills, and/or b) acquired externally, via licensing, patents, know-how, technical assistance, capital goods, contracting extramural R&D, scientific and technological collaboration, joint-ventures. (SMITH and WEST, 2005).

Furthermore, innovation inputs may represent different types of knowledge, which arise depending on its form (embodied or disembodied) and the strategy by which it was obtained by the firm (externally acquired or internally created). Accordingly, knowledge may be essentially of three different types: a) acquired disembodied (e.g., patents, licenses etc.), b) acquired embodied (eg. capital equipment, software) and c) internally created (codified and tacit knowledge). Firms may differ in how they combine their innovation inputs which give rise to different technological strategies or Innovation Practices (IPs).

We define IPs based on PENROSE (1959) and CHANDLER (1990), who emphasize the role of knowledge-based assets and firm-management skills in production diversification for firm-sustainable growth. Therefore, a firm's <u>IPs may be defined as the activities involved</u>

in combining its technological assets which contribute to the firm's innovative capacity. Such activities include the management of key resources for innovation, such as qualified personnel, teams, processes, physical and financial capital, problem solving, responding to uncertainty, and control of risks oriented to the innovation process.

Therefore, on the premise of the resource-based approach, we can suppose MNEs are not 'a monolithic block'. On the contrary, their IPs can differ significantly a) across countries, depending on the nature and extent of differences in the institutional environment they face in each host country and b) within a country due different paths of technological capabilities across industrial segments (BELL and PAVITT, 1993; 1995) and firm specific factors, such as size, age and technological mandates.

METHODOLOGY

In order to test the propositions mentioned above, we used a combination of descriptive statistics methods, i.e., *Factor Analysis* (FA) and the Answer Tree Technique (ATT). FA is a correlation technique, which provides the best combinations between a set of variables; the model also reduces the variables in a smaller number of factors, which will represent the highest variance between the original data. The factors will show the predominant IPs in the sample of foreign firms selected from Brazilian and Indian database. The concept behind the factor analysis application is that innovation process manifests in different ways across firms, since they need different combinations of tangible and intangible assets to innovate, which in turn indicates differences in the strategy of combining external and internal technologies as well as differences in the type of subsidiary mandates.

The ATT will test the reliability of two variables, sector and age in predicting the IP of firms. This technique will compose sub-groups of population for each predictor selected, based on a chi-square distribution (CHAID). In other words, the segmentation tree will classify predictors and sub-groups of firms according to the most statistically significant differences between predictors and within categories of each predictor. So, the tree 'grows' as long as the 'null hypothesis' of independence between predictors is rejected. We give the application of both statistical methods which orients this study – that is, the diversity of IPs within the block of foreign firms; the influence of selected predictors on IPs: and differences in MNE innovation practices across countries.

Before processing data in FA, normalization effort was required, as the variables presented large standard deviations in their distribution. The high level of asymmetry occurred due to the large number of firms with values near to "zero", on the one hand, and a small number of firms with high values, on the other. In order to tackle this problem, the original variables of expenses in technology were weighted by the net revenue[6] of the firm. The weights cover two strategies. One is analytical, providing a proxy for the intensity of expenses with embodied and disembodied technology (by variables of royalties and capital good acquisitions, respectively), as well as, intensity of internal technological effort (based on R&D variable). The second is statistical, reducing the dispersion coefficients of the variables and preserving the relation between them. After the 5 innovation inputs were weighted, FA were applied in each sample.

The variables

The variables which represent innovation inputs and the sample of MNE's affiliates have been extracted from 2001 *Brazilian and Indian databases*, whose financial information are based on standard accounting procedures used by firms for measuring of economic activities.

[6] The best weight in this case should be the total cost of the firm with technology acquisition, but such information was not provided by the PAEP.

Table 1 – Variables which represent innovation-inputs, type of knowledge represented and measures

Innovation Inputs	**Type of knowledge**	**Measure**
1. Local royalty spending for technical assistance	intangible; codified-knowledge acquisition	Local Royalty/Sales
2. Foreign royalty spending for technical assistance	intangible; codified-knowledge acquisition	Foreign Royalty/Sales
3. Internal Research and Development (R&D)	intangible; tacit and codified-knowledge creation	R&D/Sales
4. Local acquisition of machine and equipment	tangible; knowledge embodied in capital goods	Local Capital Equipment/Sales
5. Foreign acquisition of machine and equipment	tangible; knowledge embodied in capital goods	Foreign Capital Equipment/Sales

Sources: Brazilian database (SEADE/PAEP/2001); Indian database (2001)

Variables **1** and **2** represent MNE purchase of "codified or disembodied technology", while variables **4** and **5** are a proxy for purchases of "capital goods or embodied technology". (HAQUE I. et al, 1995; p.72). In other words, variables 1, 2, 4 and 5 express distinct kinds of efforts expended by firms in acquiring external technologies (AGGARWAL A., 2002; p.124). In general terms, the non-formal technology transfer by acquisition of capital goods has the advantage of low cost of implementation vis-à-vis purchasing of some disembodied technology, especially patents and know-how licensing, which are required when the technology in question is more complex and tacit. (KIM et el, 1999; p.95). Variable **3** represents the endogenous effort of the firm in technological learning by way of expenses in highly-skilled human capital. It covers R&D efforts expended to gain systemic knowledge, as well as occasional product and process engineering activities. This variable might be considered a proxy for tacit technological learning, expressed in skills, experience and knowledge acquired by human resources in their intra and inter-firm linkages and with other institutions. (BELL and PAVITT, 1993; 1995; FIGUEIREDO, 2002)

Firms which strike linkages at different stages of the value chain with local and foreign suppliers of knowledge are ‘related complimentary’ while firms that strike horizontal linkages, i.e. for the same technologies are ‘related supplementary’ (SALTER and WEINGOLD, 1979; SEN and EGELHOFF, 2000). The factor analysis will reveal which type of MNEs follow either of these two strategies through examining the interaction between 5 innovation inputs used by MNEs. Subsequent to determining the diversity in firms in terms of their IP or technological choices, we will further examine the reliability of two exogenous variables such as sector and age in predicting the IPs of firms.

The predictors inserted in Answer Tree segmentation model, which will explain the IPs (dependent variables) are the following:

1. *SECTOR* is represented by 2 digit level of ISIC or NIC codes: empirical studies suggest technological nature and degrees of knowledge embodied in production and innovation activities varies by industry;

2. *AGE* is represented by year of firm’s constitution, which is an indicator of learning ‘path-dependence’: as the literature suggests, innovation is cumulative, so the ‘older’ the firm is, the higher might be its knowledge capacity building.

The sample of foreign firms

For analyzing IPs of MNE’s affiliates in Brazil and India, this study takes advantage of two databases: PAEP (*Pesquisa da Atividade Econômica Paulista*) and *Prowess*. PAEP is produced by Foundation SEADE (*Sistema Estadual de Análise de Dados*),[7] while *Prowess* is supplied by the Centre for Monitoring the Indian Economy, India.

The Brazilian economic survey was conducted among 11.000 industrial firms (with data referring to 2001) in the State of São Paulo. For the purpose of our analysis, a sub-

[7] Fundação SEADE is the government agency for the production of statistics in the state of São Paulo.

sample of the PAEP database was preliminarily selected. This has included the set of firms either wholly or partially controlled by foreign capital, hereafter named MNEs affiliates. The sub-sample comprises 689 MNEs affiliates located in the state of São Paulo, which represent approximately 1100 enterprises with foreign ownership operating in the state in 2001. This state is extremely representative in terms of FDI participation, accounting for 70% of all MNEs affiliates in Brazil. Further, it is the most important economic and technological region of the country, concentrating approximately 50% of the Brazilian industrial value-added and employment, and 70% of industrial R&D. (PAER, 2002)

The Indian dataset was constructed from the Prowess version 2.5 database, which contains cross-sectional information at the level of firms, both domestic and foreign affiliates, and classified by industry, age, equity holding information and the like. The database consists of 10.029 companies in all industries; from this population, a sub-sample of 545 MNE-affiliates which had 10% or more foreign ownership (as per IMF norms) was selected. The industries to which these MNEs belonged, were all manufacturing based, so as to ensure country comparison was taking place on equal lines.

Notwithstanding the fact that the population of MNE's affiliates in Brazil and India comprise less than 3% and 10%, respectively of the total manufacturing firms, their significant economic participation can be seen in the largest sectors of Brazilian and Indian industry, such as motor vehicles, chemicals and pharmaceutical and food products and beverages:

Table 2 - Sample of MNE's affiliates in Brazil and India
2001

Manufacturing activities	Brazil		India	
	No. of firms	% sales	No. of firms	% sales
Mineral and Oil Extraction	2	0%	12	0%
Food products and beverage	52	12%	42	8%
Textiles	17	1%	40	2%
Clothing	2	0%	6	0%
Leather products and footwear	4	0%	3	1%
Pulp and paper	13	3%	11	1%
Publishing, printing and recorded media	19	1%	2	0%
Oil refining and alcohol	3	0%	4	7%
Chemicals and pharmaceuticals	125	17%	123	25%
Rubber and plastic products	58	4%	39	4%
Non-metallic mineral products	14	1%	24	2%
Basic metals	19	3%	48	12%
Metals products	45	3%	11	1%
Mechanical machinery	133	10%	59	6%
Computers and office machines	5	0%	6	0%
Electrical machinery	48	5%	22	5%
Electronics material and telecom	21	8%	27	3%
Instruments and automations equipment	15	1%	6	0%
Motor vehicles	63	29%	42	13%
Other transport (aircraft and rail equipment)	7	0%	7	3%
Others (tobacco/furniture/wood products etc.)	24	1%	11	8%
Total	689	100%	545	100%

Sources: SEADE/CMIE

EMPIRICAL RESULTS

Table 3 compares the percentage of MNEs' subsidiaries in India and Brazil in terms of their use of innovation inputs. Although developing countries are generally believed to be intensive users of foreign technologies, the data shows that less than 50% of MNE subsidiaries depend on foreign sources of embodied and disembodied technologies. This suggests that MNE affiliates in these two countries rely more on local innovation inputs than those sourced from overseas. In terms of the type of knowledge inputs employed, a greater percentage of MNEs in both countries appear to rely on embodied (capital goods) rather than disembodied (i.e. royalties and technical assistance) forms of knowledge inputs. <u>This implies</u>

that process rather than product innovations are important to compete in these emerging economies.

More importantly, local rather than foreign suppliers of capital equipment appear to play a predominant role in providing innovation inputs in both countries. These results lend support to an earlier innovation survey by Mani (2008) which suggests that MNEs in both countries have strong linkages with local suppliers for acquisition of embodied technology such as machines and equipments.

Table 3 - % of MNE's affiliates investing in innovation inputs
Brazil and India, 2001

	% of diffusion (1)	
Innovation inputs	Brazil	India
Local Royalties and technical assistance payments	5.7	27.9
Imported Royalties and technical assistance payments	11.9	27.0
Local Machines and equipments acquisition	67.8	76.9
Imported Machines and equipments acquisition	30.9	45.3
Internal R&D activity (2)	45.6	30.6

(1) The percentage corresponds to the frequency of foreign firms which had expenses with any kind of the innovation inputs above in 2001;

(2) For Brazil the indicator of internal R&D activity used for this proposal was 'number of internal R&D personal'

Despite these similarities, there appears to be large differences between MNEs in these two countries in their use of types of knowledge inputs. Relative to Brazilian counterparts, a larger percentage of affiliates in India depend on externally acquired knowledge, both disembodied and embodied, suggesting that MNE linkages with the local innovation system are deeper and more widespread. In contrast, a larger percentage of Brazilian subsidiaries are involved in internal knowledge creation through R&D activities (45.6%) relative to Indian subsidiaries (30.6%). We next report the results from factor analysis, which captures the predominant innovation practices (IPs), i.e., combination of innovation inputs prevalent in MNE-affiliates in India and Brazil.

The main results are summarized as the following:

Table 4 – Components extracted from factor analysis, which represent the main interactions between technological inputs selected

Technological inputs selected	Brazil			India		
	1	2	3	1	2	3
Local royalties (patents, trademarks, know-how, technical assistance)	**0.831**	0.084	0.019	**0.763**	0.265	-0.001
Imported royalties (patents, trademarks, know-how, technical assistance)	**0.818**	-0.052	0.039	0.290	**0.665**	-0.162
Local capital goods (machines and equipments)	0.085	**0.801**	0.013	0.045	0.003	**0.978**
Imported capital goods	-0.053	**0.786**	-0.013	-0.196	**0.735**	0.133
Internal R&D expenses	0.046	0.000	**0.999**	**0.758**	-0.203	0.045
Innovation Practice	**IP1**	**IP2**	**IP3**	**IP4**	**IP5**	**IP6**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The factor analysis identified 3 pre-dominant categories of IPs, i.e., 3 combinations of innovation inputs each for MNE-affiliates in Brazil and in India respectively. Among MNEs in Brazil, the three main IP categories labeled as IP1, IP2 and IP3 comprise of the following combinations of innovation inputs:

- **IP 1**: innovation practice of firms in this category mainly relies on combining externally acquired **disembodied technology** (measured by royalties paid) from both local (L) and foreign (F) sources. This IP essentially reflects combining two similar types of knowledge assets *horizontally*, both of which are *disembodied* . In this category firms are acquiring related **supplementary assets** from both local and foreign **(L+F)** sources.

- IP 2: innovation practice of firms in this category mainly relies on combining externally acquired **embodied technology** (measured by spending on capital equipment) from both local (L) and foreign (F) sources. This IP essentially reflects combining two similar types of knowledge assets *horizontally*, both of which are *embodied***.** Like in IP1, firms in this category (IP2) are also acquiring related **supplementary assets** from both local and foreign **(L+F)** sources.

- **IP 3**: innovation practice of firms in this category mainly relies on a internally created **tacit knowledge** through in-house **R&D**.

In the case of MNE in India, the three main IP categories labeled as IP4, IP5 and IP6 comprise of the following combinations of innovation inputs:

- **IP 4**: innovation practice of firms in this category mainly relies on combining externally acquired **disembodied technology** from local sources (measured by local royalties paid) with internally created **tacit knowledge** through in-house **R&D.** This IP essentially reflects combining two different types of knowledge assets *vertically*, disembodied with tacit, indicating a combination of "c**omplimentary" assets;**
- **IP 5**: innovation practice of firms in this category mainly relies on combining externally acquired **embodied technology** (measured by imported capital equipment) with externally acquired **disembodied technology** (measured by imported royalty). This IP essentially reflects combining two different types of knowledge assets *vertically*, embodied with disembodied, indicating a combination of "c**omplimentary" assets** both from foreign sources **(F+F);**
- **IP 6**: innovation practice of firms in this category mainly relies on a externally acquired **embodied technology** from local **(L)** sources.

Finally the influence of industrial sector and age of the firm in predicting IP was determined by using the Answer Tree Technique (ATT). The results of this analysis (Table 5) show that the industrial sector to which the firm belongs is highly predictive of innovation practices in both countries. However in the case of Brazil, the *age* of the firm also appears to be highly predictive of firm IP involving internally created knowledge.

Table 5 - Main Results of Factor Analysis (FA) and Answer Tree (AT)
Manufacturing sector
2001

Country	Main correlations from FA	% Variance in FA	Name of the factor (Innovation orientations)	Main predictor in AT	Best representative group of firms for AT (node; mean-score)	Second predictor
BRAZIL (no.of foreign firms=689)	Local (L) and Imported (F) royalties	28%	**Acquired (L+F) disembodied technology**	Sector	pulp and paper; publishing and printer; computers and office materials; electronic and telecom. (node 1; mean-score=0.75; % of firms=7,4)	-
	Local (L) and Imported (F) capital goods investments	25%	**Acquired (L+F) embodied technology**	Sector	Mineral and oil extraction; food and beverages; textile; pulp and paper; rubber and plastic; basic metals; computer and office materials; motor vehicles; other transport (node 2; mean-score=0.2; % of firms=31%)	-
	Internal R&D	20%	**Internally created knowledge**	Age	1930 > year of constitution >=1970 (node 3; mean-score=0.2; % of firms=22%)	-
INDIA (no. of foreign firms=532)	Local (L) royalties and internal R&D	26%	**Complimentary (L) technology (internal plus acquired disembodied)**	Sector	mineral and oil extraction; publishing and printing; non-electrical machinery; computers and office materials; motor vehicles (node 1; mean-score=0.4; % of firms=23%)	-
	Imported (F) royalties and imported (F) capital goods	21%	**Complimentary (F) technology (acquired embodied plus acquired disembodied**	Sector	mineral and oil extraction; textiles; clothing; pulp and paper; publishing and printing; non-metallic products; non-electrical machinery; computers and office materials; electrical machinery; motor vehicles (node 1; mean-score=0.3; % of firms=41%)	-
	Local (L) capital goods	20%	**Acquired (L) embodied technology**	Sector	Textiles; clothing; pulp and paper; chemical and pharmaceuticals; computer and office materials (node 2; mean-score=0.14; % of firms=34%)	Age — 1985> year of incorporation >=1996; for Group of firms included in 'node 2'

Sources: SEADE/CMIE

Discussion based on empirical results

Differences in location bound resources and capabilities resulting from unique institutional contexts and national innovation systems were predicted to result in distinct patterns of IPs of MNE affiliates in Brazil and India. The results of our factor analysis have confirmed these distinct patterns for the two countries. In Brazil, MNE affiliates pursuing IP1 and IP2 seek *supplementary assets* for innovation by striking horizontal linkages with foreign and local entities. Under IP1 they acquire disembodied technologies – licensed know-how from foreign and local sources; under IP2 they purchase embodied technology – capital goods from foreign and local suppliers. According to the AT results, specific industrial sectors are associated with firms pursuing IP1 and IP2.

IP2, i.e., the practice of combining local and imported embodied technology (capital goods) is characteristic of process-oriented innovations which become critical in mature industries with standardized products. As may be expected, the industries in which IP2 is most prevalent include mineral and oil extraction; textiles; pulp and paper; rubber and plastic; basic metals; transport equipment, i.e., mature industries. Hence this points to strong technological capabilities in capital goods sector in Brazil which MNE affiliates rely heavily on for innovation activities.

IP1, i.e., the practice of combining local and imported disembodied technology (local and foreign know-how) may be important in more dynamic and growth oriented industries. Industries in which IP1 is most prevalent include publishing and printing, electronics and telecommunications, computers and office equipment etc. that are driven by new emerging information technologies.

Yet another category of firms pursuing IP3 appear to be engaged in developing absorptive capacity by internal knowledge creation through in-house R&D

rather than external acquisition of knowledge. According to Answer tree results in the present study, the most representative group of firms which have been adopting *internal-knowledge creation* (IP3) are older affiliates that were established in Brazil during the import-substitution period (from 30's to 70's). These results confirm, on the one hand, that firm-age can strongly explain the deepening of local technological effort. On the other, it confirms that industrial policy in Brazil induced the development of productive and technological capabilities. Firms pursuing IPs thus compete solely on the basis of higher levels of internal technological competency induced by industrialization process and national policies that existed until the end of 70's – such as national content requirements and import restrictions. The technological capabilities accumulated during the import substitution period in Brazil appear to have created a 'good locking' between local and foreign firms. This is despite the liberalization process in 90's and the abolishment of national content requirements for foreign investments after WTO. Firms that depend on internal capabilities alone are engaged in a line of research activity for generating emerging new technologies in Brazil.

Interestingly, the results of factor analysis (FA) for innovation practices (IP) of MNEs in Brazil differed significantly from an earlier study by FRANCO and QUADROS (2003). Using the same technique (FA) and key-variables to identify technological strategies in a sample of foreign firms operating in Brazil in the earlier study using 1996 data, the authors found a strong positive correlation between local capital goods investment and internal R&D activity.

In contrast, results in this study for IP using 2001 data show that firm acquisition of locally produced capital goods is not correlated with their internal R&D activity, but is strongly correlated with the acquisition of foreign capital goods. This shift in IP over time indicates that MNEs in Brazil are broadening their sourcing from purely local suppliers to also include global ones for external innovation inputs. In other words, a shift towards a 'local technology substitution' seems to have occurred. IP3 from FA for Brazil suggests that some affiliates have intensified their local technological effort based on internal R&D activity.

India liberalized in 1991, some two decades later than Brazil. There still exists a large overhang of pre-liberalization institutions and policies, the impact of which is likely to endure on the IPs of MNE subsidiaries in India, especially those established prior to 1991. In the pre-liberalization era, India's national innovation system was geared towards building strong capabilities in chemical technologies and process skills. This resulted in developing strong technological capabilities in certain sectors such as pharmaceuticals, chemicals, minerals and oil, steel, and other heavy industries. However high import tariffs and other policy distortions restricted technological development in others such as motor vehicles, consumer goods etc (LALL, 1987; KUMAR, 1996; RAY, 2005). Therefore MNE subsidiaries have responded by adapting IPs that are able to leverage the local technological strengths in certain industries and redress weaknesses in others by using their own proprietary technologies developed in their home countries.

The results of FA for MNE affiliates in India suggest that the predominant IPs appear to involve seeking *"complementary assets"* – one where two different types of knowledge are combined for firm innovation by pursuing vertical inter-firm linkages with others. Complementing internally created tacit-knowledge through R&D, with locally purchased disembodied knowledge (IP4), provides firms with access to rare firm specific advantage. This practice, which relies on combining tacit and codified know-how, may be important in industries which have grown under the import substituting regime, focusing on indigenous development of technologies that are appropriate for the local market (see LALL, 1987). Industries in which IP4 is most prevalent include mineral and oil extraction, publishing and printing, non-electrical machinery, computers and office equipment etc. The products of many of these industries are now incorporating new information technologies in which abundance skills exist in India.

IP5 also involves acquiring *"complementary assets"*, since it combines embodied (capital goods) with disembodied technologies (know-how) both acquired from abroad. IP5 may be viewed as a 'local-substitution' orientation since relies entirely on foreign innovation inputs. This practice may be important for subsidiaries that exploit technological gaps in local innovation system in India to serve the local markets with new products based on advanced foreign technologies as in the case of motor vehicles. Equally, MNE subsidiaries in India may be combining two streams of foreign knowledge and exploiting the local cost advantage to serve as export oriented platforms. MNE subsidiaries adopting IP5 belong to industries such as non-electrical machinery; computers and office materials; electrical machinery; motor vehicles in which the need to facilitate the transfer of corporate parent's technology to subsidiary, and to provide local technical services is very important.

IP6 indicates a strategy of relying entirely on acquiring embodied knowledge (capital equipment), from local sources. This strategy appears to be driven by the imperatives of cost-advantages and may be expected to be pursued by MNE subsidiaries to serve local markets and compete with strong local players that have developed strong process capabilities. Results of the ATT show that IP6 is pursued in industries such as chemicals and pharmaceuticals, computers and office equipment, textiles – all of which are known to have spawned strong local competitors (Ray, 2005; Kumar, 2006). A second predictor associated with IP6 is the age of the firm. Firms adopting this practice were typically established between 1985 and 1996, Despite liberalization, many foreign firms in India are continuing to rely on capital goods from local suppliers for process innovations. Embodied technology purchase from local sources has to do with efficiency enhancing mechanisms undertaken by MNEs. Imports are substituted by locally produced capital goods due to the comparative advantage that exists in the capital goods sector. The promotion of heavy and capital goods industry since the 1950's has resulted in India's present ability to produce sophisticated capital equipment, even for high-technology industries (LALL, 1987). Therefore, the location specific advantages embodied in locally produced capital equipment and the linkages spurred by MNEs with local suppliers through years of cooperation are significant enough for older MNE affiliates to draw on for their IPs.

In sum, the way MNE-affiliates combine innovation inputs (IP) differ both within and between the two countries, resulting from their unique institutional contexts and national innovation systems. As well, we saw that firm age and subsidiary mandates play an important part in shaping their IPs in these two countries.

CONCLUSION

The different IPs found in both countries suggest that 'geographic location' matters for analyzing the way multinationals capture, manage and create strategic assets for innovation in developing host-countries. Therefore, despite the fact that both countries have had similar industrialization processes – based on import-substitution and development of production capacity – the local knowledge-based assets created by specialization and domestic investments differs significantly. In other words, institutional contexts matter insofar as how they shape the behaviour of MNEs in host countries. Due to differences in the way in which MNE-affiliates in India and Brazil combine innovation inputs, each country appears to be moving along different technological trajectories. Thus, differences in innovation practices in the two countries are leading to different streams of specialization and technological capabilities.

Information about what role policymakers should be playing in stimulating foreign investment in Brazil and India is of critical importance given that these countries are competing with each other, as well as with countries in the OECD to attract FDI. Finding out if MNE's IP's in both countries are complementary, or supplementary or what exogenous and endogenous variables explain patterns of interaction can help policy makers to design more accurate strategies to integrate the local innovative capacity building to the global value-chain.

Hence three policy implications arising from this comparative study are salient. First, since MNEs draw on particular combinations of local and foreign produced embodied and disembodied technologies, it may imply that reductions in trade and tariff distortions in innovation inputs from overseas would have the impact of encouraging external inflow of specific intermediate innovation inputs; such inputs can have positive externalities for internal R&D efforts of MNEs who may then be motivated to perform more technology intensive IPs. Equally, however, wholesale import of technology from foreign sources, without any coherent policies such as requirements for technology absorption, local content and the like, can have a very deleterious effect on technological capabilities in host countries (see LALL, 1996, 2004).

The second policy implication is whether there are sufficient incentives that promote R&D expenditures by private enterprises, apart from expenditures by public R&D and educational institutions. For example, R&D grants and tax offsets (LALL and TEUBAL, 1998) in Japan, Korea and Taiwan spurred vigorous R&D spending among productive enterprises in these countries, with the result they are among the top 10 R&D spenders (as % of GDP) in the world today (LALL and URATA, 2004). For India much of the R&D was conducted in the government sector consisting of government research institutes and public sector undertakings (MANI, 2001). This structure needs to shift towards private R&D, and in particular, MNEs should be encouraged to do more R&D.

The third implication is the encouragement given by the government to patent intellectual property created – the outputs of innovation resulting from R&D. Any innovation generated through this R&D is significant for the host country, not only in terms of the resources employed but also in terms of potential tax revenues from IPRs that result. Unless governments can ensure that patents (and appropriate royalties) are generated and reside in the country, incentives and subsidies to encourage R&D may not provide the desired results to the local economy (RAY, 2005).

Finally, as is clear from the results, MNEs innovation activities draw heavily on the capital equipment sector which seems to have a very powerful influence in both in Brazil and in India. LALL's (1987) study showed that by 1984, India had achieved global competitiveness in capital goods. It is up to the policymakers to sustain this performance today – perhaps by inducing local suppliers to expand globally – as many pharmaceuticals, automotive and electronic component makers are doing in India; or by giving more incentives to perform higher level R&D. For MNEs in question a more precise knowledge about the costs and benefits of different kinds of knowledge linkages between foreign and local suppliers in two specific emerging economies would enable them to position better in the transnational network of knowledge creation.

Our study attempted to understand these germane issues by examining at which level the MNEs and host countries are connected to the global innovation system. By analysing their IPs in selected industries, we have obtained 'clues' as to what factors determine the global linkages between MNEs and emerging economies. Future studies on the impact of differences in IPs on firm-innovation performance in MNE-affiliates in the two countries will enhance our understanding of the specific effects of individual innovation practices.

Before we end our paper, we take this opportunity to point to an inevitable and unavoidable limitation of this analysis. Our study focuses on five distinct innovation inputs to examine innovation practices in firms in India and Brazil. However, innovation and knowledge creation involve many other inputs for capturing tacit and intangible elements of knowledge creation, such as cumulative efforts of learning, which are developed through interactions between individuals and their social/business networks. Mapping such interactions require longitudinal studies, which was beyond the scope of this paper. Even so, the selected inputs used in this paper are widely accepted as being highly important to firm innovation. Moreover, the fact that robust measures for these inputs exist for both India and Brazil, allows a reliable comparison of firm innovation strategies between the two countries.

REFERENCES

AMSDEN, A., TSCHANG, T. and GOTO, A. (2001). "Do foreign companies conduct R&D in developing countries? A new approach to analyzing the level of R&D, with an analysis of Singapore", *ADB Institute Working Paper*, nº 14, March.

BELL, M. (1985). Learning and the accumulation of industrial technological capacity in developing countries. In: Fransman, M., King, K. (Orgs.). *Techonogical capability in the third world.* New York: Macmillan.

BELL, M. and PAVITT, K. (1993). "Technological accumulation and industrial growth: contrasts between developed and developing countries", *Industrial and Corporate Change,* Vol.2, No.2, pp.157-210

BELL, M. and PAVITT, K. (1995). "The development of technological capabilities", In: *Trade, technology, and international competitiveness*, HAQUE, I., Economic Development Institute of the World Bank

BRENNER, T. (2007) Local knowledge resources and knowledge flows, *Industry and Innovation*, 14(2), pp. 121-128.

BUDERI, R. and HUANG, G. (2006). *Guanxi – Microsoft, China and Bill Gates plan to win the road ahead*, Handom House Business Books

BURKLEY, P.J. and PERVEZ, N.G. (2004). 'Globalization, economic geography and the strategy of multinational enterprises', *Journal of International Business Studies*, n. 35, p. 81-98

CANTWELL, J. and MOLERO, J. (2003). '*Multinational enterprises, innovative strategies and systems of innovation*', Edward Elgar, USA

CANTWELL, J.A. and MUDAMBI, R. (2001). 'MNE competence-creating subsidiaries mandates: an empirical investigation', University of Reading Discussion Paper in International Investment and Management, no.285, July

CARLSSON, B. (2006), Internationalisation of innovation systems: a survey of literature, *Research Policy*, 35, pp. 56-67.

CAVES, R. (1996), *Multinational enterprise and economic analysis*. 2nd Ed. Cambridge, Cambridge University Press.

CHANDLER, Jr. (1990). *Scale and scope: the dynamics of industrial capitalism*, Harward University Press

DAHLMAN, C. (2007). 'Technology, Globalization, and International Competitiveness', In: *Department of Economic and Social Affairs, Industrial Development for the 21st Century: Sustainable Development Perspectives*, United Nations, New York, 2007, p.61

DUNNING, J. (1993). *Multinational Enterprises and the Global Economy*, Wokingham, United Kingdom and Reading, Mass.: Addison Wesley.

DUNNING, J. (ed.) (2002). *Regions, globalization, and the knowledge-based economy*. Oxford University Press

DUNNING, J. and NARULA, R. (1995). "The R&D Activities of Foreign Firms in the United States", *Int. Studies of Mgt. & Org*., Vol. 25, pp. 39-73, M.E. Sharp, Inc.

DUNNING, J. (1998), 'Location and the multinational enterprise'. *Journal of International Business Studies*, Vol. 29(1), pp. 45-66.

FIGUEIREDO, P. (2002). "Does technological learning pay off? Inter-firms differences in technological capability-accumulation paths and operational performance improvement". *Research Policy*, n.31, pp.73-94

FRANCO, E. and QUADROS, R. (2003). Patterns of technological activities of transnational corporations affiliates in Brazil', *Research Evaluation*, Surrey, v. 12, n. 2, p. 117-129, 2003

FU, X. and GONG, Y. (2008). "Direct technical change, indigenous and foreign innovation efforts and drivers of technology upgrading: evidence from China", paper presented in the *Conference 'Confronting the challenge of technology for development: experiences from the BRICS*, Sanjaya Lall Program for Technology and Management (SLPTMD), QEH, University of Oxford, 29-30 May, Oxford

GHOSH, R. and SOETE, L. (2006). Information and intellectual property: the global challenges, *ONU-MERIT Working Papers*, ISSN 1871-9872

GOMES, R., CONSONI, F. and GALINA, S. (2007). 'Tendências recentes da internacionalização da P&D: um survey com multinacionais instaladas no Brasil', *XII Seminario Latino-Iberoamericano de Gestión Tecnológica – Altec*, 26-28 setembro

GRANSTRAND, O., HAKANSON and SJOLANDER (1993), Internationalisation of R&D: a survey of some recent research, *Research Policy*, 22 (5&6), pp. 413-431.

JOHNSON, B. and LUNDVALL, B. (2000). 'Promoting innovation systems as a response to globalizing learning economy', contribution to the project '*Local productive clusters and innovation systems in Brazil: new industrial and technological policies*' (*draft*)

KATZ (1985). Technological innovation, industrial organization and comparative advantages of Latin American metalworking industries. In: Fransman, M., King, K. (org.) *Techonogical capability in the third world*, New York: Macmillan.

KUEMMERLE, *W.* (1999). The drivers of foreign direct investment into research and development *Journal of International Business Studies,* 30(1), pp. 1-24.

KUMAR (1997). "Technology generation and technology transfer in the world economy: recent trends and implications for developing countries", *INTECH*, Discussion Paper Series, September, no.9702

KUMAR, N. (2001). 'Determinants of location of overseas R&D activity of multinacional enterprises: the case of US and Japanese corporations', *Research Policy*, 30, 159-174

KUROKAWA, S., IWATA, S. and ROBERTS, E. (2007), Gloal R&D activities of Japanese MNEs in the US: A triangulation approach, *Research Policy*, 36, pp 3-36.

LALL, S (1992). "Technological capabilities and industrialization". *World Development*, Vol.20, No.2, pp.165-186

LALL, S (2004) Introduction and overview, in Sanjaya Lall and Shujiro Urata Eds., *Competitiveness FDI and Technological Activity in East Asia*, Cheltenham, Edward Elgar.

LALL, S e ALBALADEJO, M. (2002). "Indicators of the relative importance of IPRs in developing countries", *QEH Working Paper Series*, No.85, April

LALL, S. (2000). 'FDI and Development: policy and research issues in the emerging context', *QEH Working Papers Series*, No. 43, June

LALL, S. (2002). 'Globalization and development – perspectives for emerging nations', paper prepared for *BNDES 50th Anniversary Seminar*, Rio de Janeiro, Brazil, September 12

LALL, S (2002), Linking FDI, technology development for capacity building and strategic competitiveness, *Transnational Corporations*, Vol. 11(3), pp. 39-88.

Le BAS, C. and SIERRA, C. (2002), Location versus home country advantages in R&D activities: some further results on multinationals locational strategies, *Research Policy,* 31(3), pp. 589-609.

MANI, S. (2001), 'Role of government in promoting innovation in the enterprise sector: An analysis of the Indian experience', The United Nations University INTECH Discussion Paper Series #2001-3 (in collaboration with Nagesh Kumar).

MANSFIELD, E. (1974), Technology and technical changes In *Economic Analysis and the Multinational Enterprise*, ed. John Dunning, George Allen and Unwin, London, pp. 147-183.

MEYER-KRAHMER and REGER (1997). 'European technology policy and internationalization: an analysis against the background of the international innovation strategies', paper written for the *ETAN group on Technology Policy in the Context of Internationalization: how to strengthen Europe's competitive advantage in technology*, Karlsrule, July

MUDAMBI, R., PISCITELLO, L. and RABBIOSI, L. (2007). 'Mandates and Mechanisms: reverse knowledge transfer in MNEs', paper presented in the international conference '*Four decades of International Business at Reading: looking to the future*', Reading, UK, 16-17 April

NIOSI J. and BELLON, B. (1996), The globalization of national innovation systems, in J. De La Mothe, G. Paquet (Eds.), *Evolutionary Economics and the New International Political Economy*, Pinter, New York, pp. 138-159.

OCDE (2005). 'Oslo Manual – The measurenment of scientific and technological activities', European Commission, Eurostat

OECD (2006). 'Science, technology and industry Outlook', available in: http://www.oecd.org

PAPANASTASSIOU, M. and PEARCE, R.D. (1999), Multinationals, technology and national competitiveness, Edward Elgar, Cheltenham

PATEL AND PAVITT (1998) "National systems of innovation under strain: the internationalization of corporate R&D", *Science Policy Research Unit*, University of Sussex, Brighton (draft).

PATEL, P. (1993). Localised Production of Technology for Global Markets. Mimeo. Brighton, UK: SPRU;

PAVITT, K. (1998), The social shaoing of the national science base, *Research Policy,* 27 (8), pp. 793-805.

PENROSE, E. (1959). *The theory of the growth of the firm*, Oxford University Press

POLANYI, M. (1966), *The Tacit Dimension*, London, Routledge & Kegan

QUADROS, R., BERNARDES, R. and FRANCO, E. (2001). Technological innovation in Brazilian industry: an assessment based on the São Paulo innovation survey, *Technological Forecast and Social Change***,** nº 67, pp. 203-219, New York.

QUADROS, R., FURTADO, A. and FRANCO, E. (2000). 'Explaining Technological Innovation in Brazil: testing the significance of firm size, firm nationality and firm's sector belonging', *Workshop on Measurement of Innovation, 4th International Conference on Technology and Innovation*, Curitiba, 28-31 August, Brazil

RAMAMURTI, R. (2001), Developing countries and MNEs: extending and enriching the research agenda, *Journal of international Business Studies*, 35, pp. 277-283.
RAY, P.K. (2005). *FDI and industrial organization in developing countries-the challenges of globalization in India*, Ashgate, UNSW, England
REDDY, P. (1997). "New Trends in globalization of corporate R&D and implications for innovation capability in host countries: a survey from India", *World Development*, vol.25, nº 11, pp. 1821-1837
RUGMAN, A. and VERBEKE, A. (2001), Subsidiary specific advantages in multinational enterprises, *Strategic Management Journal*, 22(3), pp. 237-250.
SALTER, M. and WEINHOLD, W.A. (1979) *Diversification through acquisition strategies for creating economic value*, The Free Press, New York.
SEN, F.and EGELHOFF, W.G. (2000), Innovative capabilities of a firm and the use of technical alliances, *IEEE Transactionson Engineering Management*, 47(2), pp. 174-183.
STEWART, F. (1990). "Technology Transfer for Development", In: EVERSON, E. and RANIS, G. (org.), *Science and Technology - Lessons for Development Policy*, London: Intermediate Technology Publications.
UNCTAD (2001). *World Investment Report*. 'Promoting linkages', New York and Geneva
UNCTAD (2002). *World Investment* Report – transnational corporations and export competitiveness, United Nations, New York and Geneva
UNCTAD (2004). '*World Investment Report* – the shift towards services', United Nations, New York and Geneva
UNCTAD (2005). '*World Investment Report* – transnational corporations and internationalization of R&D', United Nations, New York and Geneva
UNCTAD (2005), *Transnational Corporations and the Internationalization of R&D,* World Investment Report, United Nations, New York and Geneva.
YORGASON, D. (2007). 'Research and development activities of U. S. multinational companies – preliminary results from the 2004 benchmark survey', report prepared for the Bureau of Economic Analysis (BEA), March