

**TRANSFER OF TECHNOLOGY IN MULTINATIONAL ENTERPRISES
AND THE ROLES OF SUBSIDIARIES: AN EMPIRICAL INVESTIGATION**

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ABSTRACT

?? This paper considers the Multinational Enterprise (MNE) as a differentiated learning network with subsidiaries playing a critical role in managing knowledge. Drawing on sample of 92 subsidiaries operating in Greece, this paper empirically tests the relationship between sources of technology acquired and/or generated (internally or externally) and relates them to differently strategically motivated subsidiaries.

KEY RESULTS

- ?? Our findings record the existence of a multifaceted network of technology generation and transmission which is differentiated among the different types of subsidiaries. In particular:
- ?? The results confirm the fact that larger and innovative subsidiaries have granted access to wider sources of technology.
- ?? Subsidiaries granted with dynamic mandates as well as subsidiaries of a more efficiency –seeking nature are likely to be better embedded in the local environment.

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1. INTRODUCTION

This paper considers the Multinational Enterprise (MNE) as a differentiated learning network with subsidiaries playing a critical role in managing knowledge (Birkinshaw et al., 1998). Building on recent advances regarding the strategic evolution of subsidiary roles we argue that the MNE is a vehicle of integrating knowledge generated internally and externally from its global operations (Birkinshaw and Hood, 1998; Bartlett and Ghosal, 1989). Today, rather than accepting predetermined roles, subsidiaries are asked to actively engage in developing their operations and explore procedures that would increase the overall efficacy of the whole MNE (Birkinshaw and Hood, 1998; Birkinshaw, 1996; Crookell and Morrison, 1990). There are many cases of subsidiaries that perform specific value-added activities, which are fundamentally “embedded” in their respective host-countries knowledge systems (evidence is provided by; Kuemmerle, 1999; Dunning, 1996; Cantwell, 1995; Jarillo and Martinez, 1990).

Drawing on sample of 92 subsidiaries operating in Greece, this paper empirically tests the relationship between sources of technology acquired and/or generated (internally or externally) and relates them to differently strategically motivated subsidiaries.

Foreign Direct Investment (FDI) has been encouraged in Greece since the early 1950s, in order to revive and expand the country's industrial base. Recent data on inward FDI show that major investing force in Greece is the European Union (EU), with approximately 70% of total inward FDI in 2001 (ELKE, 2003). The largest European investing countries include the Netherlands, Luxembourg, France and Germany. Greece also receives a significant amount of FDI by other European countries and the US. Thus, the post war development of the Greek economy has largely been based on the know-how and technologies imported from abroad in the form of licensing and import of capital goods as local industrial R&D is also very limited (Giannitsis and Mavri; 1993). However, the opening up of new markets, mainly Eastern European markets, accelerated the process of restructuring on behalf of Greece based MNE subsidiaries. We observe that since 1992 major subsidiaries such as 3E in beverages (a Coca-Cola subsidiary), DELTA in dairy products (a

Danone subsidiary) expanded their mandates by engaging in production abroad and intensifying their exports. These new developments turned the attention of foreign investors to Greece's competitive advantages including the existence and potential of knowledge generating assets (see Appendix I for Greece's performance for selected scientific input variables as they are presented in the latest Global Competitiveness Report 2002).

Two are the distinctive contributions coming out of this analysis : Firstly, we show strong evidence that the operations of MNE subsidiaries in an otherwise peripheral economy of the EU rely in fact on a multifaceted knowledge creation network that goes beyond mere technology transfer. Secondly, we present for the first time a concrete and detailed subsidiary- level analysis regarding foreign operations in Greece. The rest of the paper is organized as follows: section 3 sets the theoretical background, section 4 analyses the research questions to be examined and presents the sources of technology under investigation, section 5 presents and discusses the empirical findings and in section 6 we conclude.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

All major theoretical approaches to FDI take under consideration, explicitly or implicitly, the technological capabilities and characteristics of the MNE. Technology has been given different definitions (Freeman, 1987). It was described as a procedure for organize knowledge in order to produce or as a body of knowledge about certain classes of events and activities (Rosenberg, 1990) or, a more generic definition, knowledge of how to do all those things related with economic activity. According to Dunning, technology embraces all forms of a corporation's physical assets, human learning and capabilities that lead to efficient production of goods and services (Dunning, 1993). Following the microeconomic and macroeconomic approaches of international production, firms are engaged simultaneously in two types of action regarding technology, (i) defensive, in order to protect it (Magee, 1977) and (ii) offensive it, in order to expand it and differentiate it.

Loasby (1999) has argued that the firm exists in order to organize the utilization of knowledge. The effective application of technological resources and advancements worldwide, may then lead a corporation to an upgrading involvement in global innovative activities, which in turn, may generate distinctive capabilities for the whole MNE environment (Birkinshaw et al., 2002).

Superior, firm specific technology, may lead the contemporary MNE to the development of a sustained competitive advantage that may induce and facilitate the penetration of foreign markets through exports and local production (Hakanson, 1981; Johanson and Vahlne, 1977; Casson and Buckley, 1976), by capturing the distinctive needs of host countries and adapt subsidiaries into new environments^{1,2}

Earlier thinking associated the generation of technology in MNEs with home country innovation procedures justifying the notion of competitive advantage reflecting the resource competencies and market conditions of their home countries (Dunning, 1990; Hymer 1976; Caves, 1971; Vernon, 1966). At the same time, the benefits of a more decentralized technological approach are gaining growing recognition (Hedlund and Rolander, 1990). In a global environment that is increasingly characterized by technological and market heterogeneity, creative subsidiaries with specific product mandates may be the best way of effectively monitoring knowledge flows on behalf of MNE group (Papanastassiou and Pearce, 1999). Therefore, headquarters' technology planning should screen not only the diffusion of technology acquired in the home country, but also the technological inputs derived from overseas subsidiaries stemming from either their in house R&D departments or established localized knowledge (Ivarsson and Johnsson, 2003; Hakanson and Nobel, 2001; Andersson and Forsgren, 2000; Kummerelee, 2000; Dunning, 2000; Patel and Vega, 1999; Pearce, 1999)

3. SOURCES OF TECHNOLOGY IN FOREIGN SUBSIDIARIES IN GREECE

The mounting evidence that MNEs have increased the extend of their R&D performed outside their home countries (Almeida et al, 2002; Cantwell and Janne, 1999; Norhia and Ghoshal, 1997; Granstrand, et al., 1993; Pearce and Singh, 1992; Hedlund, 1986) lead us to investigate the sources of knowledge inputs MNEs intend to use in this procedure of technology decentralization, which seems to be the dominant trend in new settings of FDI (Gupta et al, 2000; Niosi, 1999). Two are the basic research questions this study aims to answer:

¹ For further analysis on the relationship between knowledge creation and a firm's competitive advantage, see Argote, 1999.

² The possible strategic contraposition of technology as a firm's competitive advantage and its decentralized strategy may be attributed to the degree of complexity. Complex technologies tend to be transmitted through internal channels, Arora and Fostfuri, 2000; Simonin, 1999.

Research question 1 (RQ1): To what extent subsidiaries operating in an otherwise peripheral economy utilize internal and external channels of knowledge transmission?

Research Question 2 (RQ2): Is the subsidiary role a decisive factor in determining which of the technological sources will be accessed or not?

Against this background and in order to evaluate the technological scope of foreign MNEs operations in Greece, seven possible sources are investigated in order to understand the impact of technology transfer and creation on specific subsidiary roles. Here, in this paper, we adopt a typology emerging from White and Poynter (1984) and we distinguish among three major subsidiary roles:

Truncated Miniature Replicas (TMRs) which they tend to produce well established final products already existing in the MNE group value chain. An additional form of TMR which has a more specialized- narrow product mandate, i.e. a Specialized Miniature Replica (SMR) is also investigated. Rationalized Product subsidiaries (RPS) involved in the production of intermediate goods and finally World Product Mandates (WPM) which are assigned with the introduction of innovative products and thus expand the product line of the MNE group (for an extended analysis on product mandates, see Birkinshaw and Hood, 2000; Taggart, 1997; Birkinshaw and Morrison, 1996; Pearce, 1995; Crookell and Morrison 1990; Rugman and Bennett 1982; Poynter and Rugman, 1982).

Data on Greek based subsidiaries were obtained through a postal questionnaire survey research conducted between 2000-2001. The total number of questionnaires sent out was 314. 92 usable responses received (corresponding to 29.3% response rate), out of which 57 refer to European multinationals and the remaining 35 to multinationals outside Europe. The complete population of subsidiaries (i.e. 314) was extracted from the ICAP database. In Greece two are most reliable sources on FDI data: The first is the Bank of Greece. However, the limitation with the Bank of Greece database is that it has only recently started to collect subsidiary level data (i.e. since 1997). On the other hand, ICAP is a private organization which has been dedicated in the collection of firm level data since 1964. Therefore, we decided to use ICAP database due to its apparent inter temporal consistency in the collection of firm level data (see Appendix II for the frequency distribution of the main survey sample by (a) home country and (b) by individual sector breakdown).

In the survey, respondents were asked:

Survey Question 11: Please grade the following sources of technology for your operation as being: (4) our only source of technology; (3) a major source of technology; (2) a secondary source of technology, and (1) not a source of technology

- (a) Existing technology embodied in established products we produce***
- (b) Technology of our MNE group from which we introduce new products for the European market, which differ from other variants introduced in other markets***
- (c) R&D carried out by our own laboratory***
- (d) R&D carried out for us by another R&D laboratory of our MNE group***
- (e) R&D carried out in collaboration with another local firm***
- (f) R&D carried out for us by local scientific institutions (e.g. universities, independent laboratories, industry laboratories)***
- (g) Development and adaptation carried out less formally by members of our engineering unit and production personnel***

The first source of technology, subsidiaries were asked to evaluate, was “existing technology embodied in established products we produce” (ESTPRODTECH). These technologies provide the basis of the current commercial success of the MNE through the embodiment in the most competitive of their commercial goods (Manea and Pearce, 2000). In playing this role, ESTPRODTECH is an essential part of the “inward investment” package that contributes to the development of host country. This source of technology is dominant to all industries, since 65.6 % of the respondents characterized it either as “only source of technology” or as “main source”. Overall, this source of technology emerges as the more prevalent in for all home countries with a quite remarkable average response (AR) of 3.28. ESTPRODTECH also appears as the strongest source of technology in all four subsidiaries types. Although this is more or less expected for the first three types of overseas production the outcome is more surprising for subsidiaries that are ascribed with the production of differentiated products for the host country. One possible explanation for that could be that technology embodied in the established product

range is already quite sophisticated so as to allow, with minor alterations, its adaptation to commercially new products for the host country. Thus, some subsidiaries take advantage of the existing technology embodied in well commercialized products while others perform as seekers and implementers of new technological competencies so as to firstly, contribute to the production of innovative products and secondly, to individualize their presence in the MNE network (Birkinshaw, 1996).

Table 1 Relative Importance of Sources of Technology[†] in MNE subsidiaries in Greece

<i>Relative Importance of Sources of Technology[†] in MNE subsidiaries in Greece (Average Responses[‡]), N=91</i>							
	A	B	C	D	E	F	G
By Location of HQ							
EU Countries	3.21	2.03	2.25	1.59	1.65	1.68	1.53
Other European Countries ⁵	3.14	1.92	2.50	1.78	1.50	1.42	1.35
USA	2.78	1.85	2.35	2.28	1.55	1.35	1.42
Japan	3.62	1.66	2.00	2.62	1.33	2.00	1.33
Rest of the World ⁶	3.66	1.33	1.66	1.33	1.33	1.72	1.45
Total	3.28	1.75	2.15	1.92	1.47	1.63	1.41
	X²=2.99⁺⁺⁺						
By Sector[‡]							
Manufacturing	3.41	1.83	2.43	2.12	1.55	1.76	1.44
Services	2.95	1.67	1.87	1.72	1.39	1.50	1.37
Total	3.28	1.75	2.15	1.92	1.47	1.63	1.41
	X²=27.12						
By Type of Subsidiary[‡]							
Production of Well Established Products (TMR)	3.06	1.95	2.26	1.84	1.55	1.55	1.46
Specialization and supply of MNE network part of the Established Product Range (SMR)	2.50	2.10	2.25	1.60	1.55	1.75	1.25
Production of Component Parts for Assembly Elsewhere (RPS)	3.20	1.62	2.25	1.41	1.66	1.82	1.86
Production of Differentiated Products (WPM)	2.83	1.91	1.54	1.75	1.62	1.54	1.45
Total	2.89	1.89	2.07	1.65	1.59	1.66	1.50
	X²=14.12⁺						

* significant at 10%, ** significant at 5%, *** significant at 1%

[†]Sources of technology

A existing technology embodied in established products we produce- ESTPROD.

B technology of our MNE group from which we introduce new products for the European market, which differ from other variants introduced in other markets- GROUPTECH.

C R&D carried out by our own laboratory-OWNLAB.

D R&D carried out for us by another R&D laboratory of our MNE group- GROUPLAB.

E development and adaptation carried out less formally by members of our engineering unit and production personnel-ENGUNIT

F R&D carried out in collaboration with another local firm-OTHERFIRM

G. R&D carried out for us by local scientific institutions (e.g. universities, independent laboratories, industry laboratories)- LOCALINST

Notes

1. Respondents were asked to grade each source of technology for their operations as (i) our only source, (ii) a major source, (iii) a secondary source, (iv) not a source

2. The average response was calculated by allocating the value of 4 to the only source of technology, the value of 3 to the main source, the value of 2 to a secondary source and the value of 1 to not a source

3. Manufacturing sector includes Pharmaceuticals, Electronics, Food Industries, Automobiles and Textiles. Service sector includes Consulting Companies, Hotels, Banks and Publishing Corporations.
4. Covers subsidiaries that described themselves as only or predominately each type.
5. Includes subsidiaries from Switzerland, Cyprus, Liechtenstein, and Russia
6. Includes subsidiaries from South Korea, Panama and Canada

Source: Authors, Survey on Foreign Subsidiaries in Greece

The second technology source was defined as “technology of our MNE group from which we introduce new products for the European market, which differ from other variants introduced in other markets” (GROUPTECH). The difference of this type of technology source compared with the first one is that the later allows the subsidiary for a more active participation in the innovation generating process. Group-originated technologies have not yet been embodied in products but are available, in sufficiently precisely defined forms, to be accessible to fulfill different subsidiaries needs (upon request). Only 2.4% of the respondents considered GROUPTECH as their only source, 24.7% as a major source, and 52% as a secondary source. This indicates that only 20.9% of subsidiaries did not have access to this technology source. In terms of ARs we observe that GROUPTECH is the third most important source of technology. Not surprisingly is more prevalent to SMRs. It seems that these subsidiaries try to build their competencies based on both their past activity as well as on a more systematic involvement with the development and application of new group-level technology particularly when they are “invited” to cater the specialized needs of their customers which in our case are other parts of the group.

Subsidiaries were asked to evaluate the importance of technology provided by the R&D department of the subsidiary (OWNLAB). Out of the 92 respondents which evaluated this source, 42.1% replied that it did not play any role in their technological identity, 22.4% rated it as a secondary source, 32.8% considered it as a major source and only 2.7% as an exclusive source. Concerning the role of subsidiaries, ARs indicate that in house R&D is more important to subsidiaries that produce well-established products and is almost irrelevant to subsidiaries that differentiate their production. There is an extensive literature on the roles of overseas R&D units (Hakanson and Nobel, 1993a, b; Pearce, 1999). Apparently the weak support of a local R&D unit to WPMs, in contrast for the rest of the subsidiary types suggests the existence of Support Laboratories (SLs) which are mainly involved in the technological adaptation of existing goods rather than the development of new products or processes (Kuemmerle, 1997; Papanastassiou and Pearce, 1994)

Technological competencies have been verified to be central to the shaping of ownership advantages of many MNEs (Asakawa, 2001; Papanastassiou and Pearce, 1994). It is evident that Greek subsidiaries mainly rely on the technology provided embodied in established products. Nevertheless, the fact that these subsidiaries are going through a creative transition, grants increased importance to local R&D departments. The function of these laboratories is, then, rather to define the technological needs of their subsidiaries and to satisfy them with the utmost efficiency, than to develop and market new products expanding the innovative process of the MNE group *per se*.

Another potential source of technology accessed by MNE subsidiaries in Greece “R&D carried out for us by another R&D laboratory of our MNE group” (GROUPLAB) was rated as the sole source by only 1.4% of the respondents, a major one by 18.4% and a secondary one by 48.8% of the respondents. This indicates that 41.4% of subsidiaries do not rely at all on this source of technology. In terms of ARs this the most weak of the internal sources with TMRs using it relatively more extensively.

A last possible in-house source of technology, which nevertheless falls short of formal R&D, was defined as “development and adaptation carried out less formally by members of our engineering unit and production personnel” (ENGUNIT). The essence of this source is the tacit knowledge embodied in such personnel, which is likely to reflect a variable mix of the mainstream characteristics of subsidiary’s own knowledge heritage (Almeida and Kogut, 1999). According to results provided by ARs, this is the less important source concerning intra-firm knowledge sharing, with the 57.6% of respondents replied that it is not a source of technology. Related to the types of subsidiaries, we observe that this source becomes relatively more significant (probably as it would be expected) to RPSes.

In summarizing our results so far, it is evident that: Greek subsidiaries are getting support for their operations from various intra-MNE sources of technology including a local R&D unit. In our case evidence suggests that this is an SL laboratory. At the same time two thirds of the respondents affirm that they make use of the internal MNE channels of transferring knowledge and this becomes more evident in export oriented subsidiaries (Kogut and Zander, 1993; Bartlett and Ghoshal, 1986).

Finally, two more sources of technology were also examined which evaluate the existence of external linkages with the local economy or put it otherwise test for the intensity of the subsidiaries' embeddedness. According to Hakanson and Nobel (2001, p. 398) "Subsidiaries that are strongly embedded in the local environment ...are believed to be in an advantageous position to absorb and combine new technical and market knowledge in innovative ways".

The first of two sources was "R&D carried out in collaboration with another firm" (OTHERFIRM). As mentioned above, there is evidence that collaboration between firms has emerged as a substantial source of technological inputs for subsidiaries (Kummerelee; 2000, Dunning; 2000, Hagedoorn; 1990), nevertheless for foreign operations in Greece, 48.6% of the subsidiaries replied that it made no contribution to their technological scope and 24.7% rated it as a secondary source for their operations. This could be a point for further discussion, since such arrangements are likely to be relatively inexpensive means of attempting to secure subsidiary level access to new technological perspectives (Manea and Pearce, 2000). Moreover there is enough empirical evidence to prove that subsidiaries are involved in regional networks of knowledge (Almeida, 1996). According to the results provided by ARs these inter-firm collaborations by Greek subsidiaries are somewhat stronger for RPSes. In line with other suggestions for creative ambitions within such type of subsidiaries, this may suggest: Firstly, an aim of widening and individualizing their markets by supplying components to firms outside their own group, secondly, by entering into technological collaboration agreements with other independent companies to develop new inputs for their goods and thirdly just simply the need to upgrade the value of their inputs in order to meet higher quality requirements by their existing customers (Papanastassiou, 1999; Papanastassiou and Pearce, 1999).

The interaction with local Greek scientific institutions as a second possible source of collaborative R&D was also reported as limited. Thus, "R&D carried out for us by local scientific institutions (e.g. universities, independent laboratories, industry laboratories)" (LOCALINST) was not perceived as relevant technological source by 64.8% of responding subsidiaries and rated as no more than a secondary source by 31.4% more. Consequently, as it would be anticipated, LOCALINST seems more likely to be called into play a rather supplementary role than a source of direct technological inputs (Papanastassiou and Pearce, 1994). Apparently, and despite the recent growth of public research, the existing institutions

of the national technology infrastructure are still insufficient to create a critical mass of research to attract the industry's interest for technological collaboration (Soitaris, 2002)

4. ECONOMETRIC ANALYSIS AND RESULTS

Regressions tests were run with each of the seven sources of technology as the dependent variable against the four different subsidiary roles and controlled by firm characteristics (see table 1 for definitions). The set of independent variables also includes industry and country dummies, sales of the subsidiary, (expressed in million Euro) and the proportion of subsidiary's exports (i.e the ratio of Exports to Sales). The last two variables intend to capture the size of the subsidiary and its market scope respectively. (The correlation matrix and descriptive statistics are presented in Appendix III).

As an econometric technique ordered logit was applied since the dependent variable is a qualitative one, ascribed with ascending degrees of importance. An ordered logit (or probit) model is built around a latent regression the same manner as the binomial logit (probit) model and it is of the following form $y^* = X\beta + \epsilon$

where y^* is unobserved and what we observe comes in the following form: When y^* takes on the values 0, 1, 2, ..., m, the ordered logit model estimates a set of coefficients (including one for the constant) for each of the $m - 1$ points at which the dependent variable can be dichotomized. (STATA, 7.0 Manual help guide under `ologit`)³:

$$P(Y < k) = F(-XB_k) \quad k = 1, \dots, m$$

Results on the regressions are presented in table 2.

³ Data were run with STATA 7.0. The proportional odds property of Stata's `ologit` command restricts the B_k coefficients to be the same for every dividing point $k = 1, \dots, m$

Table 2: Regressions with sources of technology as the dependent variable

<i>Importance of Sources of Technology¹ in MNE subsidiaries in Greece, N=72</i>							
	A	B	C	D	E	F	G
By Profile of Subsidiary							
Sales ²	-0.166 (1.477)	-0.951 (3.211)	1.105* (2.220)	2.814* (2.301)	-0.047 (0.551)	-0.133 (0.207)	0.427 (0.290)
Exports	2.212 (0.950)	0.211* (1.461)	0.745 (0.114)	1.516 (0.991)	-1.714 (1.740)	0.449 (0.135)	1.117 (0.850)
By Location of HQ							
EU	-1.015 (1.381)	1.551 (1.089)	1.445** (1.081)	2.511** (2.680)	-0.985 (1.004)	1.952 (1.771)	4.916 (0.203)
By Sector							
Manufacturing ³	-3.455 (3.407)	0.953** (0.980)	-1.433 (1.776)	3.212** (1.701)	2.202 (1.471)	0.950 (0.110)	1.443* (2.580)
By Type of Subsidiary⁴							
Production of Well Established Products-TMR	-0.104 (0.052)	0.890 (1.026)	0.183* (0.766)	0.405 (0.027)	0.814 (0.521)	0.912 (0.886)	-0.715** (0.490)
Specialization and supply of MNE network part of the Established Product Range-SMR	0.513* (0.931)	0.771 (0.225)	0.880 (0.437)	-0.471* (0.206)	0.132 (0.307)	0.454 (0.015)	0.884 (0.360)
Production of Component Parts for Assembly Elsewhere in the MNE group-RPS	0.380* (0.433)	0.382 (1.007)	0.481 (0.770)	0.829 (0.750)	0.770 (0.450)	0.880* (0.261)	0.581** (0.480)
Production of Differentiated Products-WPM	-0.890 (0.427)	0.884* (0.250)	0.504 (0.147)	-0.515 (0.355)	0.412 (0.551)	-0.134 (0.380)	0.774** (0.286)
Statistics							
X ²	2.05**	1.45	2.12**	1.04	1.05	1.51	1.87*

Notes

1. For full description of technology sources (dependant variable), see Table 1.
2. Sales are grouped in three categories according to their volume. Less than 20.000.000 euros takes the value of 1, between 20.000 – 40.000.000 euros takes the value of 2 and more than 40.000.000 euros takes the value of 3
3. Manufacturing sector includes Pharmaceuticals, Electronics, Food Industries, Automobiles and Textiles
4. Covers subsidiaries that described themselves as only or predominately each type.

Source: Authors, Survey on Foreign Subsidiaries in Greece

A positive relationship is observed between ESTPRODTECH and SMRs as well as RPSes. This outcome confirms that established technology comes in support of a more standardised horizontal (the case of SMRs) and vertical (the case of RPSes) production aiming though to wider intra- MNE markets (Venables, 1999).

GROUPTECH is found to strongly support export oriented subsidiaries providing further support to our arguments regarding the restructuring of operations of Greece based subsidiaries which however cannot be achieved independently and requires technological support from the group. The strong positive sign for WPMs suggests that creative subsidiaries in Greece have not reached yet this level of emancipation to

rely on their own forces through a locally based laboratory but nevertheless in order to cover the needs of their wider markets they have to have access to updated technological information. This resembles to a “knowledge user” as defined by Randoy and Li (1999, p.84). At the same time the strong positive result of OWNLAB for TMRS and its insignificance for WPM rounds up the previously stated proposition. In line with previous empirical findings, OWNLAB seems to favour large (in terms of sales) subsidiaries (Hakanson and Nobel, 2001; Andersson and Forsgren, 2000). Large subsidiaries can in fact afford both to have their own R&D laboratory as well as to enjoy technological support from another MNE laboratory whilst SMRs are less likely to have an interaction with such a laboratory. The specificity of their operations apparently does not imply any important troubleshooting arrangements that they cannot resolve by applying other means rather than to end up approaching another group laboratory which could be a quite costly operation (Teece, 1981). Regression results for ENGUNIT are totally weak.

Regarding the last two regressions with the two external sources of technology as the dependent variables, we notice some interesting patterns: RPSes, which reflect efficiency-seeking motivations (Dunning, 1993), are better integrated in the local productive and scientific community as they seek both the collaboration of local firms as well as local research institutions (Phene and Almeida, 2003). Moreover, the negative relation between LOCALINST and TMRs and the positive relation between LOCALINST and WPMs clearly indicates that product differentiation requires creative inputs that only research institutions such as universities can provide (Frost, 1998; Roth and Morrison, 1990). This last result provides, on one hand, some encouraging signs regarding the capabilities of the local scientific community which apparently has gained the confidence and recognition of foreign investors and, on the other hand, the effectiveness of collaborative agreements at a pre-competitive stage (Porter, 1990).

5. CONCLUSIONS

As we argued in the introduction of this paper the contemporary MNE is a continuously evolving institution which influences- and at the same time get influenced by- its external environment. This results in a more complicated and dynamic organisation structure which can deal more effectively with internal and external competitive pressures. Consequently, subsidiaries are not allocated

necessarily *ad hoc* specific roles and a more decentralised approach to technology generation and diffusion becomes central to the strategic evolution of the MNE. Drawing on sample of 92 subsidiaries operating in Greece, a peripheral country in terms of FDI received, and by applying a typology of subsidiaries derived by White and Poynter (1984) we addressed two RQs regarding the extent and availability to various technological resources to MNE subsidiaries in Greece and the impact of specific subsidiary roles on the accessibility of technology respectively. Our findings record the existence of a multifaceted network of technology generation and transmission which is differentiated among the different types of subsidiaries. The results confirm the fact that larger and innovative subsidiaries have granted access to wider sources of internally generated technology. Subsidiaries granted with dynamic mandates (WPMs) as well as subsidiaries of a more efficiency –seeking nature (RPSs) are likely to collaborate more intensively with local firms and scientific institutions compared to TMRs. Apparently this outcome comes in support of recent evidence which clearly demonstrates that current developments in the wider geographical region Greece is neighboring to, i.e. Balkans and Eastern Europe, has increased the level of value added of certain foreign subsidiaries which have been evolving to “regional hubs” (Birkinshaw, 1998). These subsidiaries seek for more sophisticated inputs which substantially support their “new” upgraded mandates and thus become more embedded in the local environment (see Demos et al. 2003 and Louri et al., 2000 on the determinants of outward FDI undertaken by foreign subsidiaries in Greece). As a final remark, the issue of embeddedness becomes central to policy making in terms of attracting FDI by encouraging the adoption of FDI promoting policies that place emphasis (among other things) in the quality of local scientific institutions and the creation of clusters. This will allow for a more substantial development of local channels of knowledge transmission which is fundamental to the development of Greece’s competitive advantages (Porter, 2003).

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APPENDIX I

Greece's performance for scientific and technology selected indicators as presented in the Global Competitiveness Report 2002ⁱ

Indicator	Country Rankingⁱⁱ
Availability of scientists and engineers	21?
University/industry research collaboration	34?
Quality of scientific research institutions	51?
Quality of math and science education	52
Company spending on R&D	56
Local availability of specialised research and training services	57

Source: Global Competitiveness Report, 2002.

- i. Total number of countries included in the report was 80
- ii. Arrows indicate a change of 5 or more ranks since 1998

APPENDIX II

Frequency distribution of the sample by home country

Home Country	Number of Subsidiaries
EU Countries	41
Other European	16
Total European	57
USA	22
Japan	8
Rest of world	5
Total Outside Europe	35
Total	92

Frequency distribution of the sample by individual sector breakdown

Sector	Number of Subsidiaries
Food and Beverage	30
Heavy Industry*	25
Pharmaceuticals	11
Automobiles and Transport Equipment	10
Textiles	4
Services**	12
Total	92

* Heavy Industry includes Mechanical Engineering, Chemicals, Metal Manufacturing, Electronics, Industrial and Agricultural Chemicals and other Manufacturing

** Services include Banks, Hotels, Consulting and Publish Corporations

APPENDIX III

INSERT CORRELATION MATRIX

Filename: MIRPAPAN.doc
Directory: D:\Documents and Settings\sxs01ag\My
Documents\web
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Change Number: 2
Last Saved On: 27/02/2004 14:26
Last Saved By: Anne Goodwyn
Total Editing Time: 0 Minutes
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As of Last Complete Printing
Number of Pages: 24
Number of Words: 6,719 (approx.)
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