Employee Scientific Movements within Multinational Corporations

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Abstract

This study examines an under-investigated issue in international human resource management related to R&D employees' scientific movements within MNEs. Analytically, it seeks to shed some light into the scope and extent of the transfer of home-country human capital inputs; the frequency, direction and motivation for host-country scientific personnel transfers and the impact of specific contingency factors (strategic, organizational and demographic variables) on the essence and direction of these movements. The contribution of the paper in terms of theory development is the empirical validation of our core argument that four sets of factors (subsidiary mandates, strategic positioning of decentralized R&D laboratories, value of subsidiaries' stock of knowledge and employees' aspirations towards their career development) comprise core determinants in investigating scientific movements within MNEs. Evidence derived from our research was collected by 669 expatriates and local R&D professionals employed in the decentralized MNE laboratories located in Greece. Our results suggest that there are significant R&D personnel movements, both to and from the home country, which are largely affected by the roles of the subsidiary and the R&D units. Overall, the study indicates the need to accept a new perspective towards the centralized views on technology generation and development advocated in theoretical models; suggesting "a contingency perspective" when analysing the investigating theme of R&D employee movements, with considerable research and managerial implications.

Keywords: scientific movements; decentralized R&D; subsidiaries; Greece

Introduction

The globalization of the world economy, trade liberalization and the resulting intensification of competition in regional and international markets have stimulated extensive literature on multinational enterprises (MNEs) since the early 1960s (e.g. Hymer 1960/1976; Vernon 1966; Servan-Schreiber 1967). One of the topics that has recently gained broad recognition and emerged as a distinctive area of investigation deals with the management of multinational subsidiaries and their contribution to the strategic evolution of the MNE network (Paterson and Brock 2002). This is due to a well-established consensus among researchers that, in the quest for sustained competitiveness, MNEs should redefine the roles of their overseas subunits and adopt a genuinely perspective on not only the *application*, but also the *development* of their production, technological and managerial competences (Pearce 1999). Correspondingly, scholars have widely recognized the creative potentials of subsidiaries and the importance of innovation and technology as core competitive imperatives (e.g. Conner and Prahalad 1996; Bartlett and Ghoshal 1989). In this regard, the requirements for the effective transfer of knowledge inputs between the centre and MNE periphery have been targets of increasing research interest (Riusala and Suutari 2004). Indeed, according to Hurdley and Hood (2001), one of the most frequent and persistently asked questions concerning MNE activity nowadays relates to the scope and determinants of corporate global learning, the extent of technology centralization and the contribution of dispersed subunits in knowledge production.

As MNEs were confronted to meet the dual challenge for appropriate global integration and effective local adaptation of worldwide operations, new theoretical frameworks have emerged in the literature. Recent developments perceive MNEs as

knowledge-based entities (Doz et al. 2001; Spender 1996) or differentiated learning networks (Gupta and Govindarajan 2000; Birkinshaw et al. 1998), where knowledge and technology could be leveraged in geographically dispersed locations. Following those perceptions, subsidiaries are not conceived anymore as an outlet for the effective commercialization of MNEs' well established product range, but are also asked to actively engage in the creation of new products and production processes. Accordingly, nowadays MNEs adopt a more dynamic perspective on technology creation and deployment, which is closely related with the differentiated roles assigned to their subsidiaries.

Since the benefits of a more decentralized technological approach have been theoretically founded and empirically verified (Luo 2006; Allred and Swan 2004; Asakawa 2001; Pearce 1994; Lall 1980) as likely to be central to the creation of ownership advantages for many MNEs, the way that the transfer of knowledge competences occur across different units comprise a focal issue for international management. As individuals are considered as "prime movers" of knowledge creation within an organization (Nonaka 1994), one would expect a rich literature on the roles, direction and determinants of employees' scientific movements among MNE research units. However, in relation to the technology imperative, the majority of conceptual and empirical research is focused on the organizational mechanisms of knowledge sharing (Foss and Pedersen 2002), the link between inter- and intra-firm technology transfers and motives beyond foreign direct investments (Birkinshaw and Hood 1998; Conner and Prahalad 1996; Kogut and Zander 1993) as well as firms' "absorptive capacity" (Cohen and Levinthal 1990) and knowledge spillover effects (De Bondt 1996; Spence 1984). In relation to personnel movements, while the issues of *managerial* know how transfer (e.g. Boyacigiller 1990), generic (e.g. Shay and Baack

2004; Bonache and Brewster 2001) or more specific investigations on expatriates (e.g. Hocking et al. 2007; Haas, 2006) and repatriates (Bossard and Peterson 2005) have been extensively studied, international movements of R&D experts were not regarded as a significant research question and hence was little appreciated by the academic and business community. This is probably due to the fact that even nowadays, management theorists pay scant attention to issues which are specifically directed to the main implementers of MNE knowledge, i.e. the R&D professionals (Manolopoulos 2006).

However, the examination of this issue is crucial since the international transfers of researchers and the diffusion of their expertise, foreign assignments and staffing of overseas R&D laboratories may enable MNE to expand its technological trajectory and define the future sources of a vital competitive edge. This is not only because human assets are an emerging source of advanced competitiveness in any business setting (Schuler and Rogovsky 1998); but mainly because the mobility of researchers and scientists can be proven to be a valuable technology source for many MNEs (Papanastassiou and Pearce 1999). This is because the tacit knowledge embodied in such personnel is likely to reflect a variable mix of the mainstream characteristics of the group's technological base and distinctive elements of the subsidiaries' own knowledge heritage. Surprisingly enough, despite their considerable importance, movements of scientific personnel appear to remain one of the most persistently understudied areas in international business (Lee 2003), and form the key theme of investigation in the current research.

The purpose of this paper is to provide insights upon this identified gap in the literature and investigate how the movement of scientists is related with the recently emerged approaches towards the globalization of technology creation and use. In

particular, focusing on the subsidiary level of analysis, we empirically examine the frequency, direction, motives and roles of scientific movements and we identify the impact of specific contextual influences (organizational, strategic and individual characteristics) in determining their essence. In the literature, no earlier work in this area was seemingly found and thus this is a field in which the major contribution of the study lies. By addressing the topic of R&D professionals' movements, we contribute to the knowledge on not only international human resource management, but also organizational theories, by further adding to the existing literature on factors influencing the patterns of knowledge competences within the MNE.

The rest of the paper is organized as follows: the next section will provide the theoretical underpinnings of the study, set our research framework and identify its main constructs. Following that, we lay down our research questions and present the research design and methodology. Next, based on our original survey results, we evaluate the extent, motives, roles and direction of intra-MNE scientific movements; and empirically test the impact of specific factors on the essence of these movements. The paper concludes by addressing the implications of the study for management research and practice, its limitations and directions for further research.

Theoretical development: Research framework and constructs

Previous research has uncovered a number of factors that influence intra-MNE creation and sharing of knowledge competences, associated mainly with the essence and distinctiveness of knowledge inputs (Zander and Kogut 1995), the network's organizational characteristics (Gupta and Govindarajan 2000), the relationship between headquarters (HQs) and subsidiaries (Bjorkman et al. 2004) and the willingness of a unit to share information with other units (Forsgren 1997). Following

early work that conceived MNEs as centralized hierarchies, the majority of studies referred to personnel movements from a headquarters (HQs) perspective (Bossard and Peterson 2005) and viewed transfers as a source of control over foreign operations (Harzing 2001). Since local subsidiaries were seen as mere delivery pipelines to supply the network's value-added to different countries, systematic decentralized producing and technological activities were initially rejected as a strategic alternative (Pearce 1999). Accordingly, any type of personnel movement was mainly directed from the corporate centre to the periphery of the network, looked at from the broad human resources (HR) point of view, included transfers of *managerial* expertise and served as a valuable means of homogenization, standardization and coordination of procedures on a worldwide basis. In other words, HQs send expatriate managers so as to secure that "…the MNEs' strategic goals are met, deviations from standards are corrected and subsidiaries act in accordance with HQs policies" (Paik and Sohn 2004, p. 61). Thus, the main scope of international transfers was the attempt of HQs to create safeguards against opportunism on the part of the subsidiaries and the maintenance of appropriate control over internationally dispersed subunits (Evans et al. 2002).

Later developments have argued that international assignments serve also as a source of managerial development, creating a new type of "cosmopolitan" manager (Haas 2006; Bossard and Peterson 2005) and allowing individuals to "…initially or further develop the requisite international skills and thereby become a more valuable resource to their MNE" (Shay and Baack 2004, p. 218). Subsequent empirical studies had more thoroughly investigated the impact of organizational, individual and contextual influences on those expatriate managers' degree of adjustment (Parker and McEvoy 1993) and their potential for career advancement (Suutari 2002).

As MNEs were perceived to evolve to strategically-networked differentiated heterarchies (Hedlund 1986, 1993; Birkinshaw 1994) or transnationals (Bartlett and Ghoshal 1989; Harzing and Noorderhaven 2006), another strand of research (e.g. Bjorkman et al. 2004; Szulanski 1996) focused on the multi-directional transfer of subsidiaries' knowledge competences across different MNE units. Learning and knowledge can be transferred between MNE HQs and subsidiaries as well as between subsidiaries. Having placed subsidiaries at the centre of examination, the main bulk of the relevant literature was directed towards the impact of knowledge transfers on subsidiaries' performance (O'Donnell 2000), the role of host managers to knowledge outflows (Szulanski 2000; Hansen 1999), the internal stickiness factors that reduce the efficiency of knowledge sharing (von Hippel 1994) and the impact of corporate socialization in the diffusion and creation of new knowledge (Tsai 2001).

However, according to Bartlett and Ghoshal (1989), a core prerequisite for the efficient deployment and transmission of knowledge inputs throughout the corporate HQs, specialized units and the subsidiaries of the differentiated MNE refers to employees' international movements. Indeed, their global mobility and diversity of experience allows them to transfer managerial, technical and organizational know-how across different geographic locations in a way not readily duplicated by other procedures (Argote and Ingram 2000). Thus, there is enough evidence to support that international transfers of personnel are inextricably conjoined with the MNEs' strategic objective of global efficiency, local responsiveness, and worldwide learning and, therefore, the resulting scope of subsidiaries' operations in the respective host countries.

The scope of subsidiaries is very well manifested in their roles. There is a wide literature that addressed the reformulation of the strategic organization of MNEs

and the differentiated roles thereby played by subsidiaries so as to secure a widened range of objectives in an increasingly competitive and globalized environment (White and Poynter 1984; Bartlett and Ghoshal 1989; Jarillo and Martinez 1990; Gupta and Govindarajan 1991; Taggart 1997). In this paper, we apply a typology derived by White and Poynter's (1984) "scope" framework. This is because the status of knowledge – and technology – related aspects of subsidiaries is very clearly positioned within "scope" typologies (Papanastassiou and Pearce 1999). In our research we delineate three subsidiary types: the first is described as a truncated miniature replica (TMR) and produces for its local market a large part of the parent's established product range. Although this extensive localised supply responsibility characterises this market-seeking subsidiary as resembling a "miniature replica" of its parent company, it is also a "truncated" version in the sense that it lacks important attributes, most notably those relating to product innovation, implementation of new technologies and autonomous strategic decision-making (Papanastassiou and Pearce 1999). The second role which may be assigned to disperse MNE subunits is that of the rationalised product subsidiary (RPS). Here, the wide product scope of the TMR is rationalised to a focus on a much more limited range, with this then produced in more cost-efficient ways (e.g. realising economies of scale) for mainly export markets (Manolopoulos 2007). The RPS applies knowledge that is already well-established in the parent group and embodied in already commercialized proven and effectively produced goods. In that way, the RPS becomes part of an MNE group's internationally-coordinated supply network. A more complete MNE response to the challenges of the contemporary global competitive environment has been to '…use both freedom of trade and dispersed creative competences through world (or regional) product mandate (PM) subsidiaries' (Papanastassiou and Pearce 1999, p. 28). PMs

usually take on more dynamic potentials, seeking to provide a technological impetus towards a subsidiary's escape from technological dependency and towards the generation of its own individualised creative scopes and ultimately localised product development. The core of their strategy is the ability to use subsidiary-level creative resources (generated in-house or accessible through collaborative arrangements in the local economy) to develop and supply distinctive new products. Such original goods are likely to target wide market scope and ultimately, when successful, provide the PM subsidiary with a unique position in its MNE group; not only in terms of the supply network but also in terms of possession of its own particular technologies and tacit competences.

Since the focus of the current study is on the movements of R&D professionals from a subsidiary perspective, there is evidence to support (e.g. Manolopoulos et al. 2005) that the nature and extent of any type of decentralized knowledge – related activity is closely related to not only the aims of the MNEs carrying out the investment, but also to the distinctive strategic positioning of overseas research units. As a result, we argue that any study examining the frequency and essence of researchers' international transfers should also consider the different tasks of decentralized R&D laboratories as another critical operational variable. Literature has provided us with various frameworks seeking to capture the strategic positioning of foreign MNEs' labs and captivate their role (Ronstadt 1978; Hakanson 1981; Asakawa 1996). The classification suggested here derives from the work of Haug et al. (1983), and Hood and Young (1982).

This classification identifies three distinctive roles for an overseas R&D laboratory: the first refers to the effective use of the MNE group's well existing technologies and procedures. Its main function is, therefore, *adaptation development*,

either of the products or of the production process. Laboratories that focus on that role are defined as support laboratories (SLs). The role of SLs is considered critical for the successful commercialization of subsidiaries' products in already determined target markets. As the limited adaptation role of SLs declines in relevance, more ambitious positions can be found for overseas R&D in the pursuit of global competitiveness by MNEs (Manolopoulos et al. 2007). One of this is for an R&D unit in a particular country to work as a closely integrated part of a subsidiary to develop a distinctive product, which can be supplied to a regional, or even global, market (Pearce 1999). This type of R&D unit is defined as locally integrated laboratory (LIL). Instead of using the existing MNE's technology in order to produce well-established products, LILs extend the scope of the subsidiary, by using all the available resources in a creative collaboration, which expands the competitive product range of the group, i.e. they have a more "*productive*" scope (Papanastassiou and Pearce 1999). The third possible role that can be distinguished for a laboratory, or the second that plays a part in the global-innovative strategy, is to provide basic or applied research inputs into a program of precompetitive work organized by a MNE (Pearce 1999). Thus, in contrast with the previous role of the laboratories, this type will require a close coordination not with the subsidiary's functional departments but with similar laboratories of the MNE in other countries, and especially with a parent laboratory, which is expected to coordinate the overall research program (Manolopoulos 2006). The laboratories that are involved in such tasks are termed as internationally interdependent laboratories (IILs).

Among the factors that influence the role of subsidiaries, shape their knowledge capabilities, dictate the roles of overseas R&D units and determine their strategic positioning within the network's operations is their stock of knowledge

(China 2004; Davenport and Prusak 1998). According to Bjorkman et al. (2004, p. 449) "…a subsidiary with a stock of knowledge that in some capacity is unique and greater than that of other MNE units is likely to be an attractive partner", promoting, in that way, personnel transfers. Hennart and Park (1993) argued that the value of subsidiaries' knowledge stock is positively associated with acquisitions (as a mode of establishment in foreign markets), whereas Gupta and Govindarajan (2000) have found a positive correlation between the value of knowledge stock and subsidiaries' size. According to China (2004), the higher the value of subsidiaries' knowledge stock, the more advanced their strategic positioning within MNE operations. As a result, nowadays there may be an increased likelihood of more frequent personnel movements *towards* (so as other MNE units can seek knowledge and increase their potentials for knowledge-related competitiveness) and *from* (so as the subsidiary to contribute to network's collective learning) subsidiaries. Thus, it can be argued that the stock of subsidiaries' knowledge is another critical factor expecting to have an influential impact on scientific movements within MNEs.

In addition – and in accordance with the revitalized perceptions of international management (e.g. the special issues of Journal of World Business in 2005 and the one of Thunderbird International Business Review in 2004) – the literature on employees' international assignments and movements is centred around their career development; being critically dependent upon their perspectives for global career and hierarchical advancement within the MNE. Therefore, the individual perspectives of R&D employees should also be included in the analysis, since they may have a major impact on any type of knowledge competences' transfer. For example, subsidiary managers may act as self-interested and profit maximizing

individuals; being led to pure opportunistic behavior, with that having severe implications to the systematic and coherent sharing of knowledge.

To sum up, when we combine the above theoretical foundations, a research framework for the current study can be formed. We argue that, within the context of the subsidiary, international movements of scientific personnel are influenced by four critical sets of factors: MNEs' strategies at both local and decentralized R&D level, employees' individual perspectives on their career development and the stock of subsidiary knowledge. These factors should be controlled for specific organizational and demographic characteristics. Our research model, which summarizes the hypothesized relationships between the core characteristics (e.g. roles, frequency, direction) of R&D employees' movements and the main independent variables, is presented in Figure 1.

(Take in Figure 1: Research model: Factors determining scientific movements)

Research questions, design and methodology

In our research, in line with recent developments, we view subsidiaries and foreign laboratories as evolving from being just a support function for MNEs to one of strategic importance and we consider that scientific movements will be *from* and *towards* the MNE center. The core of our analysis is to capture the quantitative aspect of these movements and then to provide some qualitative insights with regard to what these employees do and which are the factors that determine these scientific transfers. To be more specific, there are three basic research questions this study aims to answer:

Research Question 1 (RQ1): Which is the extent and scope of home-country scientific personnel movements?

Research Question 2 (RQ2): Which is the frequency, direction and motivation of host-country scientific personnel movements?

Research Question 3 (RQ3): Which is the impact of specific contingency factors (strategic, organizational and demographic characteristics) in determining the essence and direction of scientific movements?

The data for this study were collected between 2001 and 2005 as part of a larger scale survey investigating the configuration of multinationals within Greek economic environment. Greece constitutes an interesting case for analysis, since little research has focused on investigating international human resource management issues in the local context, partly due the fact that there is a dearth of empirical research on recently industrialized countries in general.

The research was in two phases. The first phase involved a survey of the strategic bases of MNEs' expansion into the focal country. A national questionnaire-based mail survey was used in order to acquire the necessary information. A careful process was used to develop the questionnaire for this study. All the items/scales used here drew on established research. The questionnaire itself was developed through a three-stage process: Firstly, it was scrutinised by two academics and two professional consultants, who provided improvements in wording and advice on layout. Secondly, following a major revision, the questionnaire was sent to five chief executive officers (CEOs) of subsidiaries operating in different industrial sectors. In most cases recommended corrections were similar and provided the second revision. The questionnaire was then sent to selected subsidiaries located in different host countries for the final testing. No further changes to wording or structure were needed. The questionnaire contained 17 questions, most of them being closed-ended. It was also

accompanying by a cover letter explaining the aims of the study, guaranteeing confidentiality and urging response.

The information regarding the corporations comprising the sample was provided by the International Capital (ICAP) database. The ICAP database included 317 foreign firms located in Greece in 2000. Two were excluded because of undelivered questionnaires, lowering the total sample of firms in 315. The industries involved include pharmaceuticals, chemicals, electronics and IT, machinery, food and beverages, textiles, services, miscellaneous and other manufacturing. Major countries of inward investment include U.S., Japan, EU and other European nations. Questionnaires were mailed to the CEOs of subsidiaries. Respondents were asked to answer all questions in the questionnaire and were assured of the confidentiality of the responses. Overall, three rounds of questionnaires have been sent. Three measures (sales, number of employees and subsidiary year of establishment) were compared using a χ^2 test of independence. The respondents from early and late respondents were essentially identical. The response rate for the first phase of research at a subsidiary level is approximately 42% (133 useable responses out of 315 corporations that consisted the total sample provided by ICAP), which is considered to be perfectly acceptable in comparison to similar mail surveys (Agarwal and Ramaswami 1992; Harzing 1997). Appendix I-a summarizes the response rates and the number of respondents by industry and country of HQs location. Among these 133 subsidiaries, 70 were identified to have an R&D department (52.63%). Of these, 49 (70%) reported that the adaptation of existing products and/or processes was the defining role for their R&D unit, whereas the development of new products was the most prevalent role for 16 units (22.8%). Involvement in basic research was reported as a minor

research commitment for foreign operations in Greece, capturing only 5 (7.14%) responses.

During the second phase of the survey, we sought to collect responses concerning employees' scientific transfers. Once subsidiaries with R&D laboratories have been identified, R&D professionals (having both a permanent and temporary contract and/or any other kind of professional relationship with the subsidiary) were asked to provide insights on the issues which were related to the main scope of our survey. The questionnaire for the second part of the survey was developed using the same process as the initial one. Two months after the second questionnaire was mailed out, a reminder postcard was sent to all R&D subsidiaries that had not yet responded. Incentives to increase response rate included a synopsis of the results. In total, 948 questionnaires were distributed and after two reminders, 669 useable-answered questionnaires were collected, providing a response rate at individual R&D employees' level of approximately 70%. To ensure the validity of responses, a follow up telephone conversation with 30 R&D professionals was carried out. The reported results demonstrated a high consistency with the original answers on the questionnaires. To examine potential non-response bias, we compared respondents and the population on two variables: number of R&D employees and the years of laboratory operations. None of these t-tests for differences between the sample and the population means was statistically significant at the level of 0.10 (t-test in order to evaluate the potential non response bias was used by many authors; see for example Luo 2001). Furthermore, to test the non-response bias, personal interviews with 15 R&D employees of selected non-respondent firms (according to the classification of country of origin) was arranged. Results were quite similar with those of the sample.

The descriptive statistics providing evidence on the employment levels of decentralized R&D laboratories are presented in Appendix I-b.

Frequency, scope, direction and motives for movements

Following the tradition of a product life cycle model (Vernon 1966), literature suggests an one-way direction of international transfers from the HQs to the "peripheral" subunits of the network. This is mainly founded on the perception that companies involved in foreign direct investments are expected to "export" their personnel in key positions at least for a certain amount of time. However, Table 1 reports that the movement of scientific personnel from the HQs to the R&D subsidiaries of the group located in Greece is relatively limited. While there is evidence to support (e.g. Black and Gregersen 1999) that international assignments are common practice for over the 80% of large- and midsize MNEs, of the 70 R&D subsidiaries under investigation in Greece, only 42 (60%) have employed home-country research experts for at least one month (throughout a year). Among these, only a small percentage (11.43%) of home-country scientific personnel represents more than the one-third of the total laboratory employment. The findings from Table 1 provide us with insights to relate the frequency of home country scientific personnel presence with the very essence and characteristics of *tactical* and *strategic* positioning of decentralized laboratories within subsidiaries' operations. Thus, it seems that when foreign labs support the ability to apply the group's well-established centrally-created technology effectively without making crucial contributions to the strategic evolution of the technology itself, the presence of home country personnel is limited. In particular, 47% of SLs that were surveyed reported no home country personnel within their operations, whereas in 45% of labs the percentage of home experts is less that

the one fourth of total employment. In this case, it seems that MNEs do not feel the need to increase surveillance in the focal country and/or coordinate and control research activities of minor added value. On the contrary, where there is a more clear need to enhance the medium-term competitiveness of the subsidiary or the fundamental core of scientific knowledge available to the MNE group, home country personnel presence is more frequent and persistent. Another way to interpret the result of the overall limited presence of home country experts is to consider that international assignments in Greece are not viewed as a totally desirable path for home country employees' further career development.

At a home-country level analysis, EU MNEs seem to have the most intense tendency to send home country R&D experts to Greece (maybe due to geographical proximity), whereas, an interesting finding from Table 1 is that US firms tend to be reluctant to send home personnel in their Greek scientific operations, but when they decide so, they do that at an extended scale. International research assignments from "Rest of World" MNEs seem to be at insignificant levels. The proportion of home country scientific personnel in decentralized R&D units seems to be positively related with the technological intensity of the sector within which the subsidiary operates. Thus, high technology industries seem to require more often parent-company scientific personnel. This is mainly due to the considerable presence of home country researchers in pharmaceuticals and chemicals; indicating the underlying imperative of these corporations to use a multifaceted context of technology sources, their forward-looking potential and their long - established tradition in the internationalization of research activities.

(Take in Table 1: Proportion of home country scientific personnel in decentralized R&D units, %)

In line with the work of Allen and Katz (1986), in evaluating the scope of such home-country scientific personnel movements, three potential roles were investigated: (a) managerial, (b) scientific and (c) a combination of both managerial and scientific responsibilities. A very interesting result from Table 2 is that the role of foreign assignments seems to be very distinctively related with the differentiated roles of laboratories. Thus, decentralized labs which are involved in pre-competitive research activities use home country personnel in the scientific work of the unit, whereas the expansion of the creative scope of subsidiaries and the commitment to the development of innovative products seem to create organizational concerns and coordination challenges to the network. In this regard, HQs assign mainly managerial duties to their scientific personnel sent abroad. Adaptation of existing products and/or processes to local conditions requires a combination of both managerial and scientific skills.

Overall, according to the results provided in Table 2, the participation in managerial roles was the most prevalent, capturing 43.6% of responses (31 replies), while scientific followed with 23 replies (32.3%) and participation in both roles with 17 replies (23.9%). Using home-country personnel to organize the laboratory's programme of work may be somewhat more prevalent in medium- and low-technology than high-technology sectors. Participating in both roles is more common in medium- and low-technology sectors. Perhaps the nature of these industries (less need for precise coordination; no imperative need for research leadership in particular scientific disciplines, low levels of international interdependencies with other group units) makes it somewhat less desirable, less necessary or less feasible to separate the managerial and bench-scientific roles (Papanastassiou et al. 2001). Researchers employed in industries where technology at the edge is not considered a vital element

of competitiveness may be acknowledged with a wide range of goals, such as the management of financial resources, technology transfer and innovation policies and organizational changes. At a home country level, EU MNEs tend to employ home personnel more often in scientific roles, whereas US MNEs in managerial. The overall relatively low percentage concerning the participation in the scientific work of the laboratory as a major motive for the movement of research personnel from HQs to subsidiaries may indicate that either the focal country has the qualified local nationals to fill available positions or MNEs centralize important scientific work. An alternative explanation of the results from Table 2 comes in support to the work of Manolopoulos (2006); indicating that the utilization of managerial talent is a totally desirable career path for researchers.

(Take in Table 2: Roles of home country scientific personnel in MNE subsidiary laboratories)

In order to provide insights for our second research question, we follow the work of Haug et al. (1983), and examine three types of host-country personnel movements: (a) to the parent, (b) to another R&D laboratory of the group and (c) to another host-country research facility. Among all 598 respondents, 257 (43%) have never moved from their current working environment. For all industrial sectors and MNEs' home country, host-country scientific movements to the parent laboratory are the most prevalent (Table 3), with high-technology industries and EU MNEs showing above-total average responses. This finding suggests the strong dependency of foreign subsidiaries in Greece from parent operations; indicating weak signs of a genuine decentralized technological strategy. Movement to other MNE laboratories appears as another, relatively, strong choice (average of 1.87), showing the networking of scientific linkages not only from and towards the parent laboratory, but also from and

towards the other laboratories of the MNE "periphery". The least prevalent movement is towards "other country R&D facility"; capturing an average of 1.55. The above finding indicates that there is no strong evidence to support that collaboration between foreign firms and local research institutions emerges as a substantial source of technological inputs for subsidiaries. This could be a point for further discussion concerning subsidiaries' technological trajectory, since such influence for research movements is likely to be a relatively inexpensive mean of attempting to secure subsidiary-level access to new technological perspectives generated in the host country environment.

Although movements towards the parent laboratory for SL employees were expected, as the effective local use of existing MNE technologies require collaborative work with and supervision from the hub where the relevant inputs were originally initiated, it is, nevertheless, quite surprising that such direction is the prevalent one for LIL employees, as well. Being part of the MNE group's global innovative strategy, LILs are assigned with the task to introduce the new product in a way that fully responds to the needs of host customers. In order to achieve this very distinctive product development competence, LILs were expected to work in a closely-integrated fashion with other creative subsidiaries of the network and local scientific institutions. Here, it seems that the product development work implemented in a LIL located in a more intermediate-level economy requires networks with parent "central" lab, which could act as custodian of the core group technologies from which the distinctive product variants are to be created by the "peripheral" subsidiary. On the contrary, the frequency of host personnel employed in IILs movements towards other group labs was highly anticipated. The aim of such labs is to both widen and deepen the group's scientific scope and thus enhance the knowledge competences of

the network. They are likely to do this as part of an internationally-dispersed network of such facilities that aim to provide the MNE group with access to a balanced portfolio of research inputs. Thus, the implementation of joint projects, the mutual sharing of research inputs and findings and the overall interconnectiveness of IILs' type of work with other labs of the group seems to be an imperative for success.

(Take in Table 3: Movements of host country personnel to other scientific laboratories)

By reviewing the literature in scientific transfers, in investigating the motivations for intra-MNE scientific movements, the following four possibilities were identified: (a) training, (b) improvement of knowledge of existing MNE technology, (c) participation in joint R&D programmes and (d) provision of international experience to the individual. The most prominent reason in order to explain the intra-firm movement of scientific personnel was found to be "to improve their knowledge of existing MNE technology", capturing in total 176 replies (51.6%). This finding reinforces the view previously developed here that the technology strategies of subsidiaries located in Greece are largely dependent upon group-level creative knowledge capacities. Results come in support to recent evidence (e.g. Marin and Bell 2006; Manolopoulos et al. 2005; Manea and Pearce 2004) which clearly demonstrate that in the intermediate-level economies, subsidiaries are generally dependent upon existing group knowledge inputs and their technological status is based around the local activation of elements of the standardized existing competences of the parent group. Training comes second in relevance with 21.4% of all replies (73 respondents); highlighting the fact that specialization of researchers and continuous familiarization with the recent developments is more and more recognized as a key factor for the success of technology and innovation process. This finding could imply that once

MNEs establish subsidiaries in locations where the infrastructure (e.g. education) and the general economic context improve they do not need to transfer personnel so extensively. The participation in joint R&D projects and the provision of international experience to individual researchers as motives for host country scientific personnel movements are at almost insignificant levels. Since according to many HR scholars (e.g. Inkson et al. 1999; Tung 1998; Feldman and Thomas 1992) the international experience of employees and their exposure to and involvement in multidisciplinary assignments emerge as core determinants of their career advancement in an international context and their employment in the top positions of global leaders, findings from Table 4 indicate that R&D employees in decentralized labs in Greece have limited perspectives to follow a "boundaryless" career within the MNE.

(Take in Table 4: Motivation for movement of host-country scientific personnel to other institutions, %)

Empirical Analysis: Methodology, measures, results and discussion

To gain some further insights on the factors that influence scientific movements, two models of ordered probit (OP) regressions were run with the different roles of home-country scientific personnel and the direction of host-country scientific personnel as the core dependent variables. Generally, probit models have become critical parts of the management researcher's analytical arsenal (Hoetker, 2007). In our case, ordered probit was applied, since according to the construct of the research our dependent variables (ψ) are based on an attitudinal survey scored using a 4-point Likert-type scale (Likert 1932), which generates data in the form of ordinal responses. In this case ψ represents not a quantity, but nevertheless a bigger value of ψ means more prevalent (Model I) or more frequent (Model II). Therefore, ψ is a qualitative polychotomous

dependent variable. If the qualitative dependent variable was only polychotomous, literature would suggest that we could use linear regression models. Since it is also ordinal, linear models should be rejected because they would erroneously specify the data generating process in assuming that there is no order in the different categories that ψ could take (Liao 1994). Thus, linear models would consider the difference in ψ between a 1 and a 2 as equivalent to the difference between a 2 and a 3 and a 3 and a 4 (Manolopoulos 2006). Ordered probit (OP) model is used for estimation in the context of an ordinal polychotomous dependent variable. While taking into account the existence of a ranking, OP also assumes that the size of the difference between any two adjacent ratings is not known but does not matter to the carrying out of the analysis. Another advantage of OP models emerges from the nature of the survey question. Since responses to a research question of that type depend partly on its wording, and because in linear regressions the responses are modeled directly (Daykin and Moffatt 2002), the results cannot be invariant to the wording of question. However, the distribution over population of the underlying frequency should be invariant to the wording of the question. Because OP model estimates the parameters of the underlying distribution, rather than the response itself, any such framing effects are likely to be avoided (Manolopoulos, 2008).

Overall, six regressions were run with the roles of subsidiaries, the roles of decentralized R&D laboratories, the stock of subsidiary knowledge and employees' perspectives on the desired career development as the core independent variables. As already analyzed, a revised version of "scope" typologies was used in order to identify subsidiaries' strategic role and three possible roles for decentralized R&D labs were distinguished. Following Gupta and Govindarajan (2000), we use acquisition (as a mode of entry) and the size of subsidiary as proxies for the value of subsidiary's

knowledge stock. Following the work of Allen and Katz (1986), the perceptions of employees' career advancement were modeled directly. In relation to the control variables, the number of personnel was used as a proxy of unit size (same as Minbaeva et al. 2003; Samiee et al 2003) and subsidiary's years of operation were used so as to have an indication of their embeddedness and networking with host country's institutions. Apart from subsidiaries' "profile" factors, the survey also controls for researchers' demographic (age, gender and marital status) characteristics. All the independent (explanatory and control) variables are defined and operationalized in Table 5.

(Take in Table 5: Operationalization of Variables)

The results of the two regression sets (Models I and II) are provided in Table 6. Regressions' diagnostics indicate that both models, including all six equations, work well, explaining a considerable amount of the observed variation in the issues under investigation. The regressions used dummies for subsidiaries' country of origin (subsidiaries whose HQs are located in US is the omitted variable) and sector (low- and medium-technology sector as the omitted source). In relation to Model I, investigating the mandates assigned to home-country scientific personnel (n= 71), the results show that from all the factors included in our research framework, the role of subsidiaries emerge as the core determinant variable. Thus, we can argue that MNEs use their internalized channels extensively in order to monitor, create and distribute technological inputs throughout their operations (Papanastassiou et al. 2001). Overall, from the three regressions of Table 6 it appears that different subsidiary roles are associated with different roles of home-country scientific personnel types of movements (managerial, scientific or both). Evidence recorded here suggest that when a subsidiary is assigned with the production of an innovative / differentiated

commodity (being a PM), it receives both managerial and scientific home-country personnel. This finding indicates that creative scientific work may be necessary in a firm seeking to advance its longer – term competitiveness, but it is not sufficient. The appropriate efficient centralized monitoring and control of the geographically dispersed value added activities from the HQs may be of equal importance. The statistical significant positive relationship between TMRs and the assignment of mainly managerial responsibilities for home-country scientific employees, reveal the increased efficiency concerns of MNEs in the procedure of supporting the ability of foreign production and marketing operations to meet the distinctive needs of local markets. In this case some scientific work seems also to comprise a perquisite for the efficient adaptation of well established technologies in a targeted market focus.

Demographic variables (age and gender of researchers) comprise another set of influential factors in determining the roles assigned to MNE expatriates. The assignment of managerial responsibilities for home country scientific personnel is positively related with the age of researcher. This indicates that more experienced scientific employees are more dedicated to the commercial success and organizational performance of the MNE, identifying themselves within the organization. Surprisingly enough, regression results suggest a statistical negative relationship between males and the foreign assignment of scientific work. This finding contradicts the work of Manolopoulos (2006) that has argued that females seem to be more affected by status-seeking behaviors and the advancement in the managerial ladder of a corporation. It can be argued that male expatriates may adjust better to the complexity associated with expatriate managers' adjustment to new work roles, organizational and national cultures (Shay and Baack 2004). Scientific home-country movements are favoured when the subsidiary operates in technologically intensive

sectors, while managerial responsibilities are positively related with the scientific staffing of European foreign operations. The roles of the laboratories seem to play an insignificant role (only SL for scientific personnel), but this may be attributed to the relatively small number of employees working there (see Table 1).

Take in Table 6: Regressions with the roles of home country personnel and the direction of host country personnel movements as dependent variables

As far as Model II that refers to the transfers of host-country personnel from Greece to other countries (n= 341), our results suggest that the role assigned to decentralized labs is the most influential factor in determining the direction of scientific movements. In this regard, both the support of (i) the ability of an overseas production subsidiary to make the most effective use of existing standard group technology and (ii) the ability of the subsidiary to develop new products that will decisively encompass its perspective on the needs of the local market, require extensive coordination, monitor and control of the scientific work with the HQs. Results are even more reinforced by the negative statistical relationship between SLs and the scientific movements to "other host-country R&D facilities". Laboratories' precompetitive research phase (IIL) role seems to generate strong international interdependencies with other group units and local scientific institutions. Interfunctional teams with other group labs are also prevalent to the more creative scope (LIL) of a decentralized research unit.

While with regard to movements to other MNE group laboratories, our findings show that none of the subsidiary roles has an effect on the dependent variable, our results suggest that movements to the parent laboratory are less favored when a subsidiary acts as a PM and more prevalent when the local subsidiary has been acquired. According to evidence provided by Model II, it appears that when

managers feel that top technical careers are not relevant to their promotion, they move to the central and/or other MNE group laboratories. This can be due to the fact that these employees seek some international experience that not necessarily is associated with acquisition of technical skills and knowledge. Finally, as regards the movements to another host-country facility, the results show that these are largely positively affected by organizational size. Generally, the results show that the strategic evolution of MNEs (which can be represented in mandates assigned to both the subsidiary and the overseas research unit) are linked to different host-country personnel movements.

Conclusions

The results of this study shed some light to the unexplored issue in international human resource management of R&D employee movements within MNEs. Specifically, the study sought to illuminate the extent and essence of the transfers of home-country scientific human capital inputs; the frequency, direction and motivation of host-country scientific personnel transfers; and the impact of specific contingency factors (strategic, organizational and demographic characteristics) on the direction of these movements. This research is particularly salient in the international domain due to the importance of scientific personnel in technology creation, development and use. In order to investigate the above issues, we have developed a theoretical framework, arguing that any contribution that attempts to conceptualize the above topics should combine organizational and strategic theory. The framework was empirically tested and all the sets of factors used have proved to be significantly associated with intra-MNE transfers of scientific personnel.

On the empirical side, the study suggests that there are significant R&D personnel movements, both to and from the home country, which are greatly

influenced by the roles of the subsidiary and the R&D laboratories. This finding indicates that MNEs' international human resource strategies are directly related to the strategic perspective of MNEs towards global competitiveness. Home country experts are mainly assigned with the managerial responsibility to coordinate and control decentralized research programs that aim at the longer-term development of the subsidiaries, whereas local personnel scientific movements are mainly targeted at the reinforcement of subsidiaries' current competitive position.

With regard to the implications for research, this study alludes to the need for 'a contingency examination' when analysing the investigating theme. MNEs operations are now much more associated with integrated scientific networks supported by multi-directional scientific personnel transfers. TMR subsidiaries affect differently than PMs the home country personnel and host-country personnel movements; whereas somewhat surprisingly RPS subsidiaries do not affect the personnel roles and movements. This is likely to be due to the Greek sample of the current study in that few MNEs may view their Greek R&D operations as rationalised product subsidiaries. Similarly, different R&D roles relate to dissimilar types of host-country movements (SLs to movements to parent laboratories; LILs to other MNE laboratories etc.). Overall, our results meet the expectations for a middle-income European peripheral economy, where the incorporation of value-added activities in subsidiaries' operation does nor comprise a strategic priority for many MNEs, thus signs of centralization are evident and anticipated. However, there is scope to support that there is a tendency that local scientific personnel attempt to update their research skills. This also may be the foundations for more distinctive positioning of local R&D in MNEs' creative scopes.

In relation to the implications for management practice, the study shows that different subsidiary and R&D roles may require people with various managerial and technical aspirations. Not all employees are capable in succeeding in all roles and subsidiaries of the MNE group and the insights learnt from this study can be illuminating to MNE managers. Moreover, international assignments are also affected by the employees' career aspirations within the multinational network. This is an especially valuable lesson for transferring and promotion policies of MNEs.

This study would benefit if research from other countries is made. Greece is a small country on the EU periphery and the goals of MNEs for their subsidiaries and R&D operations can be specific to this economy. Thus, evidence from other countries would be particularly illuminating in this regard. Also, the study would benefit from a wider number of observations with home country personnel roles, which was rather low in this study. Again this number may be explained by the relatively modest significance of Greece as an FDI destination by big MNEs. Another limitation upon which further research could build on has to do with the lack of perceptions and beliefs of headquarter managers. Specifically, in the current study, only the subsidiary perspective was examined and this may not necessarily coincide with the viewpoint of the headquarters.

In summary, this study used a highly controlled setting and market in order to test empirically the frequency, direction, motives, assignments and determinants of scientific personnel movements. Despite the limitations of the study and the fact that there is always room for error in any questionnaire-based research, evidence seems to provide insights to our initial purposes.

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Figure 1: Research model: Factors determining scientific movements

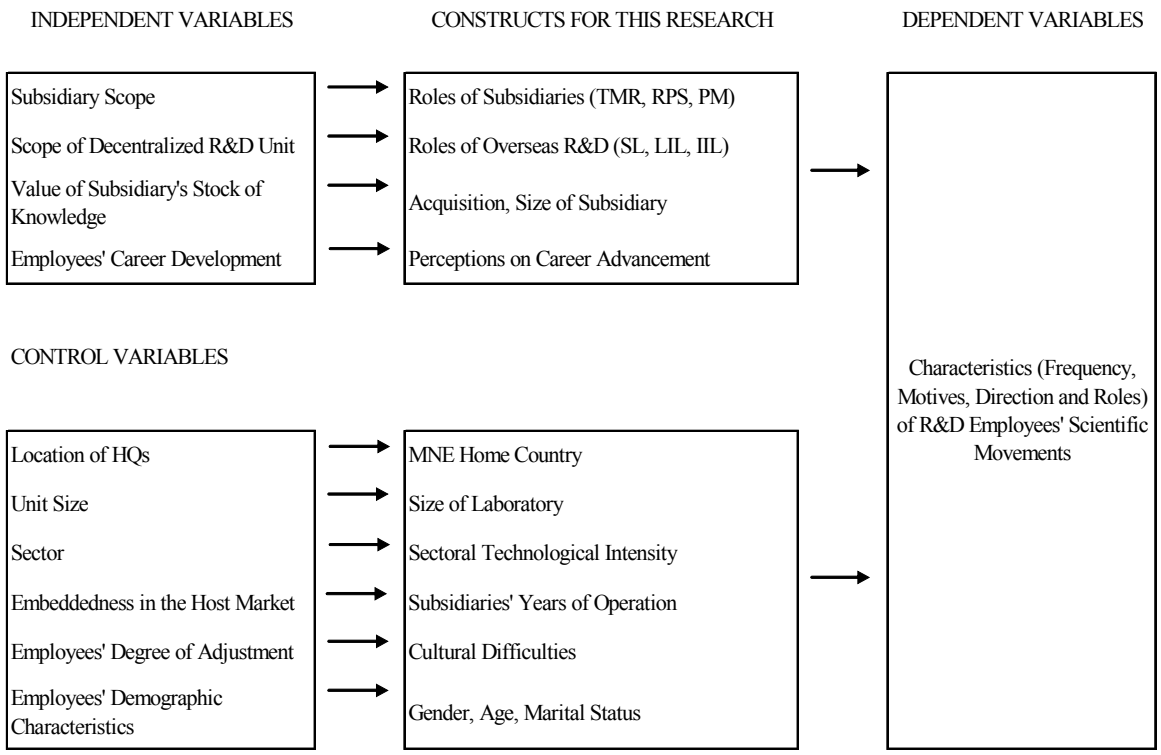

Table 1: Proportion of home country scientific personnel in decentralized R&D units, %

		Home Country Personnel in Laboratory Employment			
		0	1-25	26 and over	Total
Sector[a]					
High-technology industries[b]		45.45	40.91	13.64	100.0
Medium-technology industries[c]		39.35	47.37	13.26	100.0
Low-technology industries[d]		70.0	30.0	0.0	100.0
	Total	40.0	48.57	11.43	100.0
Home country					
EU		27.59	58.62	13.79	100.0
Other European Countries[e]		44.44	44.44	11.12	100.0
US[f]		46.15	38.47	15.38	100.0
Rest of World[g]		60.0	40.0	0.0	100.0
	Total	40.0	48.57	11.43	100.0
Role of laboratory					
SL[h]		47.0	45.0	8.0	100.0
LIL[i]		25.0	56.0	19.0	100.0
IIL[j]		20.0	60.0	20.0	100.0
	Total	40.0	48.57	11.43	100.0

Notes

Number of observations (n)=71. Includes home country personnel that intend to work in the host country lab for at least one month throughout a year.

[a] The classification of sectors in high-, medium- and low- technology industries was basen on the work of Pearce (1994).

[b] Covers telecommunications electronics and IT,chemicals and pharmaceuticals.

[c] Covers food and beverages and manufacturing

[d] Covers miscellaneous, textiles and other manufacturing.

[e, f, g] See Appendix I-a

Roles of Laboratories

[h] SL: To facilitate the adaptation of existing products and/or processes to make them more suitable to local market and conditions

[i] LIL: To play a role in the development of new products

[j] IIL: To carry out basic research (not directly related to current products) as part of a wider MNE group-level research programme

Source: Authors' survey

Table 2: Roles of home country scientific personnel in MNE subsidiary laboratories)

	Roles of Home Country Personnel[a]					
	Mainly to organize the laboratory's programme of work		Mainly to participate in the scientific work of the laboratory		To participate in both roles	
	Number	Percent over Total	Number	Percent over Total	Number	Percent over Total
Sector						
High-technology industries[b]	9	12.7	14	19.7	4	5.6
Medium- and low-technology industries[c]	22	30.9	9	12.6	13	18.3
Total	31	43.6	23	32.3	17	23.9
Home country						
EU	12	16.9	13	18.3	7	9.8
Other European Countries[d]	8	11.2	5	7.0	6	8.4
US[e]	5	7.04	4	5.6	3	4.2
Rest of World[f]	6	8.04	1	1.4	1	1.4
Total	31	43.6	23	32.3	34	23.9
Role of laboratory[g]						
SL	15	21.1	8	11.2	13	18.3
LIL	14	19.7	8	11.2	2	2.8
IIL	2	2.8	7	9.9	2	2.8
Total	31	43.6	23	32.3	17	23.9

Notes

Number of observations(n)=71

[a] Respondents were asked to evaluate the prevalence of managerial and scientific role as being: (i) only role, (ii) major role, (iii) secondary role, and (iv) not a role. In cases where respondents have characterized both managerial and scientific roles as being "only" and/or "major" role, we consider that they participate in both roles.

[b, c] See Table 1

[d, e, f] See Appendix I

[g] See Table 1

Source: Authors' survey

Table 3: Movements of host country personnel to other scientific laboratories

		Average Response [a]		
		To the parent	*Other MNE group labs*	*Other country R&D facility*
Sector				
High-technology industries[b]		2.11	1.95	1.52
Medium-technology industries[c]		2.07	1.88	1.64
Low-technology industries[d]		1.96	1.77	1.51
	Total	2.05	1.87	1.55
Home country				
EU		2.14	1.88	1.42
Other European Countries[e]		2.08	1.84	1.68
US[f]		1.95	1.91	1.57
Rest of World[g]		1.85	1.84	1.70
	Total	2.05	1.87	1.55
Role of Laboratory [h]				
SL		2.04	1.65	1.48
LIL		2.07	1.95	1.60
IIL		2.08	2.66	1.79
	Total	2.05	1.87	1.55

Notes

Number of observations (n)=598

[a] Respondents were asked to evaluate movement of personnel to each type of facility as occuring very often (over 3 times per year), frequently (1-2 times per year on a regular basis), occasionally (when there is a need) or never. The average response was then calculated by allocating responses of very often the value of 4, frequently the value of 3, occasionally the value of 2 and never the value of 1.

[b, c, d] See Table 1

[e,f,g] See Appendix I

[h] As in Table 1

Source: Authors' survey

Table 4: Motivation for movements of host-country scientific personnel to other institutions, %

		Motivation[a] *(percentage)*				
		A	B	C	D	Total
Sector						
High-technology industries[b]		27.2	43.5	18.2	11.1	100.0
Medium-technology industries[c]		18.5	59.4	14.1	8.0	100.0
Low-technology industries[d]		12.3	53.4	16.2	18.1	100.0
	Total	21.4	51.6	16.1	10.9	100.0
Home country						
EU		22.2	47.2	21.4	9.2	100.0
Other European Countries[e]		20.8	54.9	14.8	9.5	100.0
US[f]		21.1	52.2	7.3	19.4	100.0
Rest of World[g]		19.8	61.2	7.1	11.9	100.0
	Total	21.4	51.6	16.1	10.9	100.0

Notes

Number of observations (n)=341. Respondents were asked to tick the most relevant reason.

Reasons for movement of scientific personnel

A: Predominately to train them in the host country laboratory

B: To improve their knowledge of existing MNE technology

C: To participate in joint R&D programmes

D: To provide international experience to the individual

[a] Respondents were asked to tick the most prevalent case

[b, c, d] see Table 1

[e, f, g] see Appendix I-a

Source: Authors' survey

Table 5: Operationalization of variables

Variables	As appear in regressions	Type[a]	Operationalization
Independent Variables			
Role of Subsidiary			In order to evaluate their role, subsidiaries were asked to grade each of the following roles in terms of importance in their operations as being: (i) not part of their role, (ii) main role, (iii) secondary role and (iv) only role
			(i) The production of standardized products
			(ii) The production of specific products or component parts of the whole range
			(iii) The production of differentiated products
Truncated miniature replica	TMR	L/D	Subsidiary that produces standardized products (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Rationalized product subsidiary	RPS	L/D	Subsidiary that specialize its production in specific products or component parts of the final product (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Product mandate	PM	L/D	Subsidiary that produces differentiated products (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Role of Laboratory			In order to evaluate laboratories' role R&D manager was asked to grade each of the following roles in terms of the importance in the operations of the research department as being: (i) not part of their role, (ii) main role, (iii) secondary role and (iv) only role
			(i) Adaptation of existing products and/or processes to make them more suitable to our markets and conditions
			(ii) To play a role in the development of new products for our distinctive markets
			(iii) To carry out basic research (not directly related to the current products) as part of a wider MNE group level research program
Support laboratory	SL	L/D	Laboratory that adapt existing products and/or processes (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Locally integrated laboratory	LIL	L/D	Laboratory that has a distinctive role in the development of new products (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Internationally independent laboratory	IIL	L/D	Laboratory that carries out basic research (4=only role, 3=main role, 2=secondary role, 1=not part of role)
Stock of Subsidiary Knowledge			In order to identify the value of subsidiary stock of knowledge, two proxies were used: acquisitions (as a mode of entry) and the size of the unit
Acquisition as mode of entry	MoE	B/D	1=subsidiary established in the local market through acquisition, 0=otherwise
Size of subsidiary	SUBSIZE	L/D	In order to evaluate the size of subsidiary, the volume of gross sales expressed in million Euros was taken under consideration. 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
Employee Development			Respondents were asked to evaluate as (i) absolute desirible, (ii) quite intresting and (iii) not an option the following career alternatives: (i) Follow a top managerial career (ii) Follow a top technical career in challenging scientific projects and research activities inside or outside the corporation
Top Managerial	TOPMAN	L/D	Respondents with aspirations of top managerial career were asked to evaluate the perceived impact of international assignments as being: 3=absolute desirable and very related to promotions, 2=quite relevant to promotions; but not a determinant factor and 1=irrelevant to promotions
Top Technical	TOPTECH	L/D	Respondents with aspirations of top technical career were asked to evaluate the perceived impact of international assignments as being: 3=absolute desirable and very related to promotions, 2=quite relevant to promotions; but not a determinant factor and 1=irrelevant to promotions

Control Variables

EU countries	EU	B/D	1=parent from EU, 0=otherwise
Other European countries	OTHEREUR	B/D	1=parent from other European country, 0=otherwise
Rest of world	ROW	B/D	1=parent from rest of world countries, 0=otherwise
Unit size	LABSIZE	C	Size of Laboratory (Number of personnel the laboratory employs)
High technology sector	HIGHTECH	B/D	1=subsidiary operating in high technology sector, 0=otherwise
Age of subsidiary	AGESUB	L/D	Age of subsidiary (Number of years the subsidiary has been established in Greece). According to the years of operation, subsidiaries were characterized as well established, recently established and new established. Well established are the subsidiaries that operate in Greece before 1975 and take the value of 3. Recently established are the subsidiaries that begun to operate between 1976 and 1995 and take the value of 2. Newly established are the subsidiaries that identified their presence after 1995 and take the value of 1.
Cultural adjustment	CULTURE	L/D	Respondents were asked to evaluate the difficulties associated with their cultural adjustment in the other country as being (i) major, (ii) important, (iii) minor and (iv) trivial. Trivial difficulties in cultural adjustment take the value of 4, minor difficulties take the value of 3, important difficulties the value of 2 and major difficulties the value of 1.
Age of respondent	AGERES	L/D	According to the date of researchers' birth three categories were created: R&D professionals over 45 years old take the value of 3, R&D professionals between 36 - 45 take the value of 2, under 36 years old take the value of 1.
Gender of respondent	GEN	B/D	1=male, 0=female
Marital status	STATUS	B/D	1=married, 0=single

Notes

[a] Binary (B); / Likert - Type (L); / Discrete (D); Constant (C)

Table 6: Regressions with the roles of home country personnel and the direction of host country personnel movements as dependent variables[a]

Rergressions[b] with home country personnel roles (Model I)				Regressions[b] with direction of host-country personnel movements (Model II)			
Roles	A	B	C	Direction	A	B	C
TMR	.509** (.198)		.588*** (.216)	TMR			
RPS				RPS			
PM	.732** (.282)	.882*** (.305)		PM	-.490* (.298)		.799** (.371)
SL		-.642*** (.236)		SL	.706** (.329)		-588*** (.216)
LIL				LIL	.487* (.188)	.304*** (.071)	
IIL				IIL		.282* (.122)	.811** (.358)
MoE				MoE	.434* (.214)		
SUBSIZE				SUBSIZE			.827** (.384)
TOPMAN				TOPMAN			-.400** (.222)
TOPTECH	-.441* (.182)			TOPTECH			
EU	.852** (.501)	-.459** (.226)		EU			
OTHEREUR				OTHEREUR			
ROW				ROW			
LABSIZE				LABSIZE	-.675*** (.246)		.449** (.196)
HIGHTECH			-.757** (.321)	HIGHTECH		.950*** (.311)	
AGESUB				AGESUB			
CULTURE		-.715* (.490)		CULTURE			
AGERES	.109*** (.006)		.799** (.371)	AGERES			-.290** (.059)
GEN		-.311** (.086)		GEN			
STATUS				STATUS			
n=71				*n=341*			
Pseudo R-square	0.20	0.21	0.18	Pseudo R-square	0.20	0.19	0.27
F	2.91**	2.96***	2.67*	F	3.86***	3.68**	1.86*
LR chi^2	25.67***	26.12***	23.24***	LR chi^2	20.39**	20.21**	26.59***

*** significant at 0.01, ** significant at 0.05, * significant at 0.10

Figures in () is standard error

Roles of home-country scientific personnel

A: To organize the laboratory's programme of work

B: To participate in the scientific work of the laboratory

Data Appendix I-a: Sample by industries and country of HQs origin

Sector	Total Population (Firms provided by ICAP)	Number of Respondents	Response Rate	Number of Respondents with R&D	Rate of R&D Subsidiaries in our Sample
Automobiles and Transport Equipment	19	11	57,89%	0	0,00%
Chemicals	18	8	44,44%	5	62,50%
Telecommunications, Electronics and IT	15	7	46,67%	5	71,43%
Food and Beverages	47	29	61,70%	19	65,52%
Manufacturing	62	31	50,00%	18	58,06%
Miscellaneous[a]	19	9	47,37%	4	44,44%
Other Manufacturing[b]	34	8	23,53%	6	75,00%
Pharmaceuticals	31	16	51,61%	12	75,00%
Services	51	10	19,61%	0	0,00%
Textiles	19	4	21,05%	1	25,00%
Total	*315*	*133*	*42,22%*	*70*	*52,63%*

HQs Country of Location	Total Population (Firms provided by ICAP)	Number of Respondents	Response Rate	Number of Respondents with R&D	Rate of R&D Subsidiaries in our Sample
EU Countries	129	57	44,19%	29	50,88%
Other European Countries[c]	78	31	39,74%	18	58,06%
US[d]	62	28	45,16%	13	46,43%
Rest of World[e]	46	17	36,96%	10	58,82%
Total	*315*	*133*	*42,22%*	*70*	*52,63%*

Notes

[a] Miscellaneous includes Agribusiness, Equipments for Bakery, Home Equipment.

[b] Other Manufacturing includes Tobacco, Paper and Forest Products, Heating and Air Conditioning and Office Machinery.

[c] Includes Cyprus.

[d] Includes Canada.

[e] Includes Japan, Australia, South Korea, Taiwan, Singapore.

Source: Authors' survey

Data Appendix I-b: Sample by respondents (home- and host-country scientific personnel)

	Home Country Scientific Personnel			Host Country Scientific Personnel			Totals		
	Total employment	Number of respondents	Response rate	Total employment	Number of respondents	Response rate	Total employment	Number of respondents	Response rate
Sector [a]									
High-technology industries[b]	38	27	71,05%	309	252	81,55%	347	279	80,40%
Medium-technology industries[c]	44	35	79,55%	411	249	60,58%	455	284	62,42%
Low-technology industries[d]	14	9	64,29%	132	97	73,48%	146	106	72,60%
Total	96	71	73,96%	852	598	70,19%	948	669	70,57%
Home country									
EU	41	32	78,05%	386	272	70,47%	427	304	71,19%
Other European Countries[e]	26	19	73,08%	251	193	76,89%	277	212	76,53%
US[f]	18	12	66,67%	137	81	59,12%	155	93	60,00%
Rest of World[g]	11	8	72,73%	78	52	66,67%	89	60	67,42%
Total	96	71	73,96%	852	598	70,19%	948	669	70,57%

Notes

[a] The classification of sectors in high-, medium- and low- technology industries was basen on the work of Pearce (1994).

[b] Covers telecommunications electronics and IT,chemicals and pharmaceuticals.

[c] Covers food and beverages and manufacturing.

[d] Covers miscellaneous, textiles and other manufacturing.

[e, f, g] See Appendix I-a

Source: Authors' survey