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How do MNC R&D Laboratory Roles Affect Employee International Assignments?

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Abstract Research and development (R&D) employees are important human resources for multinational corporations (MNCs) as they are the driving force behind the advancement of innovative ideas and products. International assignments of these employees can be a unique way to upgrade their expertise; allowing them to effectively recombine their unique human resources to progress existing knowledge and advance new ones. This study aims to investigate the effect of the roles of R&D laboratories in which these employees work on the international assignments they undertake. We categorise R&D laboratory roles into those of the support laboratory, the locally integrated laboratory and the internationally interdependent laboratory. Based on the theory of resource recombinations, we hypothesise that R&D employees in support laboratories are not likely to assume international assignments, whereas those in locally integrated and internationally interdependent laboratories are likely to assume international assignments. The empirical evidence, which draws from research conducted on 559 professionals in 66 MNC subsidiaries based in Greece, provides support to our hypotheses. The resource recombinations theory that extends the resource based view can effectively illuminate the international assignment field. Also, research may provide more emphasis on the close work context of R&D scientists rather than analyse their demographic characteristics, the latter being the focus of scholarly practice hitherto.

Keywords International assignments · Roles of R&D laboratories · R&D employees · Resource recombinations · Multinational corporations

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1 Introduction

This article examines how Research and Development (R&D) laboratories of multinational corporation (MNC) subsidiaries influence international assignments that employees working in these laboratories undertake. The emphasis on R&D scientists and engineers is topical as these persons are the main agents in the discovery and improvement of novel forms of technological progression in the ‘centres of excellence’ of the modern MNC. In MNCs such as Siemens, R&D laboratories stand out as a ‘key success factor for the company’ since their scientists and engineers develop innovations that constantly shape the cornerstones of accomplishments of the firm, according to its Head of Global Innovation Communication (Akalin 2009). It appears that R&D employees are valuable to MNCs since their tacit knowledge is actively engaged in innovation and provides the basis for generating value to firms (Kyriakidou 2011; Donnelly 2008).

This tacit knowledge represents an idiosyncratic resource that the MNC subsidiary possesses to achieve its objectives. Closely allied to the resource based view, the theory of resource recombinations posits that the way the firm recombines and reconfigures its existing resources, especially those that bring innovation, can provide value creation (Galunic and Rodan 1998). Birkinshaw and Pedersen (2009) support the view that the examination of subsidiary level resources for MNC affiliates to gain competitive advantage should be accompanied by appropriate resource recombinations. In a similar vein, the relationships between effective intra-firm learning, global sources of competitive advantage and enhanced performance are contingent upon the MNC’s ability to coordinate and imperfectly mobilise heterogeneous human resources within the entire MNC system (Caligiuri and Colakoglu 2007). International assignments provide these employees opportunities for training and development because they may offer them prospects to lead projects and offer chances to join fast-track technology programmes. It follows that international assignments offer major opportunities to MNC R&D subsidiary employees to refine, hone and recombine their knowledge. In the current study, we focus on short-term international assignments (lasting up to 12 months) as they are considered particularly useful when MNC knowledge-specific skills need to be transferred as rapidly as possible. This can hold when particular problem-solving needs arise or when an MNC research project has to be divided between units quickly (Reiche and Harzing 2011). Besides, short-term international assignments could draw a larger pool of potential R&D scientists for the assignment programmes, effectively enhancing the probability and quality of knowledge resource recombinations within the MNC.

The motivation and retention of competent R&D scientists and engineers represents a considerable challenge to MNC subsidiary management (Martin and Schmidt 2010). Providing effective training and development programmes to R&D employees through international assignments should thus be an indispensable pillar of the international human resource management strategy of the MNC. The importance of those international assignments has recently come to the fore of the international human resource management agenda (Mäkelä et al. 2009). This is

likely to do with the fact that the number of international assignees within the MNC has increased considerably lately (Chang et al. 2012). This especially holds for short-term assignments as opposed to longer-term ones (Farndale et al. 2010). However, the empirical evidence concerning the determinants that influence the use of short-term assignments is scant (Collings and Scullion 2011; Collings et al. 2009), whereas it is almost absent for those assignments of R&D scientists.

We explore the effect of the roles of R&D subsidiary laboratories on the MNC decision to assume (short-term) international assignments for their R&D employees. Following previous research, these roles are those of the support laboratory, the locally integrated laboratory and the internationally interdependent laboratory. Our focus on the R&D laboratory subsidiary roles is dictated by the person-environment fit perspective that suggests that congruence should occur between the characteristics and demands of the employee with the attributes and culture of its (*close work-environment*) (Kristof 1996). R&D roles are very likely to affect work values and career orientations of R&D experts (Chang et al. 2008). The examination of these roles is likely to contribute to the MNC ability to develop effective transmission of knowledge and knowledge resource recombinations through R&D employee assignments (Belderbos and Heijltjes 2005).

This article is structured as follows. In the next section we explore the literature on R&D roles and international assignments, and develop the three hypotheses that guide the empirical study. In the section that follows we provide details of the methodology of the research. In the penultimate section we elaborate on the statistical analysis and present our results. We explore the main conclusions and implications, and discuss potential limitations of the study in the final section.

2 Research Background and Hypotheses

2.1 International Assignments and Mobility of R&D Employees

A significant portion of the technological advancements of MNCs does take place not in the headquarters of the firm but in *foreign subsidiaries* that may act as catalysts of innovative change for the whole MNC network (e.g., Ecker et al. 2013). This is the case at Procter and Gamble where 26 R&D centres worldwide make every effort to ensure that it hires ‘great innovators’ in its R&D laboratories, who pursue the advancement of technology to satisfy customers in more than 180 countries (Dyer and Gregersen 2012). Such an innovative humanitarian project is the Procter and Gamble Purifier of Water plant in Singapore which is expected to yield more than 200 million water purifier sachets annually by 2020 to provide for the firm’s Children’s Safe Drinking Water programme (Future Ready Singapore 2014). Nowadays, subsidiaries assume (or are assigned) autonomy that can lead to initiative-taking behaviour (Ambos et al. 2010; Young and Tavares 2004). This behaviour is likely to manifest in technological innovations in foreign R&D laboratories, which typify the ‘liberalism era’ whereby headquarters have to tap into ideas from ‘centres of excellence’ abroad and leverage them throughout the whole MNC network (Birkinshaw and Hood 2001; Nobel and Birkinshaw 1998).

The competitiveness of the MNC is dependent on its ability to reorganise and recombine its resources effectively (Rugman et al. 2011; Galunic and Rodan 1998). According to Sirmon et al. (2007) dynamic resource management model of value creation; appropriate structuring, bundling and leveraging are important subprocesses for MNCs that should be adjusted according to different environments. The examination of resource recombinations in MNC R&D activities originates from the work of Schumpeter (Schumpeter 1942) who views innovation as ‘new combinations’ that incessantly yield dynamics of ‘creative destruction’ (Sledzik 2013). International assignments reflect the strategic objectives of the firm (Harvey 1996). MNCs have to design employee practices to maintain congruence with the overall strategic plan of their network, while at the same time addressing the constraints of various host environments (Caligiuri and Colakoglu 2007; Milliman et al. 1991). In that regard, international employee mobility is considered to be a major human resource management practice that is well-aligned with the MNC strategic orientation (Novicevic and Harvey 2004). Prior research (Tahvanainen et al. 2005; Evans et al. 2002) has shown that one of the chief reasons behind offering international assignments to employees is knowledge transfer. The development of knowledge flows through international employee mobility is a common MNC practice (Achcaoucaou et al. 2014).

The international mobility of knowledge employees, such as those working in R&D laboratories, is particularly important because of their intrinsic talent and expected ability to transfer skills, creative thinking and expertise within the MNC (Campbell et al. 2012). These employees constitute strategic knowledge resources and have different aspirations than those of traditional employees (Patalas-Maliszewska 2013). They are the main originators of innovations in the ‘centres of excellence’ in foreign subsidiaries. R&D scientists can effectively act as the innovation agents who recombine their expertise and generate new knowledge, transferring value between units through their international assignments.

2.1.1 Roles of R&D Laboratories

According to the liberalism era of subsidiary evolution, as MNCs develop a global approach in their outlook on innovation and technology, the units that are mainly involved in the generation, deployment and application of knowledge-related inputs are likely to be their decentralised R&D laboratories (Iwasa and Odagiri 2004; Nobel and Birkinshaw 1998). Capability flows within the MNC do not necessarily originate from headquarters (Peng and Wang 2000). It is rather ‘through subsidiary capabilities and initiatives that more knowledge flows can be facilitated’ (Peng 2001, p. 811). This fact contributes to the strategic evolution of the MNC group (Papanastassiou and Pearce 1999). MNCs constantly attempt to identify ways of bundling their knowledge resources to attain their mission and objectives through engaging in innovative resource recombinations involving their subsidiaries (Rugman et al. 2011).

Viewed in this light, employee assignments across the world are affected by the different strategic roles allocated to (or assumed by) these R&D units (Criscuolo 2005). This can hold true because foreign R&D laboratories are usually established with a specific mission to complement a perceived need in the parent organisation (von Zedtwitz 2004). R&D employees can have principal knowledge sharing roles

(Allen et al. 2007). The classification of R&D roles, which we adopt in this study, derives from Haug et al. (1983) and Hood and Young (1982). It identifies three distinctive roles for decentralised R&D units.

2.1.1.1 Support Laboratories In the first role of ‘support laboratory’ (SL), the laboratory of the subsidiary has the mandate to effectively apply (with minor adaptations when needed) technologies existent in the MNC (Papanastassiou and Pearce 1999). Other scholars use the terms ‘local adaptor’ (Ambos and Schlegelmilch 2007), ‘technology transfer unit’ (Ronstadt 1977) and ‘technical support unit’ (Håkanson and Nobel 1993) to refer to this first role of R&D unit. Its main function is to adapt the product and/or its production process to meet the local needs and immediate commercialisation of subsidiary output in a priori determined target markets. SLs rely heavily on the existing knowledge present (elsewhere) in the MNC system.

Being part of the traditional centripetal R&D structure and given the SLs’ limited strategic autonomy and capacity for technology transfer between physically distant research facilities, there is little expectation that SL employees will be induced to engage in network building with other knowledge professionals. This is primarily because their units work in isolation from other foreign R&D labs of MNCs and interact only with local subsidiary functional departments, specifically those that support marketing activities. If there is movement of R&D employees to transfer knowledge to the local laboratory, this will most likely take place through one-way movements from the headquarters and other sister subsidiaries to the subsidiary/laboratory concerned (Ferner et al. 2011). The lack of interdependence between these types of business units and the rest of the MNC may limit their ability to take advantage of the knowledge resource recombination advantage (Hansen 2002). R&D employees in these laboratories may look solely for specific technical and functional know-how in units with low levels of autonomy (Caligiuri and Colakoglu 2007). Moreover, the ‘codification of routines’, which takes place in this type of R&D lab, decreases the likelihood of resource recombinations. The reason for this is that although explicit routines can increase R&D employee understanding of the ‘know-how’, they usually decrease their understanding of the ‘know-why’ that eventually hinders their applicability into new settings (Galunic and Rodan 1998). Therefore, there are no clear expectations that SL employees will be asked to mobilise their skills, knowledge and expertise through international assignments. It follows that employee mobility from SLs in the form of international assignments is expected to be very limited or non-existent due to the restricted functions of these R&D units.

Hypothesis 1: R&D employees in SLs are not likely to assume international assignments.

2.1.1.2 Locally Integrated Laboratories The second type of R&D laboratories, namely ‘locally integrated laboratory’ (LIL), refers to the R&D unit that operates as a closely integrated part of a subsidiary in a host country to develop a distinctive product that can be supplied to a regional, or even global market (Pearce 1999).

Other studies use terms such as ‘international adaptor’ (Ambos and Schlegelmilch 2007; Nobel and Birkinshaw 1998), ‘indigenous technology unit’ (Ronstadt 1977), ‘adaptive R&D unit’ (Håkanson and Nobel 1993) to describe this type of R&D laboratory. Instead of using existing technology to improve the adaptability of well-established products, LILs extend the scope of the subsidiary by expanding the competitive product range of the MNC group, notably they have a more ‘productive’ scope (Manolopoulos et al. 2011). According to Gupta and Govindarajan (1991), these types of units are likely to have a broader strategic role since they contribute to knowledge and product innovation within the MNC. In other words, R&D employees of LILs act as conduits of knowledge. It follows that a different organisational structure whereby LILs take on a leading role in the creation of unique competences can occur.

In this integrated R&D network structure, the development of knowledge inputs is not the prerogative of the headquarters, but emerges from complex external and internal pressures to the foreign subsidiary (Manolopoulos et al. 2005; Gassmann and von Zedtwitz 1999). This is likely to increase the likelihood of mobility, communication and interaction between knowledge professionals within technical functions, and between technical functions and other functions of MNC units (Crisuolo 2005). R&D employees working in this type of foreign R&D lab undertake greater levels of global responsibility and authority in comparison with R&D employees in SLs (Bolino 2007). Operating in such conditions could mean that there is a greater need for accumulating, enriching and bundling resource processes linked to flexibility and adaptability (Sirmon et al. 2007). By utilising and redeploying those competent R&D human resources, supporting significant technology transfer and enhancing resource recombinations between MNC units, firms achieve the advancement of their innovations (Manolopoulos et al. 2005). Thus, it is likely employees in LILs will frequently be sent on international assignments acting as MNC strategic agents and contribute to the company-wide scientific and technological knowledge base (Iwasa and Odagiri 2004).

Hypothesis 2: R&D employees in LILs are likely to assume international assignments.

2.1.1.3 Internationally Interdependent Laboratories The third role for R&D units that play a crucial part in the long-term competitiveness and the global-innovative MNC technology strategy (Filippaios et al. 2009) is called ‘*internationally interdependent laboratory*’ (IIL). Prior literature uses similar terms such as ‘global creator’ (Ambos and Schlegelmilch 2007; Nobel and Birkinshaw 1998), ‘global technology unit’ (Ronstadt 1977) and ‘generic R&D unit’ (Håkanson and Nobel 1993). This last role is likely to provide the MNC group with a full range of basic research inputs into programmes of pre-competitive objectives. The ultimate aim of these research objectives is to develop an expanded knowledge base from which major new product concepts may emerge (Papanastassiou and Pearce 1999). Having no immediate commercial objective, IILs take on positions in strongly interdependent research networks and are more

extensively integrated with other globally-based R&D units. Thus, IILs have an interdependent standing that goes beyond the needs of the subsidiary with which they are associated for their day-to-day operations. This happens because basic research is unpredictable, novel, specialised and unique in its nature (Calvert 2006). Under these dynamic environmental conditions, acquiring, accumulating and bundling knowledge resources are necessary processes that could be beneficial for MNCs (Sirmon et al. 2007). Basic research further requires a common basis and understanding between professionals. IILs are closely linked to the overall strategic purpose of the whole MNC system with the aim of developing knowledge. R&D employees in IILs are in charge of generating and distributing knowledge to the entire MNC network. To this end, they can take on both strategic and developmental international assignments seeking to embody newly acquired knowledge elements within the MNC's technology strategy.

In IILs knowledge resides in the minds of R&D employees and this can increase the likelihood of these valuable knowledge resources moving into new settings to ensure that this knowledge will not be lost and consequently add value to the MNC system (Galunic and Rodan 1998). Furthermore, in this organisational structure likely characterised by inter-unit geographical, organisational and technological distance from the MNC, international assignments of knowledge professionals can facilitate knowledge diffusion and the coordination of R&D activities. This may take place especially because projects involving IILs include research work that requires break-up and prompt cooperation between MNC units worldwide (Criscuolo 2005). Consequently, we posit that:

Hypothesis 3: R&D employees in IILs are likely to assume international assignments.

3 Data and Methods

3.1 Sample and Survey Instrument

A questionnaire-based survey was carried out in MNC R&D units located in Greece. This study was part of a research project investigating employment practices affecting knowledge professionals including their international assignments. The survey took place in two phases. In the first phase, the research objective was to identify those subsidiaries with R&D activity. The dataset drew from a detailed list of foreign operations in Greece provided by the ICAP directory, a widely accepted database with complete coverage of cross-sectional company investments. ICAP has been repeatedly employed by researchers performing studies in Greece (e.g., Kessapidou and Varsakelis 2003). The dataset includes 317 foreign subsidiaries that were all contacted for participation. A very satisfactory response rate of 41.9 % corresponding to 133 useable replies was achieved (two questionnaires were returned undelivered). The firms in our sample represent well a cross-section of local MNC investments with regard to the sector of activity and the country of HQs' origin. A comparison between responding and non-responding firms concerning

firm size reveals no statistically significant differences ($p = 0.921$), thus minimizing the likelihood of a non-response bias. Out of the 133 responding MNC subsidiaries, 70 (52.6 %) reported 'in-house' R&D activity. Among those, 39 (55.8 %) originate from EU countries, four (5.7 %) from other European countries and the remaining 27 (38.5 %) from 'rest of world' countries (mainly the US). Food and beverages, and pharmaceuticals stand out as the most prevalent sectors. Four out of those 70 subsidiaries had some responses with missing observations and were subsequently dropped from the analysis. Hence, our final sampling population consists of 66 R&D subsidiaries.

In the second phase of the survey, all 883 R&D scientists employed in the 66 subsidiaries were asked to complete a structured questionnaire related to international assignments. We followed three steps in the development of our survey instrument. First, two academics and two professional consultants provided suggestions for improving its wording and layout. Second, five subsidiary chief executive officers assessed the content validity of the questionnaire. Their recommendations resulted in a revised draft. Third, we distributed the questionnaire to ten R&D employees for a final review that yielded no additional changes. To increase the response rate, Dillman's (2000) approach was followed. This included sending a cover letter attached to each questionnaire stating the purpose of the research and assuring confidentiality and anonymity.

At the end of each of the 2 months following the initial dispatch to R&D professionals, a reminder letter was sent to all participants requesting that the questionnaire be returned. In total, the questionnaires were sent three times within an interval of 5 months. Out of 883 knowledge employees, 559 useable questionnaires were collected; yielding an effective response rate of 63.3 %. This response rate is similar to or higher than that of other studies investigating MNC employee international mobility (e.g., Birdseye and Hill 1995). Non-response bias was investigated by comparing early with late respondents (Armstrong and Overton 1977) on the basis of three sample measures. No statistically significant differences between respondents and late-respondents were obtained in relation to the role of subsidiaries, number of R&D employees and years of lab operations. Consequently, response bias does not appear to constitute a threat to our findings. Out of the 559 respondents, 315 R&D employees (56.3 %) had assumed at least one international assignment within the period of reference, whereas 244 (43.7 %) had never undertaken any international assignments. The mean age of the employees was 40.39 years (standard deviation 10.90). This is in line with existing literature (e.g., Gabel et al. 2005) indicating that the average age for skilled employee international movements is in the late 30 s and early 40 s. Among respondents that undertook international assignments, 193 were males (61 %) and 122 (39 %) females.

3.2 Measures

Dependent Variable The dependent variable in our study is the *international movements (assignments) of R&D employees (MOV)* for a period of up to 12 months during the last 5 years with their current employer. A binary indicator was coded as 1 if the professionals were sent on any international assignment; and 0

if not. Although there is no single universally accepted definition of what precisely constitutes a ‘short-term’ international assignment (Green et al. 2009), the literature commonly operationalises short-term assignments as postings of between 1 to 12 months (Collings et al. 2007). We adopted this same operationalisation in the current research. Also, in line with prior studies (Caligiuri 2006; Tahvanainen et al. 2005), international assignees included R&D employees involved in any kind of assignment/project (namely strategic, managerial, developmental, functional and/or technical—for a review see Harrison et al. 2004).

Independent Variables These are the roles of MNC R&D labs of subsidiaries. A four-point Likert-type scale was employed (4 = only role, 3 = main role, 2 = secondary role, 1 = not part of a role) to evaluate to what extent the function of the laboratory was suited for: (a) adaptation of existing products and/or processes to make them suitable for the local markets and conditions (*Support Laboratory-SL*); (b) development of new products for regional or global markets (*Locally Integrated Laboratory-LIL*); and, (c) provision of basic research inputs (not directly related to the current products) as part of a wider MNC group-level research programme (*Internationally Interdependent Laboratory-IIL*) (Papanastassiou and Pearce 1999).

Control Variables We included in our analysis a set of control variables related to subsidiary/MNC influences, nature of international assignments, industry characteristics and individual demographics. First, at the subsidiary level, previous research has emphasised the positive effect of subsidiary mandate on employee international mobility (e.g., Rugman and Doh 2008; Fang et al. 2007). Following White and Poynter (1984), and Cantwell and Mudambi (2005), we posit that subsidiaries may experience one of two core roles: either revitalise the strategic evolution of their respective MNC group by *creating unique positions* in group-wide operations around their own products; or, *leverage MNC centrally-derived competencies* by replicating products, components and processes to local markets and resource conditions. We hence generated a dummy variable (SUBAUG) to code this subsidiary augmentation vs. exploitation pattern (1 = subsidiaries have evaluated the production of differentiated products for regional or global markets applying *subsidiary-level knowledge* as their only or predominant role; and 0 = subsidiaries have evaluated the provision of goods that are part of the MNC product range and/or the production of component parts using knowledge that is *already well-established in the MNC group* as their only or predominant role). Apart from subsidiary role effects, the MNC country of origin may possibly explain some patterns of MNC value-added employee international assignments (Adick et al. 2014). Three different groups were distinguished: EU countries, other European countries (*OTHER EUROPEAN*) and countries from the rest of world (*RoW*). The EU is used as the reference category in this set of country dummy variables.

At the lab level, we controlled for the confounding effects of the nature of assignments (team versus individual) in order to obtain better estimates of factors impacting on R&D employee international mobility (see Bonache and Zarraga-Oberty 2008 for an analysis). According to Spender (1996), people-embodied knowledge could be either individually-carried or group-embedded (collective). The dissemination and exploitation of organizational knowledge often requires

transferring teams due to the implementation of cross-border joint innovation projects and competence portfolios (Gassmann and von Zedtwitz 2003; Bonache and Zarraga-Oberty 2008). We control for the nature of assignments through a dummy variable whereby 1 refers to labs that have a tradition of sending collective (team) assignments (TEAM) and 0 otherwise (individual assignments). At the industry level, industry sectors can be related to MNC knowledge-related competitiveness and are included in the analysis as a control variable (e.g., Audretsch 1995). The sector of activity (*MANUF*) is captured through an industry dummy with 1 = representing subsidiaries operating in a manufacturing sector and 0 = subsidiaries operating in a service sector.

At the individual level, we controlled for the age, gender and marital status of the employee. Based on the relevance of age in international assignee studies (Feldman and Tompson 1993), a four-point Likert-type scale was designed (*AGE*) to capture the impact of age on knowledge professional international movements (1 = employees under 36 years old, 2 = between 36 and 45 years old, 3 = between 46 and 55 years old; and 4 = over 56 years old). In addition we used dummy variables for employee marital status and gender. These controls may be relevant as research on international assignments suggests that the employee work-family interface is a key determinant impacting on MNCs decisions to select assignees (Lazarova et al. 2010). This literature suggests that marital status and gender could be factors affecting assignees and their performance (Selmer and Leung 2003; Caligiuri and Tung 1999). The gender of the respondent was captured through the variable *MALE* using 1 for a male and 0 for a female R&D professional. The marital status of the respondent was captured through the variable *MARRIED*, whereby 1 refers to a married R&D professional and 0 to a single employee.

3.3 Common Method Checks

To control for common method bias, we reassured respondents on anonymity and confidentiality and separated the dependent and independent variables in different sections (and pages) of the questionnaire. Using self-report data, we also sought to address the possibility of common method variance. We analysed the data with the Harman's single-factor test. The results of the unrotated factor analysis showed that all items load clearly on six separate factors and that no single factor is dominant. Thus, common method bias does not seem to challenge the results. To explore potential multicollinearity problems, we examined the variance inflation factors (VIFs) of all independent and control variables. The variance inflation factors range between 1.03 and 1.17 (mean of 1.11), which are well below the recommended ceiling of 10. This suggests that there is no significant evidence of multicollinearity (Netter et al. 1989). A test on the skewness and kurtosis coefficients was also conducted to check the assumption of normality and the results verified that this assumption has been satisfied (all values were between the -2 to $+2$ range). Further, the residuals did not show any particular pattern, implying that heteroscedasticity does not seem to be a problem.

Since our dependent variable (*MOV*) is a binary variable, we chose a basic logit regression model as the estimation method. The use of discrete limited dependent

variable models such as logit is becoming ubiquitous in empirical management research (Zelner 2009). A logit model ensures that the probabilities will be within the (0, 1) range. The equation employed in our research is given as:

$$P(y_i = 1 / x_i) = \exp(x_i' \beta) / 1 + \exp(x_i' \beta),$$

where β is the vector of coefficients to be estimated.

We estimated the logit model using a maximum likelihood estimation procedure that results in parameter estimates that are consistent and asymptotically efficient for large samples (Greene 2012). We tested the significance of the entire logit model with the model log likelihood Chi-square, which is analogous to the multivariate F test in the linear regression testing the null hypothesis that all coefficients are zero (Bock and Aitkin 1981).

4 Results

Table 1 report the means, standard deviations and pairwise Pearson correlations between the dependent variable (MOV) and all regressors used in this study. Apart from the expected high correlation between subsidiaries of the 'EU' and those from the 'Rest of World', all other bivariate correlations are below the 0.70 threshold level and no correlation coefficient is higher than |0.41| (two-tailed p).

Table 2 presents the logit regression results. We first estimated a baseline model (Model 1) reporting only the results of the controls on the dependent variable *International movements of R&D employees* (MOV). Next we introduced the terms testing the three hypotheses (Model 2). Model 2 represents a significant improvement over the respective baseline model (pseudo R squares 0.37 and 0.22, respectively). In both models the F ratio value is large and highly significant ($F_{\text{model1}} = 26.00, p < 0.001$ and $F_{\text{model2}} = 36.31, p < 0.001$). The Wald Chi-square figures for both models are significant ($\text{Chi-square}_{\text{model1}}(8) = 119.86, p < 0.001$, and $\text{Chi-square}_{\text{model2}}(11) = 150.40, p < 0.001$), confirming the high explanatory power of our regressions.

Regarding the independent variables, hypothesis 1 predicted that R&D employees in SLs are not likely to assume international assignments whereas hypotheses 2 and 3 predicted that R&D employees in LILs and IILs, respectively, are likely to assume international assignments. The results show a significant and negative association between SL and MOV, while LIL and IIL are positively related with MOV (all at $p < 0.001$). Thus, all three hypotheses receive empirical support and the results show that the work environment of R&D laboratory roles considerably influences international assignments of R&D employees in MNC subsidiaries.

In Model 2, five control variables were identified to be significantly related to the dependent variable (MOV), notably two subsidiary-related characteristics and all three demographic variables. Regarding the subsidiary-related characteristics, the augmentation role of the subsidiary ($p < 0.001$) and manufacturing sector ($p < 0.05$) have a significant and positive relationship with MOV. Autonomous and empowered subsidiaries are likely to be associated with R&D scientists that will

Table 1 Descriptive statistics and correlation matrix

Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	
1. MOV	0.56	0.50	0	1	1													
2. SL	2.91	0.86	1	4	-0.26	1												
3. LIL	1.97	0.97	1	4	0.41	-0.01	1											
4. IIL	1.42	0.64	1	4	0.34	-0.16	0.15	1										
5. SUBAUG	0.28	0.45	0	1	0.29	-0.06	0.2	0.06	1									
6. EU	0.55	0.50	0	1	-0.16	0.1	-0.23	-0.15	-0.17	1								
7. Other European	0.05	0.21	0	1	0.16	-0.07	0.14	0.12	0.18	-0.24	1							
8. RoW	0.41	0.49	0	1	0.09	-0.07	0.18	0.1	0.09	-0.91	-0.18	1						
9. Team	0.41	0.49	0	1	0.01	-0.06	-0.02	-0.04	0.01	0.00	0.07	-0.03	1					
10. MANUF	0.40	0.49	0	1	0.28	-0.24	0.16	0.18	0.03	-0.1	0.03	0.09	0.06	1				
11. AGE	2.27	0.99	1	4	-0.04	0.05	0.09	0.14	0.02	-0.12	0.02	0.11	0.02	-0.00	1			
12. MALE	0.53	0.50	0	1	0.20	-0.05	0.01	0.06	0.19	-0.06	0.02	0.06	0.09	0.05	-0.01	1		
13. Married	0.67	0.47	0	1	0.41	-0.13	0.22	0.15	0.21	-0.04	0.10	0.00	-0.02	0.21	-0.06	0.12	1	

n = 559

Correlations above 0.09 are significant at $p < 0.05$ in a two-tailed test

Correlations above 0.11 are significant at $p < 0.01$ in a two-tailed test

Table 2 Logistic regression results on R&D employees' international movements

	MOV (model 1)	MOV (model 2)
Constant	-1.70*** (0.33)	-2.72*** (0.66)
Roles of decentralized R&D		
SL		-0.57*** (0.14)
LIL		1.04*** (0.15)
III		1.07*** (0.21)
Subsidiary/MNC characteristics		
Role of Subsidiary (SUBAUG)	1.03*** (0.25)	1.10*** (0.28)
Country of origin ^a : other European	1.98* (0.80)	0.64 (0.81)
Country of origin ^a : RoW	0.35† (0.21)	-0.25 (0.25)
Nature of assignment: TEAM	-0.05 (0.21)	0.05 (0.24)
Industry effect: MANUF	1.02*** (0.21)	0.59* (0.24)
Individual demographics		
Age	-0.08 (0.10)	-0.15† (0.11)
Male	0.57** (0.20)	0.71** (0.24)
Married	1.53*** (0.22)	1.36*** (0.25)
F value:	26.00***	36.31***
Pseudo R square:	0.22	0.37
Fit ^b	171.28***	290.48***

Dependent variable: short term international mobility of R&D personnel. Robust standard errors in parentheses

Logit regressions (cut-points omitted)

n = 559

† Significant at 0.1

* Significant at 0.05

** Significant at 0.01

*** Significant at 0.001

^a Country of origin: EU MNCs omitted

^b LR Chi-square

look for assignments abroad. Scientists in these subsidiaries may be loosely controlled by the headquarters, and so, assignments of employees from these subsidiaries can be straightforward to pursue. Employees in subsidiaries with manufacturing operations (pharmaceuticals, chemicals, electronics, food and drinks) are further more likely to be sent abroad for international assignments. Regarding demographics, the evidence suggests a marginally negative statistically significant relationship between AGE and MOV ($p < 0.10$). This finding confirms recent findings in the literature (e.g., Bussin 2015) suggesting that sending younger employees on international assignments nowadays is a key element for international management to attract and retain talented knowledge professionals. Further, the strong and positive statistically significant relationship between MALE and MOV ($p < 0.01$) indicates that gender seems to be an influential predictor of international movements. This gender result is compatible with the evidence that women still

make up a relatively low proportion of MNC employees in international assignments (Shortland 2015; Davidson and Burke 2000). Also, married status ($p < 0.001$) is an influential predictor of international movements. The statistically positive relationship between MARRIED and MOV indicates that married knowledge professionals seem to be assigned more international assignments compared to their single peers. This result is in accordance with international employment surveys (e.g., GMAC-GRS-SHRM Global Forum 2007) and other studies (e.g., Stahl et al. 2002, 2009) indicating the prevalence of married employees in international movements.

We estimated a series of alternative specifications to assess the robustness of our results. First, we substituted alternative measures for the core explanatory variables of primary conceptual interest. We employed the value-exploiting (SL) and the value-augmenting type of work (LIL or IIL) (Kuemmerle 1997). Results were in line with the findings presented in the initial regression model. Second, we employed alternative measures for the age of knowledge professionals (measured in absolute numbers) and the frequency of labs to assume assignments within the period of reference (a five point Likert-type scale was employed). Again the results were consistent with those of Table 2. Third, we added the subsidiary age (a three point Likert type scale related to firms' years of operations in the local market was used) as a control variable. The findings showed that this variable was not statistically significant and the remaining results were the same. Fourth, we added the subsidiary size (log transformed number of employees) as a control variable. Again this variable was non-significant and the remaining results were consistent with those of Table 2. All these results are available from the authors upon request. Overall, we conclude that our findings appear to be robust according to different operationalisations and measurements of our variables.

5 Discussion and Conclusions

In line with the 'liberalism era' of subsidiary evolution (e.g., Birkinshaw and Hood 2001), we argue that subsidiaries are likely to have empowered R&D laboratories that produce novel innovations for the whole MNC network. The current study seeks to complement and advance our understanding of international assignments within MNC networks (Firth et al. 2014; Starr and Currie 2009; Collings et al. 2007). Instead of simply examining the possession of subsidiary level resources with regard to their potential to create competitive advantage, it is necessary to consider recombining them with other resources on a worldwide basis (Birkinshaw and Pedersen 2009; Sirmon and Hitt 2003). The research draws from the resource recombinations theory (Sirmon et al. 2007; Galunic and Rodan 1998) that would posit that R&D professionals comprise valuable strategic resources that can be mobilised between MNC units to refine, recombine and extend knowledge. Such an appropriate bundling of these strategic resources through international assignments may prove beneficial to the entire MNC network. The likelihood of the implementation of recombinations of such knowledge-based resources is a topic that requires further attention (Galunic and Rodan 1998). The resource

recombinations theory has to the best of our knowledge not been examined in the international assignment area. The resource based view is a related perspective that has been widely applied in international human resource management (Holtbrugge and Mohr 2011), but the current study uniquely seeks to apply an extension of the resource based view in the international assignment field.

In particular, we sought to illuminate the influence of the roles of R&D laboratories as determinants of R&D employee international assignments. The emphasis on R&D scientists and engineers is topical as these persons commonly upgrade critical knowledge and generate novel innovations in the R&D centres of excellence. The evidence suggests that the determinants of R&D employee international movements for the recombining of knowledge resources should not only be sought in the traditional expatriate management research that acknowledges the importance of employee-related demographical characteristics in cross-border assignments (e.g., Hippler 2009; Starr and Currie 2009). Indeed scholarly investigation has to open up its agenda and accentuate the fact that the centres of excellence linked to R&D laboratory roles of the close work-environment of these scientists turn out to have a decisive effect on their international assignments. Different types of R&D units require distinct kinds of knowledge and resource recombinations in the MNC system. This is in line with Galunic and Rodan's (1998) study in which they argue that either combining or reconfiguring existing internal resources to synthesise novel competencies can affect the likelihood of resource recombinations. Our empirical data suggest that differences exist in the way that R&D labs organise their knowledge-sharing relationships. We found that international assignments for R&D employees working in LILs and IILs can facilitate the diffusion of knowledge and recombination of knowledge resources across the MNC. On the other hand, R&D professionals working in SLs have restricted functions and less autonomy, which may deter them from taking part in international assignments. This finding is in line with prior research conducted by Belderbos and Heijltjes (2005), who posit that expatriation policies may differ based on the strategic importance of the unit. Furthermore, the identified resource recombinations highlight the patterns that should be followed regarding the empowerment of R&D excellence in MNCs as suggested by Gassmann and von Zedwitz (1999). More specifically, in both LILs and IILs, which are characterised by autonomy and are assigned strategic roles, knowledge flows can come around the world through sending R&D employees abroad. In such work environments there is a high likelihood of mobilising and coordinating key existing knowledge resources such as human capital that eventually can lead to enrichment of capabilities (Sirmon et al. 2007). Therefore, we extend the literature as we show that effective resource recombination takes place in an R&D setting allowing autonomy, flexibility and entrepreneurialism. The findings suggest that there should be a fit between the (R&D) work context and the level of resource facilitation recombination.

Further, the investigation of subsidiaries based in Greece provides empirical evidence from a small EU peripheral economy, in which MNC R&D roles may be different from those in other countries. Most related studies on international assignments have taken place in advanced and bigger economies such as that of the US, which is a strategically important country for MNC headquarters operations.

Examination of subsidiaries based on peripheral countries does not take place to a significant extent in the existing literature. These subsidiaries may be ‘catch up’ players in MNC hierarchies. They stand out as a group of entities on which more attention has to be given since they are also likely to contribute to significant MNC technological innovations. Because of their disadvantage in terms of technological capabilities, peripheral economies may attract more competence-exploiting and demand-driven R&D activities than core countries (Narula and Guimón 2010; Cantwell and Mudambi 2000). Our empirical findings seem to imply that LIL and ILL R&D units in peripheral countries seek to promote international assignments in order to exploit foreign advanced knowledge (Shimizutani and Todo 2008).

The study provides useful managerial implications. The current complex international environment in which MNCs operate may necessitate a reformulation of the essence, scope and objectives of international assignments. MNC subsidiary staffing architecture can be oriented towards a ‘local-internal’ archetype (Mäkelä et al. 2009) that is likely to capitalise on the ground-breaking advantage of MNCs in using traditional and reverse knowledge flows (Manolopoulos et al. 2005). In their study, Sirmon et al. (2007) conclude that top-level managers should consider MNCs as a system of resources and capabilities that require appropriate structuring, bundling and leveraging processes to promote knowledge development and diffusion. Different processes are required for different environments. Our study goes one step further by identifying the structuring and bundling patterns in terms of assignment policies that human resource managers adopt for knowledge professionals in order to staff different parts of an organisation. Managers should take into consideration that the different strategic roles of the R&D units can affect the likelihood of knowledge professional mobility. Employees in SLs are less likely to assume international assignments than their counterparts in LILs and IILs. Managers in LILs and IILs in particular can use international assignments of knowledge professionals as a means to substantially facilitate knowledge development and diffusion of R&D activities across the MNC system.

This research faces limitations that may guide future research. An initial limitation relates to a range of additional factors that can influence MNC decisions to delegate international assignments to their R&D employees. Further study is likely to examine other factors associated with determinants of international assignments, such as the development stage of decentralised R&D units and subsidiaries, or the corporate tenure, educational level of respondents, and so forth. Future research may also examine the purpose that international assignments serve in host countries. Moreover, the level of involvement of MNC headquarters (rather than the subsidiary) and of the individual employee in the undertaking of international assignments is a limitation that further examination can provide insights. The results of this study can be constrained also by the investigated sample of Greek subsidiaries. Greece is a fairly small country on the EU periphery and the goals of MNC subsidiaries and their R&D operations may be unavoidably affected by this specific environmental context. Future research examining the differences in the international mobility of employees working in different types of R&D units in frontier economies and other countries is expected to shed further light in this area (Shimizutani and Todo 2008). In a similar vein, future studies would attempt to

replicate and extend the focus of this research to other host country settings with different national and economic characteristics such as China and India in which international assignment research is at a very nascent stage (Thite et al. 2009). Finally, future research in this topic could focus on manufacturing sectors in other countries to examine whether subsidiary operations in countries other than large developed ones have relatively stronger competence-exploiting and demand-driven R&D activities.

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