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How does R & D internationalization in multinational firms affect their innovative performance? The moderating role of international collaboration in the energy industry[☆]

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ABSTRACT

This paper examines the effects of the degree and geographic diversification of a firm's R & D internationalization on its innovative performance. We use an unbalanced panel dataset of 401 observations from 110 multinational firms operating in the energy industry over a period of six years to support the argument that both the degree and the geographic diversification of a firm's R & D internationalization have an inverted U-shaped relationship with a firm's innovative performance. Our results also show that collaboration among R & D units located in different countries moderates this relationship by reducing both the positive effects and the challenges of the degree of R & D internationalization. This paper extends the emerging innovation focus in the headquarters–subsidiary literature by contributing to our understanding of the implications of the international R & D activities of firms and supports the utilization of social exchange theory in order to identify the moderating influence of the collaboration among a firm's R & D units located in different countries.

1. Introduction

Cheap and talented human resources and local excellence centers have generated a rapid growth in international R & D investment in non-traditional host countries (UNCTAD, 2010), but the evidence is still limited regarding how the organization of international R & D activities in multinational enterprises (MNEs) affects the final outputs. This analysis is relevant because an overwhelming 94% of the world's 1000 largest corporate innovators conduct elements of their R & D programs abroad (Jaruzelski, Schwartz, & Staack, 2015), and there is extensive evidence that MNEs are increasingly placing satellite R & D centers in foreign countries (e.g., Bas & Sierra, 2002; Dunning & Lundan, 2009; Yamin & Andersson, 2011). Even when certain benefits of the internationalization process of R & D appear evident (e.g., cost reduction), the effects of internationalizing R & D in an MNE on the final innovative output are still unclear (Michailova & Zhan, 2015). This study analyzes how the degree and the geographic diversification of R & D internationalization in an MNE affect the firm's innovative performance and the moderating influence of the collaboration among R & D units located in different countries on that relationship.

The analysis of challenges associated with managing R & D internationalization activities in MNEs is an important area of the headquarters–subsidiary relationships literature (Kostova, Marano, & Tallman, 2016). Historically, the role of MNE subsidiaries was essentially knowledge exploitation (“R & D asset-exploiting activity”), because subsidiaries used to depend on the innovative competence of their parent companies or headquarters (Dunning & Narula, 1995). However, nowadays the emerging processes of “R & D asset-augmenting activity” in subsidiaries are generating a reverse knowledge transfer for enhancing MNEs' competitive advantage via the R & D collaboration with their subsidiaries (e.g., Achcaoucaou, Miravittles, & León-Darder, 2014; Narula, 2012). Previous literature has mostly focused on the antecedents of innovative performance at the subsidiary level (Michailova & Zhan, 2015), and evidence has shown the factors that influence the development of R & D activities in subsidiaries, including subsidiary-level characteristics, locational factors, or the interaction between both (e.g., Belderbos, Leten, & Suzuki, 2013; Cantwell & Mudambi, 2005; Halaszovich & Lundan, 2016; Mihalache, Jansen, Bosh, & Voerda, 2012; Sanna-Randaccio & Veugelers, 2007; Schulz, 2001). However, previous research has paid very limited attention to how the different forms of organizing the internationalization process of

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R & D activities in MNEs influence their innovative performance. An exception is [Hsu, Lien, and Chen \(2015\)](#), who analyze the influence of two dimensions of a firm's R & D internationalization (intensity and diversity of R & D internationalization) on innovation performance and the moderating role of international experience in a sample of emerging economies. However, they highlight that their focus on emerging economies generates ad hoc expectations because the liability of foreignness in MNEs from emerging economies generates reputational disadvantages in their initial steps in the process of international expansion ([Hsu et al., 2015](#)). We analyze different relationships in a sample of MNEs headquartered in developed countries and examine the moderating role of internal collaboration among a firm's R & D units located in different countries.

It is important to note that previous literature has widely highlighted the importance of considering different dimensions of the internationalization processes (e.g., [Hitt, Tihanyi, Miller, & Connelly, 2006](#); [Nguyen, 2016](#); [Verbeke & Brugman, 2009](#), for theoretical discussions). Although these works have focused on slightly different dimensions of a firm's internationalization of its activities, the consensus is that not making the distinction between the amount and orientation of internationalization may generate spurious results when studying multinationalism-performance linkages. In our paper, we use the well-known distinction between a firm's degree of R & D internationalization and its geographic diversification ([Verbeke & Brugman, 2009](#)). The degree of R & D internationalization reflects the scale dimension of the process, indicating the importance an MNE assigns to R & D activities in foreign countries in relation to all R & D activities. The geographic diversification of R & D internationalization reflects the scope dimension by assessing the number of different countries that participate in R & D activities (e.g., [Berry, 2013](#); [Hsu et al., 2015](#); [Lahiri, 2010](#); [Narula & Santangelo, 2012](#) for similar distinctions). These two dimensions are different because firms may develop many international R & D activities (i.e., high degree of R & D internationalization), aggregating all of them into just one or a few subsidiaries (i.e., low geographic diversification) or throughout multiple offices around the world (i.e., high geographic diversification). Similarly, a low degree of R & D internationalization may come with low or high geographic diversification (e.g., [Casillas & Moreno-Menéndez, 2012](#); [Hsu et al., 2015](#); [Lin, 2012](#), all found different but statistically significant relationships between diversity and depth, intensity and diversity, and pace and scope of internationalization, respectively). We will propose the existence of a curvilinear relationship between a firm's degree of R & D internationalization and its innovative performance and between the geographic diversification of R & D activities and innovative performance.

A firm's R & D internationalization will usually require that a firm's units located in different countries develop R & D activities, but little research has analyzed the implications of how the cooperative organization of that process matters. In general, the internationalization of an MNE's R & D activities may retain the independent working of the R & D units located in different countries (e.g., specializing each subsidiary in different fields or products) or may develop collaborative projects between R & D units located in different countries. International R & D collaboration presents a set of challenges for knowledge sharing in comparison to co-located teams ([Gibson & Gibbs, 2006](#); [Vahtera, Buckley & Aliyev, 2017](#)). The Social Exchange Theory (SET) has recently been used to analyze international knowledge sharing in global teams ([Haas & Cummings, 2015](#); [Vahtera et al., 2017](#)), and it provides a robust framework for our analysis. The SET perspective states that the success of a collaborative relationship is largely determined by acceptance, understanding, and the adoption of common behavioral norms, and these are particularly salient issues for global teams because of their geographic dispersion ([Gibson & Gibbs, 2006](#)). Although knowledge sharing across regional boundaries is of central importance for international firms ([Bartlett & Ghoshal, 1987](#); [Vahtera et al., 2017](#)), research on global teams or international collaborations in an MNE's activities in relation to innovation has been very limited ([Wang, Rodan, Fruin, & Xu, 2014](#)). Previous research has mostly analyzed the direct

influence of the relationships among inventors from different units in an MNE on the quality of innovation ([Alnuaimi, Singh, & George, 2012](#); [Berry, 2013](#); [Lahiri, 2010](#); [Liu, 2014](#)). We propose that collaboration among an MNE's R & D units located in different countries may moderate the innovative performance associated with the process of R & D internationalization.

This study makes three main contributions to the headquarters–subsidiary relationship literature. First, recent research has begun to pay more attention to the internal and external antecedents of the R & D asset-augmenting activities in subsidiaries of MNEs ([Belderbos et al., 2013](#); [Berry, 2013](#); [Hsu et al., 2015](#); [Lahiri, 2010](#)). This paper extends this literature by focusing on the corporate implications in the innovative performance of the selected degree and geographic diversification of R & D internationalization in an MNE, and it proposes an inverted U-shaped curvilinear relationship between the two dimensions and an MNE's innovative outputs.

Second, our research supports the utilization of SET in the literature on international firms ([Haas & Cummings, 2015](#); [Vahtera et al., 2017](#)) by analyzing the moderating impact of R & D collaborations among units located in different countries on the relationship between a firm's internationalization of R & D activities and its innovative performance. Our analysis is relevant because the inventors of innovative outputs may not be collocated. Our results show that a collaborative pattern among international R & D units generates relevant implications for the effectiveness of a firm's internationalization of its R & D activities by increasing the difficulties in the early steps and reducing the risks in advanced steps of internationalization.

Third, we also contribute empirically by analyzing a reinforced sample in the energy industry. The energy industries are especially appropriate for analyzing R & D internationalization because it is here that industry collaboration and networks are important determinants of the effectiveness of R & D activities ([Jacobs, 2012](#); [Jacquier-Roux & Bourgeois, 2002](#)). While previous research considering several dimensions of R & D internationalization has mainly focused on one country at a time (e.g., [Chen, Huang, & Lin, 2012](#)) or MNEs from emerging countries ([Hsu et al., 2015](#)), the energy industry allows us to consider a panel dataset (six years) of firms located in four different geographic areas in developed countries.

The remainder of the paper is organized as follows. The next section revises the literature on innovation and the internationalization of a firm's R & D activities and includes three hypotheses that address our research interests. In the third section, we describe the methodology of our study by indicating the sample, the measurement of the variables, and the method of analysis. The fourth section presents the results obtained. Finally, we conclude with a discussion of our findings and possible directions for future research.

2. Theory and hypotheses

2.1. Degree of R & D internationalization and innovative performance

The proportion of a firm's R & D activities that are carried out outside its home country is defined in this paper as the firm's degree of R & D internationalization ([Narula & Santangelo, 2009](#)). We propose that increasing the degree of R & D internationalization in an MNE generates positive synergies; however, beyond a certain threshold, the costs can outweigh the benefits.

An MNE may obtain early benefits by internationally developing some of its R & D activities outside its home country. First, the degree of R & D internationalization enables a firm to quickly increase the stock of existing knowledge ([Dunning & Narula, 1995](#); [Edler, 2008](#)) and the availability of resources to sustain innovativeness ([Hsu et al., 2015](#); [Phene & Almeida, 2008](#)). Second, beginning the process of developing some R & D activities in subsidiaries is a highly visible way to reinforce the perceived importance of an MNE's subsidiaries and increase the motivation of international managers and employees ([Williams & Lee,](#)

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