



Innovating across boundaries: A portfolio perspective on innovation partnerships of multinational corporations



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ABSTRACT

This paper examines how and under what conditions alliance portfolio diversity influences a firm's innovative performance, with special attention being given to potential performance differences between multinational corporations (MNCs) and domestic firms. Analyses of data from 1045 German firms, among which 598 MNCs, revealed an inverted U-shaped relationship between alliance portfolio diversity and MNCs' innovative performance. Findings also indicate MNCs to be better positioned than their domestic counterparts with regards to translating alliance portfolio diversity into superior innovative performance. Importantly though, this only holds for MNCs equipped with strong internal R&D capabilities and, to some extent, high human capital.

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1. Introduction

In light of rapidly changing customer demands, technological uncertainty, as well as more complex and geographically dispersed value chains, firms in many industries are increasingly questioning their once prevailing strategy of operating within their organizational boundaries. As a result, most firms today are simultaneously engaged in various collaborative arrangements with customers, suppliers, competitors, and research institutes located across the globe in order to get access to complementary resources, capabilities, and new markets (Goerzen, 2005; Lavie, 2007; Liu, Ghauri, & Sinkovics, 2010; Wassmer, 2010). To capture the realities of firms' multifaceted and complex collaboration activities, research has gradually shifted from the study of dyadic alliances to the examination of *alliance portfolios* (Goerzen & Beamish, 2005; Jiang, Tao, & Santoro, 2010; Srivastava & Gnyawali, 2011). The analytical value of taking the alliance portfolio, i.e. "a firm's collection of immediate alliance partners" (Lavie & Miller, 2008, p. 623) as the unit of analysis lies in accounting for interdependencies between a firm's different alliances (Goerzen, 2005; Hoffmann,

2007; Wassmer, 2010)¹. Managing an alliance portfolio is not only associated with different tasks, decisions, and challenges than managing an individual alliance, but also has different performance implications arising from synergistic effects (Wang & Rajagopalan, 2015; Wuyts & Dutta, 2014). A portfolio perspective is particularly fruitful for studies seeking to explain aggregate firm-level outcomes such as financial or innovative performance, which are a function of the sum of a firm's alliances rather than isolated alliances.

This study seeks to answer the question of how and under what conditions alliance portfolio partner diversity influences firms' innovative performance as reflected in the revenue share from new-to-market products and services. Previous research has provided valuable insights into the emergence, management, and effectiveness of alliance portfolios of varying size, partner characteristics, as well as structural attributes (see Wassmer, 2010 for a review). Yet, at the same time, empirical evidence on the performance effects of alliance portfolios is mixed and

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¹ The terms alliance portfolio and alliance network are generally used interchangeably in the literature. Hoffmann (2007) describes an alliance portfolio as an "egocentric alliance network" to emphasize that a portfolio approach takes a focal firm's perspective on the management of multiple alliances. As this study focuses on firms' direct ties be they formal or informal, we use the term portfolio rather than network. Network studies are traditionally more concerned with the pattern of a firm's direct and indirect ties (e.g., density, structural holes) or its position within such a network.

inconclusive. In particular, studies examining how different forms of alliance portfolio diversity (e.g., industry and technological partner diversity) affect firms' innovative performance have reported either positive (De Leeuw, Lokshin, & Duysters, 2014; Srivastava & Gnyawali, 2011), U-shaped (Wuyts & Dutta, 2014), or inverted U-shaped (De Leeuw et al., 2014; Vasudeva & Anand, 2011) relationships. On the one hand, these inconsistent findings are reflective of the opposing arguments on the benefits (e.g., access to new perspectives and complementary resources) and costs (e.g., complexity, coordination issues, and value appropriation concerns) of maintaining large and diverse alliance portfolios (Baum, Calabrese, & Silverman, 2000; Hoffmann, 2007; Lee, Kirkpatrick-Husk, & Madhavan, 2014). On the other hand, a growing number of studies specifically suggest that it is necessary to adopt a contingency perspective on alliance portfolio performance rather than looking for generalizable main effects. Accordingly, the benefits of alliance portfolios have been found to be contingent not only on partner characteristics, but also on the strategies, structural characteristics, and technological resources of the focal firm (Lavie & Miller, 2008; Wuyts & Dutta, 2014; Yamakawa, Yang, & Lin, 2011). However, research on the moderating role of focal firm characteristics is still in its infancy (e.g., Srivastava & Gnyawali, 2011).

In order to further resolve the inconsistent relationship between alliance portfolio diversity and performance, we draw on the resource-based view (RBV) of the firm (Barney, 1991; Peteraf, 1993). By shedding light on the role of collaboration partners' resources in value creation, the RBV provides a useful theoretical lens for understanding the innovation effects of alliance portfolios. We focus our analysis on multinational companies to account for the unique resource characteristics of these firms and explore potential differences between MNCs and domestic firms in their ability to capture the benefits of alliance portfolios. Based on the RBV and in line with the international business literature that argues that MNCs possess superior financial, structural, managerial, and technological resources and have a competitive advantage compared to their local counterparts (Buckley & Casson, 1976; Dunning, 1988), we expect such differences to exist. Initial evidence shows that the structural attributes of an MNC (i.e., subsidiary network) indeed play a key role in realizing value from alliance portfolios (Zaheer & Hernandez, 2011).

Our findings based on data from 1045 German companies, among which 598 MNCs, contribute to research and theory on alliance portfolios in important ways. First, at least to our knowledge, this study is the first to compare the performance effects of diverse alliance portfolios across different organizational types. As such, we provide answers to the question of which firms benefit most from alliance portfolios. Second, we not only test whether MNCs will be better positioned to realize the value-creation potential of alliance portfolios than domestic firms, but also clarify the conditions under which this is the case. For this purpose, we introduce a firm's *R&D intensity* and *human capital* as salient contingencies for the effects of alliance portfolio diversity. Our research thus answers calls to identify moderators of the alliance portfolio-performance relationship (Srivastava & Gnyawali, 2011; Wuyts & Dutta, 2014). Third, by providing empirical evidence that diverse alliance portfolios can enhance MNCs' innovative performance, we shed new light on the antecedents of innovation in multinational firms. Previous studies on MNCs' alliance activities have been conducted either at the dyadic level (Liu et al., 2010; Simonin, 2004) or, in the case of MNC research adopting a portfolio perspective, are limited to the study of financial performance outcomes (Jiang et al., 2010; Lavie & Miller, 2008; Zaheer & Hernandez, 2011). Since innovative performance is a more proximal outcome of alliance portfolio diversity than

financial performance, our study is particularly well positioned for a direct test of the theoretical relationships of interest.

2. Theory and hypotheses

2.1. A resource-based view on partnership portfolios

The RBV serves as the overarching theoretical framework for this study. From a resource-based perspective, a firm's competitive advantage lies in its unique resources and capabilities (Barney, 1991; Penrose, 1959; Peteraf, 1993). Resources are defined as "stocks of available factors that are owned or controlled by the firm", whereas capabilities "refer to a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end" (Amit & Schoemaker, 1993, p. 35). Accordingly, it is the interaction of valuable, rare, inimitable, and non-substitutable resources and effective capabilities for accumulating, combining, and exploiting resources that creates value and ultimately explains interfirm performance differences (Helfat & Peteraf, 2003; Sirmon, Hitt, & Ireland, 2007).

Interorganizational collaboration is widely regarded as an important mechanism for overcoming the limitations of a firm's resource base, and thus plays a significant role in shaping the resource-based competitive advantage of the firm (Ireland, Hitt, & Vaidyanath, 2002; Lavie, 2006). As collaboration is essentially about obtaining access to other firms' valuable resources, scholars have adopted a resource-based perspective to examine research questions related to the formation, management, and performance effects of alliances and other forms of interorganizational relationships (Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996; Hitt, Dacin, Levitas, Arregle, & Borza, 2000). This body of work suggests that the characteristics or, more specifically, resources of both the focal firm and its collaboration partners determine the value-creation potential of collaborative arrangements, with special attention being given to knowledge-based resources (Arya & Lin, 2007; Lavie, 2006).

The implication for configuring alliance portfolios is that collaboration partners should be selected based on the technological, physical, and managerial resources and capabilities they bring to the partnership (Ireland et al., 2002; Wassmer & Dussauge, 2012). On the one hand, resource characteristics influence interfirm interaction and knowledge transfer in alliances. In particular the knowledge-based view (KBV) (e.g., Grant, 1996), a theoretical extension of the RBV focusing on organizational knowledge and learning, sheds light on this important aspect of alliance portfolio management. Based on this perspective, scholars have, for example, elaborated how knowledge characteristics (e.g., complexity, tacitness, specificity) or the degree of overlap in the knowledge bases of partners affect alliance effectiveness (Mowery, Oxley, & Silverman, 1996; Simonin, 1999). On the other hand, partner selection decisions influence the quantity, quality, and diversity of resources and capabilities provided by the associated organizations (Jiang et al., 2010; Wassmer, 2010). There is some debate about whether collaboration partners with similar or dissimilar resources will prove more valuable to the focal firm (Arya & Lin, 2007; Das & Teng, 2000). Alliances with dissimilar partners are intended to acquire needed complementary resources and leverage the value of a firm's own resources. In contrast, partnerships, in which organizations contribute similar types of resources, also referred to as pooling alliances, seek to realize economies of scale or improve the competitive position in their industry (Lavie, 2006). When it comes to creating new competitive advantages (e.g., through innovation), however, selecting dissimilar partners is seen as favorable within resource-based theory (Ireland et al., 2002). Dyer and Singh (1998, p. 662) specifically assert that relational rents, i.e. "a supernormal profit jointly

generated in an exchange relationship that cannot be generated by either firm in isolation”, are more likely to accrue between dissimilar collaboration partners. Such alliances hold potential for gaining access to resources that are complementary to the firm’s own resources, and thus offer opportunities for combining resources in new ways (Das & Teng, 2000; Lavie, 2007; Wassmer & Dussauge, 2011).

Furthermore, the RBV points to the critical role played by the focal firm’s own resources and capabilities in exploiting the value-creation potential of alliance portfolios (Ireland et al., 2002). Among others, specific structures (e.g., a dedicated alliance function) and routines for managing interorganizational relationships have been identified as key factors underpinning a focal firm’s alliance capability (Dyer & Nobeoka, 2002; Kale, Dyer, & Singh, 2002). At a portfolio level, alliance capabilities entail routines for selecting partners or for coordinating activities and knowledge flows across individual alliances (Schilke & Goerzen, 2010; Wang & Rajagopalan, 2015). The literature specifically highlights the importance of absorptive capacity, that is, “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen & Levinthal, 1990, p. 128) for realizing the benefits of alliance portfolios (Lavie & Miller, 2008; Vasudeva & Anand, 2011). Within resource-based theorizing, absorptive capacity is seen as a key learning capability that is heterogeneously distributed across firms owing to their idiosyncratic knowledge bases (Lane, Koka, & Pathak, 2006).

2.2. The configuration of MNCs’ partnership portfolios—Exploring partnership diversity

Multinationals seeking to establish value-creating innovation partnership portfolios face important design or, more specifically, partner selection decisions. From a resource-based perspective, portfolios of functionally heterogeneous alliances are more likely to produce innovative resource combinations than more homogeneous ones (e.g., Dyer & Singh, 1998). In this regard, functional diversity is defined as the number of different types of organizations (i.e., customers, suppliers, competitors, universities, and research institutes) located in the home country and around the globe the focal MNC simultaneously collaborates with. Given their distinct value creation activities, technological domains, and competitive environments in which they operate, different types of organizations possess different pools of resources and capabilities (Jiang et al., 2010; Wuyts & Dutta, 2014)². Although diverse alliances are not necessarily associated with resource complementarity within an alliance portfolio, the likelihood of getting access to idiosyncratic, non-redundant inputs that may fuel MNCs’ knowledge recombination and innovation efforts increases with partner diversity (Baum et al., 2000; Phene & Almeida, 2008; Powell, Koput, & Smith-Doerr, 1996).

Partnerships with consumers or business customers, for example, can help MNCs enhance the market fit of their new products or services through gaining an in-depth understanding of the manifold needs and preferences of their customers located around the globe (Liu & Buck, 2007). Involving suppliers in the innovation process, which provide MNCs with a better understanding of potential applications of their technologies, technological solution information, or develop novel product components, can be equally advantageous (Dyer & Hatch, 2006). Although competitors are deemed particularly risky collaboration partners and are likely to have a high degree of knowledge overlap

with the focal firm, they can nevertheless make a valuable contribution (Bercovitz & Feldman, 2007). Apart from sharing the costs and risks of innovation projects, such partnerships allow for a pooling of resources to jointly overcome technological challenges in the process of co-creating new products and services (West & Wood, 2013). Moreover, competitors may possess complementary assets (e.g., distribution channels) that are especially critical in the commercialization stage of innovations (Gnyawali & Park, 2011). Finally, cooperating with research institutes or universities is seen as a valuable source of technological knowledge that is highly distinct from the focal firm’s knowledge base. As research institutions typically not only engage in applied but also basic research, their involvement is especially conducive to generating breakthrough innovations (Hess & Rothaermel, 2011; Laursen & Salter, 2006). In sum, by increasing the breadth of perspectives and portfolio resources, partner diversity stimulates creativity and offers opportunities for new, value-creating resource combinations (Srivastava & Gnyawali, 2011).

However, it is increasingly recognized that a potential trade-off exists between the benefits and costs of alliance partner diversity (e.g., Lavie & Miller, 2008; Vasudeva & Anand, 2011). Diversity in a firm’s alliance portfolio is associated with increased complexity and may pose coordination, communication, as well as knowledge transfer challenges. These issues are expected to increase the time, energy, and financial resources required to maintain productive alliance relationships (De Leeuw et al., 2014; Duysters & Lokshin, 2011; Goerzen & Beamish, 2005). For example, collaborating with different types of organizations (e.g., industry and university partners) involves a very different process of exchange given their particular goals, structures, and processes (Jiang et al., 2010). Such differences between a firm and its partners are also seen as a potential source of conflict and may increase the difficulty of building trusting relationships (Wuyts & Dutta, 2014). Others highlight firms’ limited cognitive capacity to deal with complexity and absorptive capacity constraints as key issues in the management of diverse alliance portfolios (Duysters & Lokshin, 2011; Lavie & Miller, 2008). In this regard, it is argued that beyond a certain threshold of diversity, there might be too many ideas for decision makers to select between and implement them effectively (De Leeuw et al., 2014; Laursen & Salter, 2006).

In light of the conflicting theoretical arguments presented above, we expect a curvilinear relationship between the functional diversity of an MNC’s alliance portfolio and its innovative performance, with innovative performance first increasing and then decreasing with increases in partner diversity. Empirical studies, although not focusing on MNCs, support this assumption of an inverted U-shaped relationship between alliance portfolio diversity and performance (De Leeuw et al., 2014; Duysters & Lokshin, 2011; Vasudeva & Anand, 2011). Thus:

Hypothesis 1. Functional partnership portfolio diversity is curvilinearly related (taking an inverted U-shape) to multinational firms’ innovative performance.

2.3. The benefits of partnership portfolios—Comparing multinational and domestic firms

Recent evidence suggests that not all firms benefit equally from alliance portfolio diversity. In line with the RBV, these performance differences were found to be attributable not only to partner selection decisions, but also to interfirm heterogeneity in the resources and capabilities of focal firms (Lavie & Miller, 2008; Wuyts & Dutta, 2014). In the present study, we investigate whether MNCs and domestic firms vary in their alliance portfolio performance by considering the organization type as a moderator of the relationship between partner diversity and innovative performance. In so

² The RBV conceptualizes firms as heterogeneous entities consisting of bundles of idiosyncratic resources (Barney, 1991; Peteraf, 1993). According to this heterogeneity assumption, there is always a certain degree of resource heterogeneity among firms, which is especially likely to be true for different types of organizations.

doing, we test the assumption that multinationals might be better able to manage heterogeneous partnerships given their structural characteristics, diverse knowledge base, and experience in managing interorganizational relationships (Duysters & Lokshin, 2011).

By their very nature, MNCs are organizations that control operations across national borders. The MNC can be described as a geographically dispersed network in which information and resources not only flow from the MNC's headquarter to its subsidiaries, but also vice versa as well as between subsidiaries (Ghoshal & Bartlett, 1990; Gupta & Govindarajan, 1994). International business scholars have emphasized the critical strategic role played by subsidiaries as a source of knowledge creation and innovation (Phene & Almeida, 2008). Subsidiaries are assumed to act as nodes embedded in a variety of national contexts, allowing the MNC to tap into local innovation systems and gain access to diverse knowledge that can be shared throughout the MNC (Mudambi & Swift, 2011).

Their internal subsidiary network is the first reason why we expect MNCs to be particularly well equipped to harness the benefits of diverse partnership portfolios. Globally spread subsidiaries give MNCs the opportunity to mitigate the well-known difficulties of transferring knowledge across firm boundaries, which are likely to increase with geographical distance to the collaboration partner (Phene & Almeida, 2008; Zaheer & Hernandez, 2011). Indeed, studies support this assumption by showing that geographically widespread alliance portfolios lead to better performance when there is a high degree of country overlap between an MNC's global subsidiaries and its collaboration partners. If a subsidiary acting as a liaison is located in the same country (or at least continent) as the MNC's external collaboration partner, this helps to overcome linguistic, cultural, institutional, as well as social barriers and to develop trusting relationships (Lavie & Miller, 2008; Zaheer & Hernandez, 2011).

Second and related, internationally operating firms have better access to new and diverse ideas from multiple market and cultural perspectives than their domestic counterparts (Hitt, Hoskisson, & Kim, 1997; Kotabe, Srinivasan, & Aulakh, 2002). Based on the prevalent conceptualization of absorptive capacity as a function of the firm's level of prior related knowledge (Cohen & Levinthal, 1990), the broad and diverse knowledge base of the MNC network implies a greater potential to learn from collaboration partners (Bertrand, 2011).

Third, multinationals are likely to have greater experience in managing interorganizational relationships relative to domestic firms (Duysters & Lokshin, 2011). In light of extensive headquarter-subsidiary interactions, we expect MNCs to have established routines that facilitate coordination and knowledge transfer across firm boundaries (Phene & Almeida, 2008). Consistent with the RBV, studies highlight the importance of such interfirm routines for managing innovation partnerships (Dyer & Hatch, 2006). Additionally, Belderbos, Gilsing, and Lokshin (2012) observed a greater propensity of multinational firms to be engaged in alliances. In turn, alliance experience has been identified as a strong predictor of alliance success (e.g., Hoang & Rothaermel, 2005). Lavie and Miller (2008) specifically found that alliance experience moderates the relationship between alliance portfolio diversity and firm performance.

Finally, MNCs may achieve a higher alliance portfolio performance simply because they are in a better position than domestic firms to attract strong and compatible innovation partners. As a firm's attractiveness to potential partners depends, for example, on its technological capabilities, complementary assets, and reputation, multinationals are likely to have advantages in this regard (Belderbos et al., 2012). In sum, we expect that:

Hypothesis 2. The effect of functional partnership portfolio diversity on innovative performance is more positive for multinational than for domestic firms.

2.4. The moderating role of R&D intensity and human capital

In this study, we not only examine whether there are differences in the alliance portfolio performance of MNCs and domestic firms, but also seek to identify conditions under which the proposed advantages of MNCs are more or less pronounced. To do so, we explore the role of a firm's *R&D intensity* and *human capital*. R&D intensity is frequently used as a proxy for a firm's technological capabilities or, more specifically, absorptive capacity (Cohen & Levinthal, 1990). Accordingly, firms need a sufficient level of complementary in-house expertise to evaluate, assimilate, and apply knowledge from alliance partners (Dyer & Singh, 1998; Lane et al., 2006). This view has received some empirical support (Hagedoorn & Wang, 2012; Mowery et al., 1996; Rothaermel & Hess, 2007; Salge, Bohné, Farchi, & Piening, 2012). Human capital (i.e., the knowledge, skills, and abilities of individuals) also plays a key role in realizing the value creation potential of alliance activities (Hess & Rothaermel, 2011; Leiponen, 2006). Especially since individuals act as boundary spanners between a firm and its environment, their knowledge, skills, and abilities are critical for appreciating the value of external knowledge and communicating effectively with external actors (Cohen & Levinthal, 1990; Vega-Jurado, Gutiérrez-Gracia, Fernández-de-Lucio, & Manjarrés-Henríquez, 2008).

While previous research has modeled the interplay between a firm's alliance activities and R&D (e.g. Zaheer & Hernandez, 2011) or human capital (e.g., Rothaermel & Hess, 2007) as two-way interactions, we follow a different approach. Since we are specifically interested in the comparison between multinational and domestic firms, three-way interactions between functional partner diversity, organization type, as well as R&D intensity and human capital, respectively, are examined to predict firms' innovative performance. From a theoretical standpoint, the advantage of this approach lies in taking contextual factors into account. Studies on the interaction between internal and external sources of innovation reveal highly inconsistent results in that they report either complementary (Cassiman & Veugelers, 2006; Rothaermel & Hess, 2007) or substitutive relationships (Laursen & Salter, 2006; Zaheer & Hernandez, 2011). In line with research suggesting that whether these innovation sources act as complements or substitutes may depend on the specific context (e.g., type of industry, firm, value chain activities, governance mechanisms) (Gesing, Antons, Piening, Rese, & Salge, 2015; Hess & Rothaermel, 2011), we argue that investments in R&D and human capital do not equally strengthen the alliance portfolio capabilities of MNCs and domestic firms. Instead, we expect the proposed differences between these firms in terms of translating alliance portfolio diversity into innovative performance to be more pronounced in presence of high levels of R&D intensity and human capital. This expectation is based on the three interrelated arguments of MNCs' (i) greater need for absorptive capacity, (ii) more elaborate supporting assets and processes, and (iii) lower prevalence of the not-invented-here attitude.

First, MNCs pursuing a collaborative approach to innovation face the challenging task of simultaneously maintaining their internal subsidiary network and external exchange relationships. While this dual embeddedness may facilitate the acquisition, transfer, and integration of knowledge from external sources (Zaheer & Hernandez, 2011), coordinating and monitoring activities becomes increasingly difficult and resource-intensive. The demands placed on executives, especially information-processing

demands, increase with the complexity and geographical dispersion of a firm's operations (e.g., Hitt et al., 1997). In this regard, it is argued that a firm's capacity to deal with complexity and manage diverse intra- and interorganizational relationships is constrained by its absorptive capacity (Lavie & Miller, 2008; Vasudeva & Anand, 2011). Scholars have conceptualized absorptive capacity as bundles of knowledge management routines, which research-intensive firms develop over time. Such routines regulate uncertainty and complexity (e.g., by increasing predictability), thereby fostering coordination and knowledge transfer between organizational units or individuals (Lewin, Massini, & Peeters, 2009). Skilled employees also help firms to absorb complexity. High levels of human capital have been associated with increased information-processing skills, and thus better decision-making and performance by individuals (Khanna, Jones, & Boivie, 2014). However, although R&D and human capital investments can be thus valuable for both multinational and domestic firms, we expect MNCs to have a greater need for absorptive capacity because of their more complex structures and operations (Vermeulen & Barkema, 2002). This implies that compared to domestic firms, MNC's alliance portfolio performance will suffer more under conditions of low R&D intensity and human capital.

Second, we maintain that all else being equal, MNCs will benefit to a greater extent from high levels of R&D intensity and human capital than domestic firms due to more elaborate supporting assets and processes. This is in line with the RBV, which suggests that there are complementarities between resources in value creation, i.e. the effectiveness of a resource depends on the presence of other resources (Newbert, 2007; Rothaermel & Hess, 2007). Wiklund and Shepherd (2003), for example, note that a firm must have an appropriate organization in place to take advantage of its valuable resources. Consequently, it is argued that a firm's absorptive capacity not only depends on its prior related knowledge accumulated through R&D or the acquisition of human capital, but also on the organization's communication processes and structures that allow to transfer knowledge within and across its boundaries (Lane et al., 2006; Nooteboom, Van Haverbeke, Duysters, Gilsing, & Van den Oord, 2007). This is where MNCs with their specialized routines for intra- and interorganizational knowledge transfer are likely to have advantages relative to domestic firms. With regard to human capital, HRM research specifically points to the key role of a firm's HR system in creating a context in which highly qualified individuals are willing and able to perform (e.g., Piening, Baluch, & Salge, 2013). MNCs tend to be larger and have greater financial resources than domestic firms, and thus can be expected to have more sophisticated HR systems that increase the effectiveness of their human capital relative to smaller domestic firms.

The not-invented-here syndrome (NIH), that is, a negative attitude toward ideas, knowledge, and technologies from external sources (Katz & Allen, 1982) is the third reason why we believe that high levels of R&D and human capital are more conducive to multinational than domestic firms' alliance portfolio performance. This phenomenon can, for example, be explained by overconfidence or self-serving behaviors by which individuals or groups seek to defend self-perception, rank, and status. The tendency to reject external knowledge, which is likely to diminish the effectiveness of alliance portfolios, is particularly common in firms with strong internal R&D capabilities and a highly skilled workforce (Antons & Piller, 2015; Gesing et al., 2015). However, we argue that this negative mindset will be less prevalent in MNCs with these characteristics than their domestic counterparts. The MNC has been described as a knowledge network in which knowledge and ideas are created in all parts of the company and transferred throughout the firm (e.g., Almeida, Song, & Grant, 2002). Within this network of firms operating in different countries

and cultural environments, employees are exposed to different perspectives and recognize that others (e.g., managers in other parts of the MNC) have legitimate, though possibly diverging, points of view. Evidence shows that such experiences can indeed mitigate the NIH syndrome (Mehrwald, 1999). Relatedly, the literature suggests that the geographical distance between the source and recipient of knowledge determines the extent to which knowledge is perceived as external, and thus whether it is rejected due to a NIH attitude (Antons & Piller, 2015). As such, MNCs global network of subsidiaries as well as the fact that employees frequently interact with colleagues (e.g., during international assignments) from cultural contexts similar to that of international alliance partners may reduce the perceived knowledge externality.

To summarize the above discussion, in light of their different resource needs and characteristics, multinational and domestic firms are expected to differ in the extent to which R&D and human capital support their efforts to capture the innovation potential of diverse alliance portfolios. We specifically propose that:

Hypothesis 3a. At high levels of R&D intensity, the differences between multinational and domestic firms regarding the effect of functional partnership portfolio diversity on innovative performance are more pronounced.

Hypothesis 3b. At high levels of human capital, the differences between multinational and domestic firms regarding the effect of functional partnership portfolio diversity on innovative performance are more pronounced.

3. Methods

3.1. Setting and data

We test our hypotheses by means of a cross-sectoral sample of German multinational and domestic business groups. Data on partnership portfolio diversity, innovative performance, and structural characteristics for the three-year period from 2005 to 2007 are drawn from the 2008 wave of the Mannheim Innovation Panel (MIP). The MIP is the German contribution to the most substantial cross-country collection effort of firm-level innovation data—the European Community Innovation Survey (CIS) (OECD, 2005), which has informed influential studies on innovation collaboration (e.g., Laursen & Salter, 2006). The MIP is administered by the Center for European Economic Research (ZEW) on behalf of the German Federal Ministry of Education and Research. Among the 18,109 German firms from 21 distinct manufacturing and service sectors in the 2008 gross sample, 6684 returned usable questionnaires. This yields a response rate of approximately 36.9 percent. To account for a possible non-response bias, comprehensive telephone interviews of non-respondents were performed and provided no indication of such concerns (Klingebiel & Rammer, 2014). Out of the 6684 responding firms, 1045 (598 multinational and 447 domestic firms) self-identified as business groups and remained unaffected by missing data with regards to all our model variables.

3.2. Measures

3.2.1. Dependent variable

To capture the performance consequences of firms' partnership portfolio diversity, we follow prior research in employing the global revenue share from new-to-market products as our measure of innovative performance (Garriga, von Krogh, & Spaeth, 2013; Laursen & Salter, 2006). This indicator ranges from 0 to 100 percent and captures a firm's revenue share in 2007 that can be attributed to market novelties launched between 2005 and 2007.

Table 1
Descriptive statistics for subsample of multinational business groups.

Variable	Obs	Mean	S.D.	Min	Max	1.	2.	3.	4.	5.	6.
1. Revenue share from new-to-market products	598	4.26	9.33	0	100						
2. Firm size	598	1136.49	6388.27	1	111,151	0.07					
3. Export intensity	598	35.44	30.14	0	100	0.17 [*]	0.15 [*]				
4. Firm location	598	0.18	0.39	0	1	−0.06	−0.22 [*]	−0.07			
5. R&D intensity	598	2.09	6.49	0	76.92	0.16 [*]	−0.05	0.09 [*]	0.06		
6. Human capital	598	21.41	22.13	0	100	0.10 [*]	−0.09 [*]	0.03	0.14 [*]	0.19 [*]	
7. Functional diversity	598	2.45	1.62	0	6	0.18 [*]	0.25 [*]	0.21 [*]	−0.05	0.14 [*]	0.11 [*]

Notes: Industry dummies not included. Firm Location is a dummy variable.

^{*} $p < 0.05$

Table 2
Descriptive statistics for overall sample.

Variable	Obs	Mean	S.D.	Min	Max	1.	2.	3.	4.	5.	6.	7.
1. Revenue share from new-to-market products	1045	3.76	10.00	0	100							
2. Firm size	1045	977.93	7653.24	1	191,350	0.05						
3. Export intensity	1045	26.92	29.23	0	100	0.16 [*]	0.24 [*]					
4. Firm location	1045	0.25	0.43	0	1	0.00	−0.23 [*]	−0.13 [*]				
5. R&D intensity	1045	2.04	7.61	0	113.51	0.41 [*]	−0.06 [*]	0.08 [*]	0.11 [*]			
6. Human capital	1045	19.69	21.46	0	100	0.16 [*]	−0.12 [*]	0.04	0.12 [*]	0.24 [*]		
7. MNC identifier	1045	0.57	0.49	0	1	0.06	0.25 [*]	0.34 [*]	−0.17 [*]	0.01	0.09 [*]	
8. Functional diversity	1045	2.22	1.67	0	6	0.19 [*]	0.25 [*]	0.25 [*]	−0.01	0.15 [*]	0.10 [*]	0.16 [*]

Notes: Industry dummies not included. Firm Location and the MNC identifier are dummy variables.

^{*} $p < 0.05$

3.2.2. Independent variable

The MIP questionnaire defines innovation partners as “all enterprises and institutions, with whom your enterprise cooperates for the purpose of developing and introducing new products and processes.” Based on this definition, we measure the *functional diversity* of focal firm’s partnership portfolio (i.e., role diversity in a portfolio) as a simple count of a set of binary indicators reflecting the presence or absence of six innovation-related partnership types in the period between 2005 and 2007. More specifically, we capture whether each of the six partner types (i) business customers, (ii) consumers, (iii) material suppliers, (iv) service providers, (v) competitors, and (vi) universities and other research institutes is represented in a focal firm’s partnership portfolio.

3.2.3. Moderating variables

To test *Hypotheses 2, 3a and 3b*, we introduce three moderating variables, each captured by a well-established measure. First, the binary variable *MNC* takes the value of 1 in case of multinational business groups and the value of 0 for all domestic business groups. Second, *R&D intensity* is computed as a focal firm’s annual R&D spending in percent of its total annual revenues. Third, we include the percentage of employees holding a higher education degree as a proxy for *human capital*.

3.2.4. Control variables

We also include a set of control variables expected to influence the revenue share from new-to-market products and likely to confound the relationships of interest to this study. First, we account for differences in *firm size* measured as the logarithm of the total number of full-time employees. *Second*, we measure *export intensity* as the revenue share in percent generated outside of Germany to capture heterogeneity in the degree of internationalization. Third, the dummy variable *firm location* is meant to reflect persisting economic disparities between firms located in East Germany (1) and West Germany (0). Finally, we include a set of *industry dummies* to capture possible sectoral effects.

3.3. Analysis

Our dependent variable *revenue share from new-to-market products* is double-censored ranging range from 0 to 100 percent. Tobit regression analysis therefore appears more appropriate than standard OLS regression and is increasingly applied in CIS studies (Klingebiel & Rammer, 2014; Laursen & Salter, 2006). *Hypothesis 1* is tested using the subsample of 598 MNCs. To examine *Hypotheses 2, 3a, and 3b* pertaining to the moderating role of MNC status, R&D intensity, and human capital, we draw on data from all 1045 domestic and multinational business groups in our sample. To test *Hypothesis 1*, we introduce a linear and a squared term of functional partnership diversity. As for *Hypothesis 2*, we compute a two-way interaction term between functional portfolio diversity and the MNC dummy. As for *Hypotheses 3a and 3b*, we introduce three-way interaction terms between functional portfolio diversity, the MNC dummy, and R&D intensity (*Hypothesis 3a*) or human capital (*Hypothesis 3b*). For each model, we also report the maximum variance inflation factor, which indicates that our estimates are unlikely to be distorted by multicollinearity. Moreover, we report Akaike’s Information Criterion (AIC), based on which distinct models computed using the same set of observations can be compared.

4. Results

4.1. Results from main analyses

Tables 1 and 2 contain descriptive statistics and correlations for our subsample of 598 multinational groups and our overall sample of 1045 business groups, respectively.

Table 3 presents the results from our Tobit analyses conducted to test *Hypothesis 1* pertaining to the inverted U-shaped effect of functional portfolio diversity on innovative performance in our MNC subsample.

Hypothesis 1 predicted MNCs’ revenue share from new-to-market products to increase with the functional diversity of its partnership portfolio up to a certain point beyond which any

Table 3
Tobit regression analyses testing [Hypothesis 1](#).

	Model 1	Model 2	Model 3
Control variables			
1 Constant	−1.407*** (0.365)	−1.346*** (0.349)	−0.982** (0.416)
2 Firm size (log)	0.317*** (0.095)	0.179 [†] (0.099)	0.184 [†] (0.100)
3 Human capital	0.189** (0.094)	0.136 (0.093)	0.152 (0.094)
4 R&D intensity	0.394 (0.289)	0.315 (0.278)	0.294 (0.278)
5 Export intensity	0.269** (0.088)	0.229** (0.088)	0.220** (0.089)
6 Firm location	−0.583** (0.241)	−0.640*** (0.238)	−0.579** (0.243)
7 Industry dummies	Yes	Yes	Yes
Main effect			
8 Functional diversity		0.524*** (0.100)	1.124*** (0.302)
9 Functional diversity squared			−0.068** (0.032)
Total observations	598	598	598
Total censored observations	340	340	340
F-statistic	5.090	7.740***	7.960***
Cragg-Uhler R-squared	0.120	0.176	0.184
Δ R-squared (relative to Model 1)		0.056	0.064
Akaike's Information Criterion (AIC)	1360.334	1327.282	1324.079
Δ AIC (relative to Model 1)		−33.052	−36.255
Variance inflation factor (max)	1.43	1.44	1.44

Notes: Tobit regression analyses with robust standard errors explaining firms' revenue share from new-to-market products or services. Standardized coefficient estimates reported.

Lower values of the AIC indicate improved model fit.

[†] $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

additional increases in portfolio diversity would deteriorate a focal firm's innovative performance. Consistent with this expectation of a curvilinear, inverted U-shaped relationship, the standardized coefficient estimate of the linear term of functional diversity in Model 3 is positive and statistically significant ($\beta = 1.124$, $p < 0.01$)³, whereas the squared term is negative and also statistically significant ($\beta = -0.068$, $p < 0.05$). [Hypothesis 1](#) is thus supported. The inclusion of the squared term in Model 3 is associated with a lower AIC relative to Model 2 including the linear term only. This indicates that a curvilinear, inverted U-shape relationship fits the data better than a simple linear relationship.

[Table 4](#) presents our results for [Hypotheses 2, 3a, and 3b](#), pertaining to the differences between multinational and domestic firms in terms of translating functional partnership portfolio diversity into market novelties ([Hypothesis 2](#)—two-way interaction), which are expected to be most pronounced when R&D intensity ([Hypothesis 3a](#)—three-way interaction) and human capital ([Hypothesis 3b](#)—three-way interaction) are high. [Hypothesis 2](#) predicted MNCs to benefit more from functional portfolio diversity than their domestic counterparts. Contrary to our theoretical expectations, however, the two-way interaction term between the MNC dummy and functional portfolio diversity shown in Model 7 failed to reach statistical significance. [Hypothesis 2](#) is hence not supported. [Hypothesis 3a](#) suggested the differences between multinational and domestic firms regarding the innovation effect

³ The linear effect of partnership portfolio diversity as reported in Model 2 is also practically meaningful, as a one standard-deviation increase in functional diversity as reflected in the inclusion of 1.62 additional partner types into a focal-firms partnership portfolio is associated with a notable average increase in MNCs' revenue share from new-to-market products of 0.524 standard deviations or 4.89 percentage points.

of functional portfolio diversity to be more pronounced at high levels of R&D intensity. As depicted in Model 9, the three-way interaction term is positive and significant ($\beta = 1.330$, $p < 0.05$), supporting this hypothesis⁴. Similarly, the AIC declines after including the three-way interaction term, pointing to improved model fit relative to an alternative specification including only two-way interactions (Model 8). [Fig. 1](#) illustrates the curvilinear three-way interaction between functional portfolio diversity, MNC status, and R&D intensity, with low (high) values of functional portfolio diversity and R&D intensity corresponding to two standard deviations below (above) the mean. This plot reveals that MNCs are significantly better positioned than their domestic counterparts to benefit from functional partnership portfolio diversity when R&D intensity is high. Conversely, when R&D intensity is low, MNCs appear to have a relative disadvantage with regards to translating greater functional diversity into revenues from new-to-market products. This interaction pattern suggests that the relationship between functional partnership diversity and internal R&D intensity tends to be complementary among MNCs and substitutive among domestic firms.

According to [Hypothesis 3b](#), human capital was expected to exhibit a similar moderating effect. The three-way interaction term including human capital in Model 11 is positive and marginally significant at the 10 percent level ($\beta = 0.322$, $p < 0.10$). There is thus only weak support for [Hypothesis 3b](#). Similarly, the AIC only declines marginally with the inclusion of the three-way interaction effect.

4.2. Results from post-hoc analyses

We conducted a series of additional analyses to both examine the robustness of our substantive findings and explore important questions that arose during the analysis. As for the *robustness checks*, qualitatively identical results emerged, when we (i) used the log-transformed instead of the original values of firms' revenue share from new-to-market products as our dependent variable, (ii) employed a standard OLS instead of a double-censored Tobit estimator, and (iii) used a binary variable capturing the introduction of a new product or service instead of a ratio variable capturing the revenue share from new-to-market products as our dependent variable ([Nieto & Rodríguez, 2011](#)). These sensitivity analyses suggest that our substantive findings are robust to changes in construct measurement and estimation technique.

As for our *exploratory analyses*, we first examined the separate effects of science-based (e.g., universities or research institutes) and market-based partnership diversity (e.g., customers, suppliers, and competitors). Both exhibited a positive and significant effect on innovative performance that was comparable in effect size. Finally, we complemented our analyses by moving beyond *functional* alliance portfolio diversity to explore the role of *geographical* (i.e., in terms of partner location) and *temporal* (i.e., in terms of partner involvement in distinct innovation stages) portfolio diversity. Although these three forms of portfolio diversity are not without some conceptual and empirical overlap, our exploratory analyses yielded some noteworthy insights. Importantly, when the three portfolio diversity measures were included simultaneously, their individual effect diminished, yet remained statistically significant, pointing to the complementary

⁴ Following prior research (e.g., [Laursen & Salter, 2006](#)), we include the linear and squared term of functional partnership diversity for our main effects only and report two-way and three-way interaction effects with the linear, but not the squared term of functional partnership diversity. Indeed, the AICs of alternative models that include both linear and squared interaction effects are higher, which points to lower overall model fit. This can be interpreted as indicating that R&D intensity and human capital affect more the slope of the link between partnership portfolio diversity and innovative performance than its curvature.

Table 4
Tobit regression analyses testing Hypotheses 2, 3a, and 3b.

	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
	Controls only	Main effects	Moderators	2-Way MNC	2-Way R&D	3-Way R&D	2-Way HC	3-Way HC
Control variables								
1 Constant	−2.558*** (0.379)	−2.516*** (0.382)	−2.120*** (0.313)	−2.165*** (0.324)	−2.071*** (0.342)	−1.980*** (0.335)	−2.139*** (0.326)	−2.144*** (0.331)
2 Firm size (log)	0.370*** (0.083)	0.200** (0.087)	0.230*** (0.085)	0.233*** (0.086)	0.226*** (0.083)	0.214*** (0.082)	0.244*** (0.086)	0.246*** (0.087)
3 Export intensity	0.439*** (0.095)	0.343*** (0.092)	0.248*** (0.079)	0.250*** (0.079)	0.268*** (0.078)	0.256*** (0.073)	0.252*** (0.080)	0.250*** (0.080)
4 Firm location	−0.153 (0.212)	−0.214 (0.213)	−0.446** (0.198)	−0.451** (0.200)	−0.459** (0.194)	−0.516*** (0.193)	−0.454** (0.199)	−0.472** (0.200)
5 Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Main effect								
6 Functional diversity		1.620*** (0.332)	1.311*** (0.253)	1.374*** (0.255)	1.249*** (0.303)	1.218*** (0.289)	1.366*** (0.262)	1.390*** (0.268)
7 Functional diversity squared		−0.782*** (0.255)	−0.631*** (0.215)	−0.613*** (0.217)	−0.563** (0.241)	−0.569** (0.234)	−0.600*** (0.221)	−0.620*** (0.224)
Moderating variables								
8 MNC identifier			0.099 (0.166)	0.172 (0.193)	0.145 (0.192)	−0.002 (0.203)	0.184 (0.193)	0.190 (0.197)
9 R&D intensity			0.750*** (0.228)	0.746*** (0.229)	1.235*** (0.409)	1.743*** (0.435)	0.717*** (0.224)	0.748*** (0.228)
10 Human capital			0.191** (0.095)	0.194* (0.096)	0.176* (0.088)	0.162 (0.086)	0.472*** (0.165)	0.540*** (0.160)
Two-way interaction effects								
11 Functional diversity × MNC				−0.138 (0.174)	−0.062 (0.174)	0.029 (0.181)	−0.136 (0.176)	−0.152 (0.176)
12 Functional diversity × R&D intensity					−0.143 (0.390)	−0.699** (0.283)		
13 Functional diversity × human capital							−0.010 (0.084)	−0.215 (0.141)
14 MNC × R&D intensity					−0.884** (0.406)	−1.953*** (0.512)		
15 MNC × human capital							−0.388** (0.186)	−0.537*** (0.187)
Three-way interaction effects								
16 Functional diversity × MNC × R&D intensity						1.330** (0.594)		
17 Functional diversity × MNC × human capital								0.322* (0.174)
Total observations	1045	1045	1045	1045	1045	1045	1045	1045
Total censored observations	682	682	682	682	682	682	682	682
F-Statistic	12.610***	13.170***	12.410***	11.120***	10.780***	10.370***	9.590***	8.700***
R-squared	0.120	0.205	0.263	0.264	0.282	0.293	0.268	0.271
Δ R-squared (relative to Model 5—main effects)			0.058	0.059	0.077	0.088	0.063	0.066
Akaike's Information Criterion (AIC)	2167.591	2079.921	2018.167	2019.454	2001.215	1988.722	2017.710	2016.351
Δ AIC (relative to Model 5—main effects)			−61.754	−60.467	−78.706	−91.199	−62.211	−63.570
Variance inflation factor (max)	1.32	1.51	1.51	1.51	1.51	1.51	1.51	1.51

Notes: Tobit regression analyses with robust standard errors explaining firms' revenue share from new-to-market products or services. Standardized coefficient estimates reported. Lower values of the AIC indicate improved model fit.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

nature of functional, geographical, and temporal partnership portfolio diversity. This highlights the importance of configuring an alliance portfolio composed of partners that are diverse not only in terms of their role in the value chain, but also in terms of their geographical location and temporal involvement in the innovation process. Consistent with our main analyses, MNCs failed to outperform their domestic counterparts when it comes to translating not only functional, but also geographical and temporal partnership portfolio diversity into superior innovative performance. Interestingly, this remained the case even when MNCs were endowed with high levels of R&D intensity.

5. Discussion

In this study, we sought to understand how and under what conditions alliance portfolio diversity influences firms' innovative performance. Several key findings emerged with regard to this

question. First, we identified an inverted U-shaped effect of MNCs' functional partnership portfolio diversity on their innovative performance. Second, differences between multinational and domestic firms in their ability to realize the benefits of functional alliance portfolio diversity were found to be contingent on the level of R&D intensity and, to some extent, human capital.

Our primary theoretical contribution to alliance portfolio research lies in identifying important boundary conditions under which alliance portfolios enhance a firm's innovative performance. With some exceptions (Lavie & Miller, 2008; Wuyts & Dutta, 2014), research examining how the focal firm's attributes its alliance portfolio success is largely missing. In this study, we have specifically brought the multinational firm and its unique characteristics into the foreground. Our results underscore the need to simultaneously consider the characteristics of MNCs' alliance portfolios and internal resources when seeking to understand alliance portfolio performance. Most notably, a

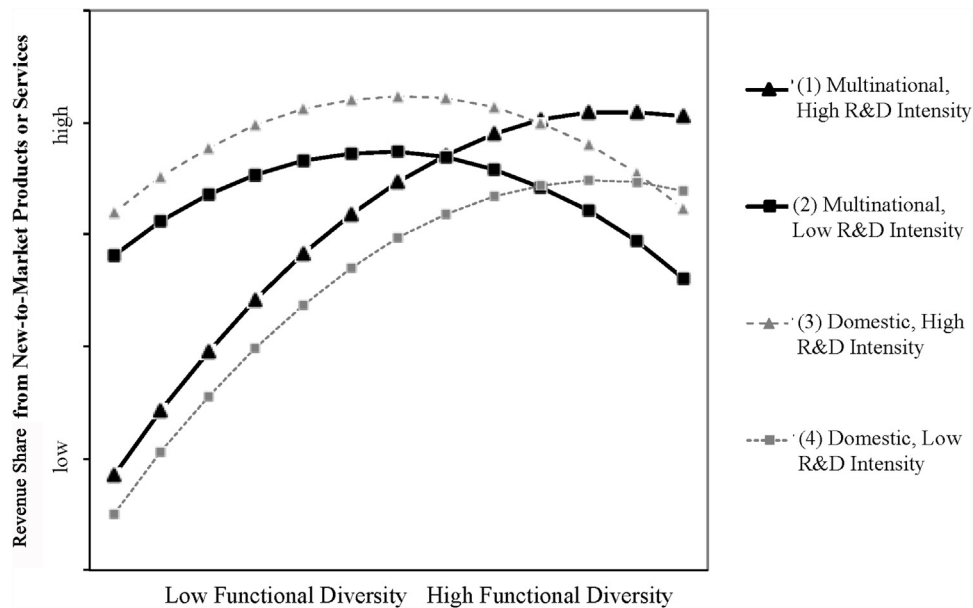


Fig. 1. Three-way interaction between functional portfolio diversity, MNC status, and R&D intensity.

nuanced picture emerges with regard to the expected differences between multinational and domestic firms in their alliance portfolio performance. While there are no such differences when viewed in isolation, especially under high levels of internal R&D, multinational firms benefit more from functionally diverse alliance portfolios than domestic firms⁵. This can be interpreted not only as underlining the importance of a firm's technological capabilities for absorbing external knowledge per se (e.g., Cohen & Levinthal, 1990), but also as supporting our assumption that MNCs need sufficient resources to deal with the complexity of simultaneously managing various internal and external network relationships, and thus to realize their structural advantages compared to domestic firms. It should be noted, however, that in light of our post-hoc tests these findings must be treated with some caution. The non-significant three-way interactions for geographical and temporal portfolio diversity suggest limits to the generalizability of our findings across different forms of alliance portfolio diversity and clearly point to the need for further research on this complex issue.

That being said, the above findings also inform the ongoing debate on whether internal R&D and external knowledge sourcing are complementary innovation activities or substitutes to each other (Gesing et al., 2015; Hagedoorn & Wang, 2012; Hess & Rothaermel, 2011). Interestingly, our three-way interaction analyses revealed the relationship between portfolio diversity and R&D to be complementary among MNCs, yet substitutive among domestic firms. This suggests that firm-level contingencies (e.g., size or structures) need to be considered to understand the interplay between internal and external innovation activities.

Furthermore, by examining how a firm's bundle of internal resources and external network resources interact to create value, this article offers a contribution to resource-based theory. The RBV is traditionally limited to an inward-looking view of firms' value

creation activities, as criticized by proponents of the relational view who argue that strategic resources may span firm boundaries (e.g., Dyer & Singh, 1998), and has mainly focused on the characteristics that single resources should have to generate competitive advantage (Becerra, 2008). Yet, it is increasingly recognized that resources rarely generate benefits on their own but rather as part of resource combinations (Newbert, 2007; Wassmer & Dussauge, 2011). Our findings on the interplay between different organizational types (MNCs vs. domestic firms), R&D, and various alliance portfolio configurations expand current understanding of value-creating resource combinations.

Finally, our research advances knowledge on MNC innovation by theorizing and examining the antecedent role of alliance portfolios. There are a few studies on the relationship between alliance portfolio configurations and innovation (e.g., Srivastava & Gnyawali, 2011; Vasudeva & Anand, 2011; Wuyts & Dutta, 2014). Yet, these studies do not focus on multinational organizations, while those that do examine financial performance outcomes (Goerzen & Beamish, 2005; Lavie & Miller, 2008). Our finding that alliance portfolio diversity is associated with positive but decreasing returns to innovation is consistent with some (Vasudeva & Anand, 2011), but not all, studies from other contexts. Wuyts and Dutta (2014) observed quite the opposite relationship, i.e. a U-shaped effect of partner diversity on innovative performance. However, the common theme of these studies and our research is that at a certain level of alliance portfolio diversity, the costs of adding further idiosyncratic partners exceed the benefits of gaining access to unique resources that fuel the innovation process. From a theoretical standpoint, future studies may therefore benefit from integrating different theories to better understand the countervailing effects of alliance portfolio diversity. For example, combining elements of the RBV and transaction cost economics (e.g., Williamson, 1985), which focuses on the costs of partner diversity (Goerzen & Beamish, 2005), could provide further insights into the conditions under which MNCs' alliance portfolios are more or less effective.

5.1. Managerial relevance

Over the last decades, the locus of value creation has gradually moved away from the individual firm to networks of collaborating

⁵ Srivastava & Gnyawali's (2011) study offers alternative explanations as to why we did not find support for Hypothesis 2 according to which there will be differences in the alliance portfolio performance of multinational and domestic firm. Their findings suggest that technologically weaker and less diverse firms benefit at a higher rate from technologically diverse alliance portfolios. Among others, this can be traced back to the greater need of these firms to acquire external resources and, consequently, more focused approach to do so. This effect may compensate for MNCs' greater (potential) capacity to manage alliance portfolios vis-à-vis domestic firms.

firms. This shift toward collaborative innovation processes implies that firms must manage an increasingly complex network of relationships with heterogeneous external partners. In line with scholars highlighting the managerial challenges and costs associated with large and diverse alliance portfolios (Goerzen, 2005; Wassmer, 2010), our study suggests that managers need considerable diligence when configuring their firm's alliance portfolio. Although our findings clearly point to the benefits of diverse alliance portfolios, simply increasing the diversity of alliances is not an effective strategy given the observed inverted U-shaped relationship between alliance portfolio diversity and firms' innovative performance. Instead, we make a case for a tailored alliance portfolio where each partner is purposefully selected as a function of both its unique contributions and the specific requirements of the focal firm. This is even more important when considering our observation that differences in the resource endowments and structural attributes of firms account for variance in their alliance portfolio performance. Hence, we argue that managers must critically evaluate the firm's alliance portfolio capabilities before expanding the diversity of partnership activities. In particular, our findings indicate that multinational and domestic firms should take different paths to achieve innovation success. As shown in Fig. 1, the innovative performance of MNCs is highest when simultaneously engaging in diverse alliance activities and internal R&D. For MNCs lacking R&D capabilities, we recommend to opt for moderately diverse alliance configurations that place fewer burdens on their absorptive capacity or, alternatively, to increase R&D expenditures if they have sufficient financial resources. In contrast, simultaneously pursuing extensive internal knowledge generation and alliance activities may not be the optimal strategy for domestic firms. Considering the observed substitution effect between alliance portfolio diversity and internal R&D, domestic firms that tend to face more resource constraints than MNCs are better off concentrating their knowledge acquisition efforts on either internal R&D or alliances. Especially a combination of low to moderate alliance portfolio diversity and high levels of R&D investments appears conducive to innovation in a domestic context. Somewhat surprisingly, domestic firms pursuing this approach (i.e., low to moderate partnership diversity and high R&D) even outperform their multinational counterparts⁶.

5.2. Limitations and future research

Notwithstanding its contributions to research and practice, our study is subject to limitations. Empirically, we relied on firm-level data collected by means of an official national innovation survey, the MIP. While this approach has notable advantages including a relatively high response rate and a representative coverage of all main sectors of economic activity in Germany, it is necessarily limited to managers' subjective perceptions of firm and innovation partnership characteristics. Unfortunately, the MIP does not contain valuable pieces of information such as the size of MNCs' internal subsidiary network and external partnership portfolio. Although our functional partnership diversity measure captures

⁶ As a tentative explanation as to why domestic firms achieve higher innovative performance than multinational firms under conditions of low to moderate partnership portfolio diversity and high R&D intensity, we argue that domestic firms may achieve a greater "fit to market" with their technological solutions developed through R&D. Knowledge is particularly valuable in the context in which it is generated. As domestic firms are less export-oriented and develop new products primarily for their home market, local R&D activities might be sufficient to successfully innovate. In contrast, given their export orientation, MNCs often need to modify and adapt their products in order to satisfy international demands. These additional requirements may explain why MNCs rely more strongly on combining internal R&D with diverse alliance activities that provide complementary market and technological knowledge.

portfolio diversity rather than portfolio size, future research may wish to control more explicitly for the potentially confounding effect of portfolio size. Alternative measures that allow for a more fine-grained analysis of the focal firm's and its portfolio partners' structural, technological, and human resources are also needed to deepen our understanding of MNCs' alliance portfolio capabilities and potential differences vis-à-vis domestic firms. In particular, by explicitly measuring the degree of complementarity between the focal firm's and its partner's resources rather than inferring that functionally diverse organizations in an alliance portfolio actually possess heterogeneous resource endowments, future studies could provide additional insights into the performance implications of alliance portfolios. Similarly, rather than using R&D intensity as a proxy for absorptive capacity more advanced measures that distinguish between a firm's potential and realized absorptive capacity would be welcome (Zahra & George, 2002). As a further limitation, our study adopts a partial time lag between our measure of functional portfolio diversity and innovative performance, but fails to track the evolution of alliance portfolios and individual partnerships over time. This is a shortcoming considering the fact that prior alliance experience is likely to affect MNCs' payoff from collaboration (Lavie & Miller, 2008). Finally, we examined MNCs operating in multiple sectors, yet originating from a single country—Germany. Although we expect our findings to hold for other highly technology- and export-oriented economies, their broader generalizability remains a subject for future research. In light of these limitations, we encourage scholars to replicate and extend our study ideally based on longitudinal, archival data (e.g., patent data), covering not only multiple sectors but also multiple countries.

6. Conclusion

Our primary aim was to gain a better understanding of the role played by a firm's internal characteristics in realizing the innovation benefits from alliance portfolios, and thus to extend the emerging literature on value creation in alliance portfolios that remains characterized by inconsistencies and mixed findings. To this end, we focused on multinational firms as a specific type of organization and explored potential differences with domestic firms in their alliance portfolio performance. However, these emerged only among firms with high levels of R&D intensity and, to a lesser extent, human capital. These findings are a reminder that the relationship between alliance portfolios and firm performance is a complex one that is contingent not only on the configuration of the alliance portfolio, but also on the focal firm's resources and capabilities. While additional research is needed to unravel the mechanisms influencing alliance portfolio performance, this study takes an important step in this direction.

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