

Effect of firm's diverse experiences on its alliance portfolio diversity: Evidence from India

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Abstract

This study examines the effect of diverse experiences on a firm's alliance portfolio diversity (APD). Drawing on the organizational learning perspective, it argues that a firm's learning from diverse experiences enables it to reap the benefits and mitigate the risks of high level of APD. Thus, an experienced firm may choose to form or maintain relationships with diverse partners to get the intended benefits of APD. In particular, the study hypothesizes that a focal firm's product and international diversification experience, alliance experience, and alliance experience heterogeneity are positively associated with its APD. A longitudinal investigation of 90 Indian firms, for the period 2004–2014, provides support for all the hypothesized relationships. In general, findings, which are robust to multiple estimation methods, suggest that a firm's diverse experiences influence its APD. Findings of this study contribute to the alliance portfolio and organizational learning literature by examining the experiential antecedents of APD.

Keywords: alliance portfolio diversity, diversification, alliance experience, organizational learning, alliance experience heterogeneity

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INTRODUCTION

Firms that engage in multiple alliances manage them as a portfolio, rather than managing each alliance in isolation (Wassmer, 2010; Faems, Janssens, & Neyens, 2012). Managing a portfolio of alliances is a challenge, requiring substantial managerial attention and skills (Heimeriks & Duysters, 2007; Schilke, 2014). Over the last two decades, alliance portfolio has emerged as a unit of analysis, and researchers have started addressing various important questions central to this emerging research stream (Wassmer, 2010; Faems, Janssens, & Neyens, 2012). Researchers have studied various aspects of alliance portfolio, such as origin and evolution (Hoffmann, 2007; Lavie & Singh, 2012), characteristics and configuration (Rothaermel & Deeds, 2006; Andrevski, Brass, & Ferrier, 2013), and management of alliance portfolio (Heimeriks & Duysters, 2007; Schilke, 2014). While the questions of performance impact of alliance portfolio characteristics have attracted a great deal of attention from researchers, questions pertaining to antecedents of alliance portfolio have received relatively less attention (Wassmer, 2010; Lee, Kirkpatrick-Husk, & Madhavan, 2014). Moreover, most of the studies are limited in generalizability because these studies are conducted in narrow industrial contexts (e.g., Beckman, Bird Schoonhoven, Rottner, & Kim, 2014) and/or have considered only specific type

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of alliances, such as technology alliances (e.g., Jacob, Belderbos, & Gilsing, 2013; Castro, Casanueva, & Galán, 2014).

In particular, researchers, concerned with alliance portfolio diversity (henceforth APD), have focused primarily on the APD-performance linkage (Wassmer, 2010; Lee, Kirkpatrick-Husk, & Madhavan, 2014); and, only a few researchers have attempted to examine the antecedents of APD. These researchers have taken various theoretical perspectives such as social capital and relational perspectives (Beckman et al., 2014; Golonka, 2015), resource- and knowledge-based views (Duysters & Lokshin, 2011), real options (Tao, Jiang, & Santoro, 2014), and organizational learning perspective (Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014). The studies that draw on organizational learning perspective have focused mainly on one dimension of learning, i.e. *learning from similar experiences* (Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014). A study by Jacob, Belderbos and Gilsing (2013), on a sample of 2,488 European firms, found that firms build on their prior international alliance experience to enhance the geographical diversity of their alliance portfolio. Similarly, a study of 12,811 Dutch and foreign innovating firms found that prior alliance experience and patenting are key antecedents of APD (van Beers & Zand, 2014). However, organizations learn not only from similar experiences, i.e. prior alliance experience, but also from other diverse experiences, such as experience in diverse product-markets and/or geographic markets. The effect of *learning from diversity* on focal firm's APD is less researched (Barkema & Vermeulen, 1998; Schulz, 2002).

This study attempts to address such gaps in the literature, which focuses primarily on *learning from similar experiences* perspective while examining the antecedents of APD. In particular, it integrates these two streams of learning – *learning from similar experiences* and *learning from diversity* – perspectives with regard to antecedents of APD (Barkema & Vermeulen, 1998; Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014). Moreover, considering that alliance behavior of firms from emerging markets may be different than those from developed markets (Hitt, Ahlstrom, Dacin, Levitas, & Svobodina, 2004), this study conducted in the Indian context would complement prior studies which were mostly based in the context of developed countries.

The main objective of this study is to examine experiential antecedents of APD. Drawing primarily on organizational learning perspective, it examines the effects of prior product and international diversification experience, prior alliance experience, and alliance experience heterogeneity (henceforth AEH) on focal firm's APD. Findings of this study suggest that learnings from both similar and diverse experiences enhance a firm's ability to form and maintain diverse alliances. In particular, results of the study provide support for the hypotheses that firm's prior product and international diversification experience, alliance experience, and AEH are positively related to APD. This study makes some valuable contributions to the *learning from diversity* literature by examining the effects of diverse experiences on a firm's APD. Additionally, this study contributes to the alliance portfolio literature by examining the antecedents of APD, which remains relatively less researched.

The rest of the paper is organized as follows. First, a summary of the literature on conceptualization and operationalization of APD construct is presented; and, then, the rationale behind considering APD a two-dimensional construct is stated. Next, the theoretical background and arguments are presented to develop hypotheses. In the following section, the details of data and methods are discussed. Next, results are presented; and, theoretical and managerial implications of the findings are discussed. Finally, the paper is concluded by mentioning its limitations and providing directions for future research.

APD: CONCEPTUALIZATION AND OPERATIONALIZATION

Prior studies have mostly conceptualized APD as *variety* of information or knowledge present in the portfolio (Harrison & Klein, 2007; Lee, Kirkpatrick-Husk, & Madhavan, 2014). Researchers have considered various dimensions of APD, including partner type diversity, functional diversity,

technological diversity, and partners' national diversity (Jiang, Tao, & Santoro, 2010; Phelps, 2010; Mouri, Sarkar, & Frye, 2012; Lee, Kirkpatrick-Husk, & Madhavan, 2014; Tao, Jiang, & Santoro, 2014). These dimensions can broadly be categorized into partner attributes and alliance attributes (Wassmer, 2010).

In terms of partner attributes, APD has been operationalized based on partners' – (i) type (i.e., competitor, customer, supplier, etc.) (Duysters & Lokshin, 2011); (ii) resource (or industry) (Cui, 2013); (iii) nation of origin (Knoben & Oerlemans, 2012); (iv) technology (Phelps, 2010); (v) organizational type, such as private or public (Jiang, Tao, & Santoro, 2010); and (vi) repeatedness, i.e. repeated partnership with existing alliance partner, versus first time alliance with a new partner (Sivakumar, Roy, Zhu, & Hanvanich, 2011).

In terms of alliance attributes, APD has been operationalized as: (i) functional diversity – based on functions to be performed by the alliances, such as joint R&D, joint manufacturing, joint marketing, or combination (Hora & Dutta, 2013; Hoehn-Weiss & Karim, 2014); (ii) portfolio technology diversity – based on different technology areas in which alliances in a portfolio are present (Andrevski, Brass, & Ferrier, 2013; Wuyts & Dutta, 2014); (iii) alliance industry diversity – in terms of different industries in which alliances in a portfolio are present; (iv) governance diversity – based on governance structure of alliances, i.e. equity joint ventures (JVs) or contractual.

A majority of the studies have considered these dimensions separately, emphasizing that each of these dimensions have independent effects on the outcome variables (Jiang, Tao, & Santoro, 2010; Rogbeer, Almahendra, & Ambos, 2014). However, a few researchers have argued that since APD dimensions are not independent, it is important to combine them to understand the nature of the latent construct 'APD' (van Beers & Zand, 2014; Castro, Roldán, & Acedo, 2015). This study considers APD a two-dimensional construct that broadly reflects the partner attributes of the portfolio (de Leeuw, Lokshin, & Duysters, 2014; van Beers & Zand, 2014; Castro, Roldán, & Acedo, 2015). APD is operationalized as a formative construct comprising two partner-related dimensions: one dimension capturing diversity in terms of partner types and the other dimension capturing diversity in terms partners' geographic region of origin. These two dimensions adequately capture the *variety*, in terms of partner attributes, present in the alliance portfolio (Harrison & Klein, 2007; Lee, Kirkpatrick-Husk, & Madhavan, 2014). A portfolio with different partner types (i.e., supplier, customer, competitor, similar-business, government, or unrelated-business w.r.t. focal firm) is suggestive of the balance of firm's access to supplementary or complementary resources (Jiang, Tao, & Santoro, 2010). Additionally, partner type diversity also indicates a focal firm's capabilities and status (Stuart, 2000), and reflects how the firm balances its ties with similar and dissimilar partners (Castro, Casanueva, & Galán, 2014). On the other hand, geographic diversity indicates whether partners belong to similar or diverse cultural or institutional contexts. A firm that partners with other firms from various socio-cultural contexts gains access to variety of knowledge sources (de Leeuw, Lokshin, & Duysters, 2014; Castro, Roldán, & Acedo, 2015).

THEORETICAL BACKGROUND AND HYPOTHESES

Do firms benefit from APD?

Prior literature on alliance portfolio suggests that APD positively affects a firm's innovation (Duysters & Lokshin, 2011; Knoben & Oerlemans, 2012; Wuyts & Dutta, 2014) and performance (Pangarkar & Wu, 2012; Hora & Dutta, 2013). A focal firm may be willing to maintain diverse alliances to get benefits from APD. However, managing a diverse portfolio is a challenging task, requiring substantial managerial resources and capabilities. Researchers suggest that, at a very high level of APD, the enhanced coordination costs may offset the positive effects of APD (Hoffmann, 2007; Duysters & Lokshin, 2011;

Golonka, 2015). Nonetheless, the diminishing positive effect of APD on firm performance is contingent on a firm's capabilities to manage diverse alliance portfolio. For example, Duysters, Heimeriks, Lokshin, Meijer and Sabidussi (2012) found that portfolio management capabilities that enable a firm in managing diverse alliance portfolio moderates the relationship between APD and portfolio performance such that when alliance capabilities are higher alliance portfolio performance is maximized at a higher level of APD. Similarly, Cui and O'Connor (2012) argued that alliance management function positively moderates the relationship between portfolio resource diversity and firm innovation. In other words, these researchers suggest that management capabilities mitigate the negative effects and enhance the positive effects of APD on a firm's financial and innovation performance.

Since capabilities, developed through experiential learning, enable a firm to get the intended benefits from a high level of APD, one can expect that an experienced and capable firm would make conscious decisions to maintain or expand portfolio diversity. Put differently, this study argues that an experienced firm may decide to expand its portfolio diversity as it becomes capable of reaping the benefits and mitigating the disadvantages of the high level of APD. A more experienced firm is better equipped to reap the benefits of APD than a less experienced firm.

This study considers prior diversification and alliance experience as important sources of learnings. Diversification literature suggests that diversification experience enriches the existing knowledge base of the firm (Kogut & Zander, 2003; Zollo & Singh, 2004), and may help the firm develop capabilities to manage diversity (Bartlett & Ghoshal, 1993, 1999; Augier & Teece, 2007). Similarly, alliance portfolio researchers have examined the influence of alliance experience on the development of alliance management capabilities (Gulati, 1999; Rothaermel & Deeds, 2006; Duysters et al., 2012). In this study, the effects of prior diversification and alliance experience on a focal firm's APD have been examined. Two dimensions of firm's diversification experience – product and international – are considered. The examination of the effect of alliance experience has been further refined by considering the influence of AEH on APD.

Product diversification experience and APD

Firm's prior diversification experience enhances its knowledge-base and capabilities (Delios & Beamish, 1999; Mayer, Stadler, & Hautz, 2014). A firm's presence in multiple product-markets can be an important source of learning as the firm learns through its interactions with diverse sets of suppliers, rivals, customers, and partners (Barkema & Vermeulen, 1998). Such learning facilitates a firm's subsequent entries into related markets (Gang, 2013). From a process perspective, a firm's presence in multiple markets improves executives' capabilities to manage multiple businesses, which in turn may change the *dominant logic* of the firm (Prahalad & Bettis, 1986), thereby influencing performance of the firm (Chang & Thomas, 1989; Chakrabarti, Singh, & Mahmood, 2007). Organizations bring changes in structures and routines to meet the challenges posed by diversification (Chandler, 1982; Markides & Williamson, 1996). The refined structures, routines, and mental models may help firms better manage their business units (Doz & Prahalad, 1991; Bartlett & Ghoshal, 1993). Overall, learnings from product-market diversity improve a focal firm's capabilities to manage complexities (Doz & Prahalad, 1991; Bartlett & Ghoshal, 1993). Such learning may enhance a focal firm's abilities to manage complexities of diverse alliance portfolio. Thus, a firm having diverse experiences would be more capable of getting the intended benefits from diverse alliance portfolio than a less experienced firm.

Additionally, drawing from the observations of a few case studies, which suggest that product diversification leads to greater partner diversity (Lavie & Singh, 2012, p. 799), this study argues that a diversified firm's interactions with various customers, suppliers, and rivals from multiple product-markets may create opportunities for the firm to form alliances with different partner types. Taking the

above arguments together, this study suggests that a firm's diversification experience provides the firm opportunities to form diverse alliances and enable it to maintain or expand its portfolio diversity successfully. Thus, it is hypothesized that:

Hypothesis 1: A focal firm's product diversification experience is positively related to its APD.

International diversification experience and APD

Firms learn from their prior international diversification experience and adjust their organizational structures, routines, and practices accordingly (Yu, 1990; Bartlett & Ghoshal, 1999). An internationally diversified firm is exposed to customers, rivals, suppliers, and partners from various country- and market-contexts (Barkema & Vermeulen, 1998). Exposure to such diverse parties and circumstances helps a focal firm enhance capabilities not only to manage and coordinate operations, but also add an array of competitive tactics (Bartlett & Ghoshal, 1999; Nadolska & Barkema, 2007). Researchers, drawing on organizational learning perspective, have found that prior international experience influences managerial decisions concerning firm's strategic scope (Bowen, Baker, & Powell, 2014), growth of the firm (Mayer, Stadler, & Hautz, 2014), and choice of foreign entry mode (Barkema & Vermeulen, 1998). Based on prior international experience, a firm may choose alliances or JVs as modes of foreign entry compared with other modes (Kogut & Singh, 1988; Hennart & Reddy, 1997).

Additionally, a firm's prior international diversification experience helps it develop abilities to collaborate with partners from diverse institutional and cultural contexts (Kogut & Singh, 1988; Barkema & Vermeulen, 1998). The firm may transfer its experience to future decisions such as forming alliances with partners from similar institutional or cultural context (Kogut & Singh, 1988; Hennart & Reddy, 1997). Such prior exposures may also create cross-border partnering opportunities for the focal firm. Moreover, one may expect that a firm with international diversification experience is more able to reap the benefits from higher level of APD, compared with a less experienced firm. Additionally, a firm with prior international experience would be able to mitigate the negative concerns of high level of APD, as the accrued learning would enhance firm's abilities to manage complexities (Duysters & Lokshin, 2011). Taking together the above lines of arguments, this study expects that a firm's international diversification experience should positively influence its APD.

Hypothesis 2: A focal firm's international diversification experience is positively related to its APD.

Alliance experience and APD

Prior experience in forming and managing multiple alliances helps a firm develop alliance portfolio management capabilities and enhances the likelihood of alliance formation by the firm in future (Gulati, 1999; Rothaermel & Deeds, 2006; Duysters et al., 2012). Firms with prior alliance experience develop routines and mechanisms to reduce the risk of misappropriation of knowledge resources by partner firms (van Beers & Zand, 2014). Collaborative know-how developed by a focal firm through its prior alliances enables it to devise better conflict resolution mechanisms (Das & Teng, 2001; Nielsen & Nielsen, 2009). Moreover, firms develop learning capabilities in their prior involvements in exploration alliance, enabling the firm to invest in multiple technological alliances in future (Gulati, 1999).

Prior experience with multiple partners enhances firms' social capital, as firms become more central in their respective partnership networks (Al-Laham & Amburgey, 2010). Focal firm's prior ties improve its trustworthiness, making the firm an attractive partner for future relationships (Ahuja, 2000a; Castro, Roldán, & Acedo, 2015). Moreover, multiple prior engagements with the same partner enhance focal firm's trustworthiness with the other firms, who may not have direct linkage with the focal firm (Das & Teng, 2002). From learning perspective, a focal firm having prior experience with

multiple partners might have developed capabilities that would enable the firm to manage diverse alliances and coordinate with different types of partners in future (Duysters et al., 2012). A capable firm may choose to design a diverse portfolio in order to get the intended benefits from higher level of APD (Cui & O'Connor, 2012). Thus, it is expected that:

Hypothesis 3a: A focal firm's alliance experience is positively related to its APD.

AEH and APD

Learning from diversity literature suggests that a firm's diverse experiences enrich its learning (Barkema & Vermeulen, 1998; Schulz, 2002). Although homogeneous experience may make a firm more efficient through standardization of routines and practices, it is the diversity of experience that makes a firm capable of facing diverse circumstances effectively (Reuer, Park, & Zollo, 2001). The learning attained from prior diverse experiences saves a firm from falling into *competency trap* (Levitt & March, 1988).

Firm's prior involvement with heterogeneous partners provides the firm opportunity to learn and develop alliance management capabilities (Gulati, 1999), which enable the firm to benefit from high level of APD (Rothaermel & Deeds, 2006). Additionally, a firm's learning with and from foreign partners from various institutional and cultural contexts not only enhances its ability to gain economic benefit from collaboration, but also creates future cross-border partnering opportunities. Prior studies suggest that firms build on their prior international alliance experience to increase the geographic diversity of alliance portfolio (Jacob, Belderbos, & Gilsing, 2013). Drawing on these findings and above line of arguments, it is hypothesized that AEH will positively influence focal firm's APD.

Hypothesis 3b: A focal firm's AEH is positively related to its APD.

DATA AND METHODOLOGY

Data and sample

A panel data set of alliance portfolio of Indian firms for the period 2004–2014 was prepared. However, since some of the predictor variables of this study are related to alliance experience, alliance data were collected for the period 1990–2014. The main reason behind choosing 2004–2014 as the period of this study was the unavailability of the data prior to 2004 from some of the sources. In particular, this study relied heavily on corporate annual financial reports to complement the data gathered from other sources. These annual reports were gathered from corporate websites. The majority of the firms in our sample had not archived annual reports prior to 2004. Thus, the start period of the study was chosen as 2004. The data set for this study was prepared by referring multiple sources¹ such as Securities Data Company (SDC) Platinum database, Prowess, India Business Insight database (IBID), and annual reports of firms.

SDC is the primary reference for information related to alliances and JVs. Although, SDC is comprehensive in its coverage of alliance formation and deal specifics, it does not provide complete information related to termination of alliances (Cui, 2013). In order to get further information about the status of alliances, corporate annual reports and IBID were referred. Because of difficulties in gathering information regarding contractual alliances², this study included only JVs in the data set³. The operationalization of alliance portfolio in terms of JVs is in line with prior studies

¹ Table A1 (Appendix A) presents details of the data sources and the steps that were taken to prepare the panel data set for the period 2004–2014.

² Contractual alliances refer to non-JV cases, including a few cases of minority stockholding.

³ Authors were able to ascertain whether a JV is active or terminated in a particular year by referring to the annual reports. When a firm forms or dissolves a JV in a particular year, it mentions some details in the corresponding year's

(Reuer & Ragazzino, 2006; Collins & Riley, 2013; Cui, 2013). Furthermore, only bilateral JVs were considered. Multilateral JVs varied in terms of the number of participants, with minimum three and maximum eight partners. In order to maintain homogeneity among all the alliance units in terms of number of partners, multilateral JVs were excluded from the data set. Additionally, only the firms that were involved in more than one JVs during 1990–2014 were included in the data set (Jiang, Tao, & Santoro, 2010; Cui & O'Connor, 2012). Furthermore, as for additional data on alliances this study relied on publicly disclosed information, JVs formed by private entities (including business group holding firms) were excluded. Additionally, JVs formed by state agencies and state-owned enterprises were also excluded. Consequently, the data set contained 424 JVs by 99 publicly-listed firms during 1990–2014.

Furthermore, annual reports of these 99 firms and the IBID were searched to find additional information related to formations and terminations of JVs by these firms. Search revealed that 277 JVs in the data set were terminated at different points in time during 1990–2014. Additionally, 209 new JVs were found, which were formed⁴ by these firms but not mentioned in the SDC database. Consequently, the final data set comprised 633 JVs formed by 99 Indian firms since 1990. However, nine of these firms had all their JVs terminated before 2004. These nine firms were excluded from the panel data set. Additionally, while preparing the panel data set those firm-year observations were removed in which the respective firms had zero number of active JVs (Phelps, 2010; Tao, Jiang, & Santoro, 2014). Some firm-year observations for which the data for some control or predictor variables were not available were further removed. Consequently, the final unbalanced panel data set is comprised of 776 firm-year observations for 90 Indian firms for the time period 2004–2014.

Variables and measurements⁵

Dependent variable (DV): APD

APD is conceptualized as a two-dimensional construct that captures APD in terms of partner type and partners' geographic region of origin (de Leeuw, Lokshin, & Duysters, 2014; van Beers & Zand, 2014; Castro, Roldán, & Acedo, 2015). The composite construct APD is measured by taking average of the

(F'note continued)

annual report. Similarly, a list of active JVs are mentioned in the 'notes to financial statements' section of annual reports. The information related to formation or termination of JVs are also reported in newspapers, which authors could retrieve through IBID. The approach taken in the study to ascertain termination date of JVs is similar to the approaches taken by prior studies (Ahuja, 2000b; Cui, 2013). However, companies do not share such information for contractual alliances. Prior studies have assumed 3–5 years of alliance duration when termination related information is not available (Srivastava & Gnyawali, 2011; Bruyaka & Durand, 2012). Taking such approach may allow including contractual alliances also in the data set. However, the information about additional contractual alliances, which were formed but not included in the SDC, may not be found, as authors could find such information for JVs by scanning annual reports of the sample firms for the period 2004–2014. In the prepared data set, authors found and included as many as 209 JVs (>30% of the JVs formed by our sample firms) that were not reported in the SDC. Thus, authors decided to use the prepared data set of JVs for this study, which, they believe, contains accurate information regarding formation and termination of JVs by the sample firms. Inclusion of contractual alliances may dilute this accuracy (Cui & O'Connor, 2012; Cui, 2013). Furthermore, it has been discussed later in Appendix B that exclusion of contractual alliances may not have any major implication with regard to the findings of this study.

⁴ Formation of JVs are inferred from the list of active JVs reported in the annual financial report. The annual reports are scanned for the period 2004–2014. It is important to mention that some of the JVs were active during the period, but their formation was before 2004 and were also not reported in the SDC database. For most (>95%) of such JVs, we could find their formation-related information through IBID. For others we assumed 2004 as formation year. Since we prepared panel data set of firms' active alliances for the period 2004–2014, such assumption is justifiable.

⁵ Table A2 (Appendix A) summarizes the operationalization of the variables used in this study, along with key references.

Blau's index of heterogeneity of these two dimensions: partner type diversity and partner geographic diversity (Blau, 1977; Golonka, 2015). The Cronbach's (1951) α for the composite construct is 0.82. The value of composite construct ranges between 0 and 1, where 0 signifies the least diversified while 1 signifies the most diversified alliance portfolio.

Partner type diversity indicates a firm's ability to balance its access to supplementary or complementary resources (Jiang, Tao, & Santoro, 2010). *Partner type diversity* is measured by calculating the heterogeneity index (Blau, 1977) of focal firm's alliance portfolio in terms partner types (Duysters & Lokshin, 2011; de Leeuw, Lokshin & Duysters, 2014). *Partner geographic diversity* dimension indicates whether partners belong to similar or diverse cultural or institutional contexts. Following prior studies (Duysters & Lokshin, 2011; Bahlmann, 2014), *partner geographic diversity* is measured as heterogeneity index (Blau, 1977) based on the geographic region of origin of the focal firms. Table A2 (Appendix A) presents the categories of partner types and geographic regions used to measure the heterogeneity index (Blau, 1977).

Independent variables

Product diversification experience is measured as the entropy index of firm's sales in different four-digit standard industrial classification (SIC) industries in the year preceding to the focal year (Jacquemin & Berry, 1979; Palepu, 1985; Mayer, Stadler, & Hautz, 2014).

International diversification experience indicates a firm's exposure to different cultures and geographic markets. Following prior studies (Tallman & Li, 1996; Gaur & Kumar, 2009), international diversification experience is measured as the ratio of foreign sales to the total sales (FSTS) in the year preceding to the focal year. FSTS is a better measure of international diversification experience than the other measures, such as the count of the focal firm's foreign subsidiaries or the count of the countries in which the focal firm has its subsidiaries, as FSTS accounts for the firm's exposure to foreign market not only through subsidiaries, but also through exports (Sullivan, 1994).

Following prior studies (Hoang & Rothaermel, 2005), *alliance experience* is measured by counting the total number of alliances formed by a focal firm since 1990 to the start of the focal year. This measure captures the experience accumulated over time, reflecting the effect of learning (Anand & Khanna, 2000).

AEH measures the diversity of alliance experience. Firms that involve in alliances with different types of partners, over the time, are exposed to diverse sources of learning. Such experience might help firm in developing capabilities to form and manage alliances (Gulati, 1999; Rothaermel & Deeds, 2006). Like APD, *AEH* is measured as a composite construct that reflects a firm's heterogeneity of alliance experience in two dimensions: partner type (*AEH partner type*) and partners' geographic region (*AEH partner geographic region*). The operationalization of these two dimensions of *AEH* are mentioned in Table A2 (Appendix A). The Cronbach's (1951) α for the composite construct *AEH* is 0.78.

Control variables

Prior literature suggests various factors that may influence focal firm's alliance portfolio characteristics. Firm size has been identified as a predictor of alliance portfolio characteristics such as size and diversity (Duysters & Lokshin, 2011; Jacob, Belderbos, & Gilsing, 2013). Hence, *firm size* is included as a control variable. Following prior studies, such as Leiblein and Madsen (2009), firm size is operationalized as the natural logarithm of focal firm's revenue in the focal year. Following prior studies Ahuja (2000a), *firm age* is included as a control variable. Firm age is measured as the natural logarithm of the count of years since incorporation of the firm to the start of the focal year. Furthermore, researchers have viewed *prior firm performance* as an important factor that may influence firm behavior, and hence controlled for it while predicting alliance behavior (Gulati, 1999). Prior firm performance is

operationalized as return on assets of the focal firm in the year prior to the focal year. Additionally, Collins (2013) found significant positive relationship between focal firm's *capital intensity* and APD. Hence, following his study, capital intensity is included as a control variable. Capital intensity is measured as the ratio of capital expenditure to revenue in the focal year (Mayer, Stadler, & Hautz, 2014).

Furthermore, the sample firms were spread across 27 two-digit SIC industries. To control for the industry-level factors, 26 dummies were included. Similarly, since the panel data set is prepared for 11 years (2004–2014), 10 dummies were included to control for the year effects. Table 1 presents descriptive statistics of the sample, along with Pearson's correlation coefficient between key variables used in the study.

MODEL SPECIFICATION AND ESTIMATION

This study took panel data analysis approach to examine the hypothesized relationships. The Hausman (1978) specification test suggested using fixed effect panel analysis approach. The DV (APD) is a fraction, which is bounded between 0 and 1. The nature of the DV poses challenges to linear regression model, as using a linear model may yield predictions outside the unit interval (Baum, 2008). Papke and Wooldridge (1996) proposed fractional regression model, based on quasi-maximum likelihood estimation (QMLE) method, to handle bounded DVs in cross-sectional data. However, one of the limitations of their model was its inadequacy to control for unobserved heterogeneity, which make it less useful for panel analysis (Wagner, 2003; Gallani, Krishnan, & Wooldridge, 2015). Later, Papke and Wooldridge (2008) extended their earlier fractional response models for cross-section data to panel data. They proposed fractional probit model (FPM), based on quasi-maximum likelihood estimation method, which allow controlling for the unobserved firm fixed effects. Following a few prior studies (Wagner, 2008; Kölling, 2012; Pericoli, Pierucci, & Ventura, 2013), this study considered the FPM as the primary methodological reference (Papke & Wooldridge, 2008). Additionally, for robustness checks, estimations of FPM were compared with fixed effect panel estimates, with⁶ and without log-odds transformed DV (Baum, 2008; Phelps, 2010). In all the estimation methods, experience-related predictor variables were lagged by a year with respect to the DV to ensure the temporal precedence of the predictor variables (Phelps, 2010).

RESULTS

Table 2 presents the results of FPM based on quasi-maximum likelihood estimation. For models 1 and 2, the DV is composite construct APD. Moreover, the separate effects of predictor variables on each dimension of APD are examined in models 3–6.

In model 1, only control variables are included. The coefficients of *firm size* and *prior firm performance* are not significant. The coefficients of *capital intensity* ($\beta = 0.06, p < .01$) and *firm age* ($\beta = 0.79, p < .05$) are positive and significant, suggesting that capital intensity and firm age are positively associated with APD. In model 2, the main predictor variables are included. The coefficient of *product diversification experience* ($\beta = 0.28, p < .05$) is positive and significant, supporting Hypothesis 1 that product diversification experience has positive association with APD. The coefficient of *international diversification experience* ($\beta = 0.45, p < .01$) is also positive and significant, supporting Hypothesis 2 that international diversification experience has positive association with APD. Similarly, findings also support

⁶ Following common econometric practices (Baum, 2008), this study employed log-odds transformation to the fractional DV. As log-odds transformation is not defined when value of the DV is equal to 0 or 1, these values are recoded as 0.0001 and 0.9999, respectively.

TABLE 1. DESCRIPTIVE STATISTICS

	Means	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. APD	0.33	0.27	1												
2. Partner type diversity	0.35	0.29	0.92**	1											
3. Partner geographic diversity	0.31	0.28	0.92**	0.70**	1										
4. Product diversification experience	0.61	0.48	0.06	0.10*	0.01	1									
5. International diversification experience	0.19	0.24	0.09*	0.05	0.12**	-0.16**	1								
6. Alliance experience	5.19	3.91	0.56**	0.54**	0.50**	0.12**	0.02	1							
7. AEH	0.63	0.24	-0.18**	-0.21**	-0.13**	-0.03	0.04	-0.50**	1						
8. AEH partner type	0.66	0.26	-0.13**	-0.08*	-0.16**	0.04	0.00	-0.41**	0.91**	1					
9. AEH partner geographic region	0.60	0.27	-0.20**	-0.30**	-0.07*	-0.10**	0.07	-0.50**	0.92**	0.66**	1				
10. Firm size	10.22	1.78	0.29**	0.26**	0.28**	0.20**	0.14**	0.44**	-0.15**	-0.11**	-0.16**	1			
11. Firm age	3.57	0.63	0.10**	0.12**	0.05	0.18**	-0.29**	0.23**	-0.14	-0.04	-0.22**	0.22**	1		
12. Prior firm performance	0.05	0.11	-0.05	-0.05	-0.04	0.00	0.11**	-0.01	0.02	-0.03	0.08*	0.15**	0.00	1	
13. Capital intensity	0.17	0.83	0.06	0.07*	0.04	0.08*	-0.06	0.00	-0.08*	-0.08**	-0.06	-0.23**	-0.03	-0.04	1

Notes. *n* (firm-year observation) = 776; *N* (firms) = 90.

APD, alliance portfolio diversity; AEH, alliance experience heterogeneity.

p* < .05; *p* < .01.

TABLE 2. RESULTS OF FRACTIONAL PROBIT MODEL, QUASI-MAXIMUM LIKELIHOOD ESTIMATES^a

Variables	DV = APD		DV = partner type diversity		DV = partner geographic diversity	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-2.23 (0.38)***	-4.30 (0.42)***	-1.87 (0.42)	-3.69 (0.45)***	-2.68 (0.42)***	-5.41 (0.48)***
Control variables						
Firm size	0.06 (0.05)	0.02 (0.04)	0.093 (0.05) [†]	0.03 (0.04)	0.04 (0.06)	0.01 (0.05)
Prior firm performance	-0.45 (0.30)	-0.30 (0.18) [†]	-0.34 (0.30)	-0.21 (0.17)	-0.56 (0.35)	-0.38 (0.25)
Capital intensity	0.06 (0.02)**	0.05 (0.02)**	0.07 (0.02)**	0.06 (0.02)**	0.05 (0.04)	0.05 (0.03)
Firm age	0.79 (0.39)*	0.18 (0.37)	0.84 (0.42)*	0.17 (0.39)	0.71 (0.47)	0.25 (0.41)
Year dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Predictor variables						
Product diversification experience (Hypothesis 1)		0.28 (0.13)*		0.31 (0.14)*		0.25 (0.147) [†]
International diversification experience (Hypothesis 2)		0.45 (0.15)**		0.37 (0.19)*		0.54 (0.18)**
Alliance experience (Hypothesis 3a)		0.043 (0.015)**		0.05 (0.02)**		0.053 (0.017)**
AEH (Hypothesis 3b)		0.40 (0.20)*		-		-
AEH partner type				0.54 (0.23)*		-
AEH partner geographic region				-		0.74 (0.21)***
Observations (firm-year)	776	776	776	776	776	776
Log pseudolikelihood	-338.84	-311.37	-345.11	-316.58	-338.80	-304.23

Notes.

For models 1 and 2, DV is the composite construct APD; For models 3 and 4, DV is partner type diversity; and, for models 5 and 6, DV is partner geographic diversity. All models include individual time averages of explanatory variables as suggested by Papke and Wooldridge (2008).

^aUnstandardized coefficients are reported, with robust standard errors in parentheses.

DV, dependent variable; APD, alliance portfolio diversity; AEH, alliance experience heterogeneity.

[†] $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$.

the other two hypotheses. In line with Hypothesis 3a, the coefficient of *alliance experience* ($\beta = 0.043$, $p < .01$) is positive and significant. Finally, in line with Hypothesis 3b, the coefficient of *AEH* ($\beta = 0.40$, $p < .05$) is positive and significant. Among the control variables, the coefficients of *prior firm performance* ($\beta = -0.30$, $p < .1$) and *capital intensity* ($\beta = 0.05$, $p < .01$) are significant. However, the sign of the coefficient of the *prior firm performance* is negative.

In the next four models (models 3–6), *APD* is decomposed to isolate the effects of explanatory variables on each dimension. This refined analysis is motivated by prior studies that consider the dimensions of *APD* separately (Jiang, Tao, & Santoro, 2010; Rogbeer, Almahendra, & Ambos, 2014). For these models, *APD* is decomposed into *partner type diversity* and *partner geographic diversity*. The construct *AEH* is also decomposed into *AEH partner type* and *AEH partner geographic region*. In models 3 and 4, the DV is *partner type diversity*. In these models, *AEH partner type* is used as measure of diversity of alliance experience. Model 3 examines the effects of control variables. As in the model 1, the coefficients of *capital intensity* and *firm age* are significant. The findings of the model 4 support all the four hypothesized relationships. The coefficients of *product diversification experience* ($\beta = 0.31$, $p < .05$), *international diversification experience* ($\beta = 0.37$, $p < .05$), *alliance experience* ($\beta = 0.05$, $p < .01$), and *AEH partner type* ($\beta = 0.54$, $p < .05$) are positive and significant. Thus, findings of models 3 and 4 support that diverse experiences positively affect a firm's partner type dimension of *APD*. In models 5 and 6, DV is *partner geographic diversity*. Diversity of alliance experience is measured by *AEH partner geographic region*. Model 5 introduces the control variables. Unlike models 1 and 3, coefficients of none of the control variables are significant. Findings in model 6 support all the hypothesized relationships regarding effects of: *product diversification experience* ($\beta = 0.25$, p -value $< .1$); *international diversification experience* ($\beta = 0.54$, p -value $< .01$); *alliance experience* ($\beta = 0.053$, $p < .01$); and *AEH partner geographic region* ($\beta = 0.74$, $p < .001$). However, the coefficient of *product diversification experience* is marginally significant at $p < .1$. On the other hand, the coefficient of *AEH partner geographic region* is significant at $p < .001$.

Thus, overall, findings support that product and international diversification experience, alliance experience, *AEH* are positively associated not only with overall diversity of the portfolio (*APD*), but also separately with each dimension of *APD*. Similarly, regarding the *AEH*, the findings suggest that the overall *AEH* of the focal firm is positively associated with overall *APD*. Additionally, the study suggests that there is positive association between the corresponding dimensions of *AEH* and *APD*. In sum, findings support all the four hypotheses.

Robustness checks

For robustness checks, additional models were estimated using panel fixed effect methods, with and without log-odds transformed DV. Table 3 presents findings of these two estimation methods. For models 7–10, the DV is *APD*. Models 1A and 1B present the average partial effects (APE) calculated for the models 1 and 2, respectively (Papke & Wooldridge, 2008). APEs of a FPM are comparable with the coefficients of the panel fixed effects. However, this comparison cannot be made with the coefficients of the log-odds transformed panel fixed effects model (Wooldridge, 2010; Pericoli, Pierucci, & Ventura, 2013). Models 7 and 8 present the estimates of the panel fixed effects, and models 9 and 10 present the estimates of the log-odds transformed panel fixed effects. Models 7 and 9 include only control variables, and models 8 and 10 are full models. The coefficient of *international diversification experience* is not significant in model 8, whereas the coefficients of other predictor variables are as hypothesized. In model 10, coefficients of all the predictor variables are positive and significant. However, the coefficient of *international diversification experience* is marginally significant at $p < .1$. As log-odds transformed panel FE and FPM are considered better estimation methods than a simple panel FE (Baum, 2008; Papke & Wooldridge, 2008), the findings, in general, support all the

TABLE 3. STANDARD ESTIMATION METHODS, ROBUSTNESS CHECKS^a

Variables	Panel FE ^b		Panel FE with log-odds transformation ^{b,c}		Fractional probit average partial effect ^d	
	Model 7	Model 8	Model 9	Model 10	Model 1A	Model 2A
Constant	0.014 (0.329)	-0.05 (0.30)	-10.55 (5.93) [†]	-12.20* (5.53)	-	-
Control variables						
Firm size	0.014 (0.01)	0.004 (0.009)	-0.04 (0.19)	-0.15 (0.19)	0.021 (0.015)	0.01 (0.01)
Prior firm performance	-0.146 (0.089)	-0.1 (0.07)	-2.13 (1.39)	-1.37 (1.20)	-0.15 (0.10)	-0.093 (0.056) [†]
Capital intensity	0.018 (0.005)**	0.016(0.005)**	0.20 (0.11) [†]	0.19 (0.11) [†]	0.019 (0.008)*	0.016 (0.006)**
Firm age	0.044 (0.104)	0.05 (0.10)	2.20 (1.88)	2.47 (1.81)	0.26 (0.13)*	0.05 (0.11)
Year dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies included	No ^e	No ^e	No ^e	No ^e	Yes	Yes
Predictor variables						
Product diversification experience (Hypothesis 1)		0.109 (0.035)**		1.78 (0.58)**		0.08 (0.04)*
International diversification experience (Hypothesis 2)		0.162 (0.116)		3.67 (2.03) [†]		0.14 (0.05)**
Alliance experience (Hypothesis 3a)		0.015 (0.004)***		0.17 (0.07)*		0.013 (0.004)**
AEH (Hypothesis 3b)		0.077 (0.042) [†]		1.82 (0.78)*		0.12 (0.06)*
Observations (firm-year)	776	776	776	776	776	776
R ²	0.71	0.72	0.64	0.65	-	-

Notes.

FE, fixed effects; AEH, alliance experience heterogeneity; APD, alliance portfolio diversity.

Dependent variable: APD

^aUnstandardized coefficients are reported, with robust standard errors in parentheses.

^bFirm-specific dummies are included in the panel FE models (models 7–10) to control for unobserved firm-level heterogeneity.

^cSince log-odds transformation is undefined when dependent variable is equal to 0 or 1, standard practice was followed to recode these values as 0.0001 and 0.9999, respectively (Phelps, 2010).

^dModels 1A and 2A present average partial effects (APE) calculated for the models 1 and 2, respectively. Model 1A and 2A, with APE, are included to facilitate comparison with the panel FE model. APE can directly be compared with coefficients of panel FE, but it cannot be compared with coefficients of log-odd transformed panel FE model (Pericoli, Pierucci, & Ventura, 2013; Wooldridge, 2010).

^eTime-invariant industry dummies are not included in the fixed-effect models.

[†] $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$.

four hypothesized relationships (Hypotheses 1–3b). Moreover, it can be observed that findings of the FPM are robust to other estimation methods.

Furthermore, an unbiased measure of diversity was used to address the concerns of biasedness⁷ of APD (Biemann & Kearney, 2010). FPM is re-estimated with the unbiased measure of APD. As expected, the coefficients of *product diversification experience* ($\beta = 0.38, p < .05$), *international diversification experience* ($\beta = 0.74, p < .01$), *AEH* ($\beta = 0.75, p < .01$) are positive and significant; thus, supporting Hypotheses 1, 2, and 3b. However, the coefficient of *alliance experience* is no longer significant. Additionally, the log-odds transformed panel FE is also re-estimated with the unbiased measure of APD. The results are qualitatively similar to those of the FPM. Findings of this analysis are interesting, considering that the Blau's (1977) index underestimates the variety of a group when group sizes are relatively small (Biemann & Kearney, 2010, p. 585). A detailed explanation of this interesting finding is provided in the discussion section.

For additional robustness checks⁸, alternative measures of the product diversification experience, international diversification experience, and alliance experience are used. Product diversification experience is measured by counting the number of product segments in which a firm is present (Barkema & Vermeulen, 1998). International diversification experience is measured as the ratio of the number of outside subsidiaries to the total number of subsidiaries (OSTS) (Sullivan, 1994). The correlation between FSTS and outside subsidiaries to the total number of subsidiaries is 0.63, suggesting that any of them can be used as proxy for internationalization experience. However, considering that FSTS incorporates export sales also, it is a better indicator of a firm's internationalization experience (Sullivan, 1994). Results remained robust to the alternative measurements of product and international diversification experience. Additionally, following Rothaermel and Deeds (2006), cumulative alliance portfolio age⁹ was used as an alternative measure of *alliance experience*. It is interesting to note that the coefficient of *alliance experience* became insignificant. Some alternative explanation for the same is presented in the Discussion and Conclusion section.

In sum, findings of the main model (model 2) are robust to the alternative measures of predictor variables, with an exception of *alliance experience* variable. One explanation for this exception is that the alternative measure may be inferior to the measure used in the main FPM (i.e., model 2). In general, the findings provide support for the hypotheses related to the *learning from diverse experiences* perspective (Barkema & Vermeulen, 1998).

DISCUSSION AND CONCLUSION

Drawing primarily on organizational learning perspective, this study examines the experiential antecedents of APD. A longitudinal investigation on a panel data set of 90 Indian firm for the period 2000–2014 provide insight into how a firm's diverse experiences influences its APD. Findings of this study are robust to multiple estimation methods and have implications for theory as well as practice.

⁷ Biemann and Kearney (2010) suggested that diversity indexes such as Blau's index are systematically biased when overall sample comprises groups of varying sizes (p. 584). In particular, these researchers suggest that Blau's index underestimates the diversity of a group, especially for relatively small group sizes (p. 585). This study used the bias-corrected formula of Blau's index to measure the two dimensions of APD and, then, took average to measure the composite unbiased APD.

⁸ All the below robustness checks, with alternative measures of variables, are done on the fractional probit model (Model 2), which uses APD (uncorrected for the bias) as DV.

⁹ Cumulative alliance age is measured by adding the age of all alliances in a portfolio (Rothaermel & Deeds, 2006).

Theoretical implications

Literature suggests that experience is considered the most important source of learning (Levitt & March, 1988; Rothaermel & Deeds, 2006). Diversity enriches experience and facilitates learning (Levitt & March, 1988; Barkema & Vermeulen, 1998). Learning from diverse experiences saves firms from falling into *competency trap* (Levitt & March, 1988). Broadly, this study considered two experience and learning-related factors: first, focal firm's learning from prior diversification experience, including both product-market and international market; second, focal firm's learning from prior alliance experience. It is argued that learning attained from prior diversification and alliance experience enhances focal firm's ability to manage a portfolio of diverse alliances. A diversified alliance portfolio indicates that focal firm has access to diverse set of resources and that firm is able to strike competitive balance (George, Zahra, Wheatley, & Khan, 2001). Moreover, a focal firm may be interested in balancing its exploration–exploitation intent by purposefully engaging with diverse partners (Jiang, Tao, & Santoro, 2010). Based on these arguments, four hypotheses (Hypotheses 1-3b) are made.

In Hypotheses 1, it is hypothesized that there exists a positive relation between a firm's product diversification experience and its APD. This hypothesis is based on the argument that a firm's presence in multiple product markets may be an important source of learning (Barkema & Vermeulen, 1998). Learnings from such experience improve focal firm's capabilities to manage complexities (Doz & Prahalad, 1991; Bartlett & Ghoshal, 1993). A capable firm may maintain and get the intended benefits of high level of APD. Results provide support for Hypotheses 1 that focal firm's product diversification experience is positively associated with its APD. Additionally, APD was decomposed into its two dimensions to isolate the effects of product diversification experience. Findings suggest that product diversification experience has positive association with each of the APD dimensions. Prior studies have not examined the effect of product diversification experience on a firm's APD. Thus, findings of this study make valuable contribution to the alliance portfolio literature by emphasizing the effect of *learning from diversity* (Barkema & Vermeulen, 1998).

In Hypothesis 2, it is hypothesized that there exists a positive relation between international diversification experience and its APD. This hypothesis is based on the argument that an internationally diversified firm is exposed to customers, rivals, suppliers and partners from various country- and market-contexts (Barkema & Vermeulen, 1998), and such exposure helps a firm enhance its capabilities to manage diversity (Bartlett & Ghoshal, 1999; Nadolska & Barkema, 2007). Findings support Hypothesis 2 that international diversification experience is positively related to its APD. Additionally, the effect of international diversification experience on the each dimension of APD is also examined. Findings suggest that international diversification experience has positive relationship with each dimension. These findings are in line with those of prior studies. For example, Duysters and Lokshin (2011) argued that firms benefit from the multinational experiences of their parent firms, as the linkages of the parent multinational company facilitate focal firm in forming and maintaining alliances with diverse set of partners. Similarly, Jacob, Belderbos, and Gilsing (2013) found that firms enhance geographic diversity of their alliance portfolio as they attain international alliance experience. As the effect of firm's own overall international experience on APD has not been examined thoroughly in the prior literature, the findings of this study are valuable contribution to the alliance portfolio literature.

In Hypothesis 3a, it is hypothesized that a firm's prior alliance experience is positively related to its APD. This hypothesis is based on the argument that prior alliance experience enhances focal firm's abilities to form and manage alliances (Gulati, 1999), and such experienced firms may be able to mitigate the negative effects of high level of APD (Duysters et al., 2012). Results of the FPM (model 2) provide support for this hypothesis. Additionally, the effect of *alliance experience* is examined separately on each dimension of the APD. It is found that *alliance experience* has positive association with each dimension. The findings related to the general alliance experience are in line with prior studies that

have found significant positive association between alliance experience and APD (Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014). However, robustness checks suggest that the positive relation between alliance experience and APD is not significant when APD is corrected for its bias (Biemann & Kearney, 2010) or when alternative measure of the *alliance experience* is used. These results are discussed below.

Regarding the relationship between alliance experience and unbiased measure of APD, the panel data were reanalysed and it was observed that there were many firm-year observations for which portfolio sizes were between 2 and 5. It should be noted that Blau's index underestimates the diversity of the portfolio when the group size is relatively small, compared with a reference case having groups size equal to 10 (Biemann & Kearney, 2010, p. 587). Indeed, when APD is corrected for the bias, the mean of the variable is 0.47, which is higher than the uncorrected value of APD (0.33). The correlation between unbiased APD and *alliance experience* is 0.37, which is lower than the correlation between uncorrected value of APD and *alliance experience* (0.56). Furthermore, the coefficient of *alliance experience* becomes insignificant for the unbiased APD. Thus, it appears that when measure of APD is corrected for the bias, the *alliance experience* loses its explanatory power. From theoretical perspective, this result is insightful as it suggests that at higher level of portfolio diversity, i.e. for the unbiased measure of APD, variables related to the diverse experiences (i.e., *product diversification experience*, *international diversification experience*, and *AEH*) have more explanatory power than the general *alliance experience*. This supports the contention that, compared with general alliance experience, diverse experiences are more important when it comes to managing diversity. However, one should be cautious in accepting this claim, as more rigorous analysis is required to generalize it and to better understand the relationship between general alliance experience and the level of portfolio diversity.

Regarding the alternative measurement of the *alliance experience*, it appears that cumulative alliance experience pronounces the overestimation of overall alliance experience, as experience decay was not accounted for, despite that experience was measured since 1990 (Stettner & Lavie, 2014). Although, this overestimation might be present in the simple count measure also, it would be more pronounced when the portfolio age is used as a proxy for alliance experience. For example, suppose one observes an alliance portfolio in 2013; a portfolio that has three alliances, all being formed in 1990s, will appear to have more experience in terms of portfolio age, compared with a portfolio having three alliances that were formed during last 5 years. However, when one accounts for experience decay, recent experiences might appear more helpful, as the focal firm may not be able to benefit much from the temporally distant experiences (Stettner & Lavie, 2014). Thus, further examination with some other measure of alliance experience, which accounts for experience decay, may be helpful in understanding the relationship between *alliance experience* and *APD*. This may be an avenue of future research to examine how experience decay may influence alliance portfolio characteristics.

In Hypothesis 3b, the nature of alliance experience is considered. Drawing on *learning from diversity* literature, it is argued that firms that have prior experience of collaboration with diverse partners learn and develop alliance management capabilities (Gulati, 1999). Firms with such capabilities may maintain a diverse portfolio (George et al., 2001). Findings support the hypothesis that focal firm's *AEH* is positively associated with the *APD*. Moreover, *AEH* was decomposed into its dimensions – *AEH partner type*; *AEH partner geographic region* – to examine how they affect the corresponding dimensions of *APD* (i.e., *partner type diversity* and *partner geographic diversity*). Findings provide support that each dimension of *AEH* has positive association with the corresponding dimension of *APD*. Prior studies have not examined the influence of *AEH* on *APD*. In this regard, findings of this study make valuable contribution to the literature.

Additionally, like the findings of Collins (2013), findings of this study show that the coefficient of firm *capital intensity* is positive and significant in models 2, 8, and 10, suggesting that this finding is

robust to all the three estimation methods. Although, prior studies have not provided any theoretical insight into the nature of relationship between firm's capital intensity and alliance behavior, it appears that capital intensive firms may be keeping diverse alliance portfolio to manage their resource dependencies (Pfeffer & Salancik, 1978; Pangarkar & Wu, 2012; Cui, 2013). However, a further analysis with strong theoretical background is required to better understand the relationship between firm capital intensity and APD.

In sum, the study makes some valuable contributions to the alliance portfolio and organizational learning research. First, findings of this study contribute to alliance portfolio literature by providing empirical support to the predictions of organizational learning theory about APD. More importantly, this study integrates *learning from similar experiences* with *learning from diversity* perspectives with regard to antecedents of APD (Barkema & Vermeulen, 1998; Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014). Second, drawing on the insights from Barkema and Vermeulen (1998), this study considered firm diversification an important source of experience. Prior studies have not given much attention to the question that how the learning accrued through product or international diversification may affect a firm's alliance behavior, in particular a firm's APD. Thus, findings of this study adds to this less researched stream of *learning from diversity* literature (Barkema & Vermeulen, 1998; Schulz, 2002). Third, findings of this study adds to the less researched area of antecedents of APD by examining experiential antecedents of APD. Fourth, although prior studies have examined the influence of prior alliance experience on APD (Jacob, Belderbos, & Gilsing, 2013; van Beers & Zand, 2014), the effect of the nature of alliance experience has not been investigated thoroughly. Findings of this study suggest that leaning from partners of different types and from diverse geographies positively influences a firm's APD. In this regard, this study provides deeper insight into the relationship between nature of alliance experience (AEH) and APD. Fifth, to the best of our knowledge, this is the first study in the Indian context which examines antecedents of APD. Additionally, it is one of the few studies in emerging markets context that deal with alliance portfolio characteristics (Golonka, 2015). Alliances have become significant strategic choice for firms from emerging markets, as well (Hitt et al., 2004). Thus, this study complements the earlier studies, which are mostly undertaken in the developed markets context.

Managerial implications

The study has implications for managers as well. Strategic alliances have become significant drivers for firm growth (Wassmer, 2010; Faems, Janssens, & Neyens, 2012). However, the extent to which a firm may create and capture value through its alliances depend on its ability to simultaneously manage its multiple and diverse alliances (Gulati, 1999; Rothaermel & Deeds, 2006; Duysters et al., 2012). In this regard, findings of this study inform managers that a firm's diverse experiences are transferrable to its alliance portfolio. Thus, the learning from prior diverse experiences may help a firm better manage its APD, which may lead to superior firm performance (Duysters et al., 2012). Furthermore, as this study considers alliance portfolio at the level of corporate, it brings out how a firm's learning from prior venturing into different product and international markets may make it capable of managing diversity. Such enhanced capabilities would be helpful in getting the intended benefits of high level of APD. Moreover, the study has emphasized the central role of learning and how it may influence a firm's future alliance behavior. Thus, implicitly, this study highlights the managerial role to create routines and processes to maximize learning from experiences (Levitt & March, 1988).

Limitations and directions for future research

There are a few limitations of the present study. First, this study instantiates alliance portfolio in terms of JVs only. There are two primary reasons behind inclusion of only JVs in the portfolio. First, authors

could find accurate information regarding termination of JVs by scanning annual reports. This information is not present for contractual alliances. Second, authors could find information regarding formation of additional JVs by scanning annual reports and searching IBID. These additional JVs were not reported in the SDC. Such information is not easily available for contractual alliances. Thus, in order to preserve accuracy of the data set, this study does not include contractual alliances. However, considering that broader definition of alliance includes both contractual and equity JVs (Culpan, 2009), it was suspected that the instantiation of portfolio in terms of only JVs may limit the generalizability of the findings of this study. However, additional analysis of the data set (see Appendix B) suggests that exclusion of the contractual alliances may not have major implications for generalizability of the findings of this study. Second, since the study analyses alliance portfolio at the level of corporate, it assumes that each business unit (or business segment) shares same level of importance in the eyes of the corporate executives, and, hence, the alliance strategy is homogeneous across all business units. However, such assumption may be strong if a firm's alliance strategy varies across different business units (Hoffmann, 2007; Wassmer, 2010). A survey-based study may help overcome this limitation.

Furthermore, business groups are known phenomenon in emerging markets (Khanna & Palepu, 2000). It will be interesting to examine whether a firm's alliance portfolio characteristics vary for business group affiliated and non-affiliated firms. Since majority of the firms in the sample (>80%) were affiliates of business groups, the influence of business group affiliation on APD has not been examined in this study. Future studies may compare business group affiliated and non-affiliated firms, by taking a balanced sample. Additionally, during the study, we observed that in some cases it is the ultimate group holding company which enters into the alliance. This observation suggests that there exists a higher level at which alliance portfolio can be conceptualized in the context of emerging markets (Wassmer, 2010). Future studies may explore antecedents and consequences of APD by conceptualizing it at the level of business group.

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ORIGINALITY

The authors assure that this is an original work. The authors also declare that this paper has not been submitted elsewhere for publication.

DECLARATION

Both the authors of the article have read and approved the paper and meet the authorship criteria mentioned by the journal.

CONTRIBUTION

A few influential articles concerning the phenomenon of alliance portfolio have been recently published in this esteemed journal, encouraging authors to consider this journal a potential outlet for publication of their work. The authors believe the article fits to the journal, as it extends the extant literature on alliance

portfolio and makes valuable contributions by empirically validating the predictions of organizational learning theory about alliance portfolio diversity (APD). Findings of the study suggest how experiential learning is valuable in managing diversity. Findings inform managers that the learning accumulated through diverse experiences are transferrable toward the management of alliance portfolio.

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APPENDIX A: DATA SET, VARIABLES, AND MEASUREMENTS

TABLE A1. THE DATA SET

Data sources	<p><i>Securities Data Company (SDC) Platinum database.</i> SDC is the most widely used database in alliance research and provides rich information regarding announcement, formation, participants, and purpose of alliances (Cui, 2013; Schilling, 2009)</p> <p><i>Prowess database</i> is maintained by Centre for Monitoring Indian Economy and it archives financial and governance-related data for Indian firms</p> <p><i>India Business Insight database (IBID)</i>, a product of Informatics (India) limited, provides a unified platform to access news related to Indian firms and industries. IBID compiles and maintain information regarding Indian firms and industries, from news published in business newspapers, magazines, and periodicals since 1993</p> <p><i>Annual financial reports</i> are an important source of information not only about financial data, but also contextual data regarding corporate moves</p>
Panel data set preparation	<p>Following steps were followed to prepare the panel data set for the study (panel time period 2004–2014):</p> <ol style="list-style-type: none"> 1. Initial query on SDC resulted 3159 alliances, including equity joint ventures (1,815) and contractual alliances, i.e. non-JV (1,345), formed during 1990–2014 2. After excluding contractual alliances, the data set comprised 1815 joint ventures (JVs) formed during 1990–2014 3. These joint ventures included 1,517 bilateral (involving two partners) and 298 multilateral JVs (involving more than two partners). This study considered only bilateral JVs and excluded multilateral JVs from the data set 4. Furthermore, only those firms are included in the data set that were involved in more than one JVs during 1990–2014 (Cui & O'Connor, 2012; Jiang, Tao, & Santoro, 2010). As a result, the data set reduced to 649 JVs by 169 Indian firms 5. These 169 firms included state agencies, state-owned enterprises, private, business group holding companies (private entities created for investment purpose), and public corporations. JVs formed by state agencies, state-owned enterprises, and private entities (including business group holding companies) were further excluded from the data set. Consequently, the data set reduced to 424 JVs by 99 publicly listed firms during 1990–2014 6. Annual reports of these 99 firms and the IBID was searched to find JV formations and terminations that may not have been covered by SDC. Search revealed that 277 JVs in the data set were terminated at different points in time during 1990–2014. Additionally, 209 new JVs were found, which were formed by these firms but not mentioned in the SDC database. Consequently, the final data set comprised 633 JVs formed by 99 Indian firms since 1990 7. Nine of these 99 firms had all their JVs terminated before 2004. These nine firms were excluded from the panel data set. Additionally, while preparing the panel data set, following prior studies (Phelps, 2010; Tao, Jiang, & Santoro, 2014), those firm-year observations were removed in which the respective firms had zero number of active JVs (i.e., all JVs of that firm had been dissolved before the focal year or none of its JVs had been formed by that year) 8. Financial and diversification-related data for these firm-year observations were gathered from annual financial reports and Prowess database. Some firm-year observations were further removed for which the data for some control or predictor variables were not available 9. Consequently, the final unbalanced panel data set is comprised of 776 firm-year observations for 90 Indian firms for the time period 2004–2014

TABLE A2. VARIABLES AND MEASUREMENTS

Variables	Operationalization	Key references
Alliance portfolio diversity	A composite construct measured by taking average of <i>partner type diversity</i> and <i>partner geographic diversity</i> . The Cronbach's (1951) α for the composite construct is 0.82	Castro, Roldán and Acedo (2015); Golonka, (2015)
Partner type diversity	Measured as heterogeneity index (Blau, 1977) of diversity of the focal firm's alliance portfolio in terms partner types. Following prior studies alliance partners are divided into following categories: supplier, customer, competitor, government, related-business, unrelated-business, and others	de Leeuw, Lokshin, and Duysters (2014); van Beers and Zand (2014)
Partner geographic diversity	Measured as heterogeneity index (Blau, 1977) of diversity of the focal firm's alliance portfolio in terms partners' geographic region of origin. Following categories of geographic regions are considered: Asia, Africa, Australia, Domestic (i.e., India), Europe, Middle East, North America, and South America	Bahlmann (2014); Duysters and Lokshin (2011)
Product diversification experience	Measured as the entropy index of firm's sales in different four-digit SIC industries in the year preceding to the focal year	Jacquemin and Berry (1979); Palepu (1985)
International diversification experience	Measured as the ratio of foreign sales to total sales (FSTS) in the year preceding to the focal year	Gaur and Kumar (2009); Tallman and Li (1996)
Alliance experience	Measured by counting the total number of alliances formed by a focal firm since 1990 to the start of the focal year	Hoang and Rothaermel (2005)
Alliance experience heterogeneity (AEH)	Measured as a composite construct that reflects firm's heterogeneity of alliance experience in two dimensions: partner type (<i>AEH partner type</i>) and partners' geographic region (<i>AEH partner geographic region</i>). The Cronbach's (1951) α for the composite construct AEH is 0.78	Golonka (2015); Cui and O'Connor (2012)
AEH partner type	Measured as the ratio of count of the unique types of firm's prior partners to the total number of prior partners. Prior partners refer to the all partners with whom the focal firm has partnered since 1990 to the start of the focal year. The same categories of partners are used as those for <i>partner type diversity</i>	Gulati (1999); Cui and O'Connor (2012)
AEH partner geographic region	Measured as the ratio of the count of the unique geographic regions of origin of firm's prior partners to the total number of prior partners. The same categories of geographic regions are used as those for <i>partner geographic diversity</i>	Gulati (1999); Cui and O'Connor (2012)
Firm size	Measured as the natural logarithm of focal firm's revenue in the focal year	Leiblein and Madsen (2009)
Firm age	Measured as the natural logarithm of the count of years since incorporation of the firm to the start of the focal year	Al-Laham and Amburgey (2010)
Prior firm performance	Measured as return on assets of the focal firm in the year prior to the focal year	Gulati (1999)
Capital intensity	Measured as the ratio of capital expenditure to revenue in the focal year	Collins (2013)

APPENDIX B: ASSESSMENT OF THE IMPACT OF EXCLUSION OF CONTRACTUAL ALLIANCES ON THE GENERALIZABILITY OF THE FINDINGS

An analysis of the SDC database revealed that as many as 32 of the sample firms (around 35% of the firms in sample) had no reported contractual alliance in the SDC during the study period 2004–2014. Furthermore, it was observed that firms from the biopharmaceutical and information technology (IT) and enabled services (IT/ITES) were involved in more number of contractual alliances, compared with the firms from other industries. This observation has also been highlighted in prior studies (Lee, Kirkpatrick-Husk, & Madhavan, 2014; Wassmer, 2010). There were 23 firms in our sample that belonged to biopharmaceutical and IT/ITES industries. These firms were separated and APD (both Blau's index and unbiased measure) for these firms is calculated for the period 2004–2014 by merging the JV data with the contractual alliance data¹⁰, reported in the SDC. A *t*-test revealed that there was no significant difference between the means of the APD (both Blau's index and unbiased measure) calculated with and without inclusion of contractual alliances. Furthermore, high correlation¹¹ is found between the APD, calculated with and without inclusion of contractual alliances. Thus, this additional analysis provides some confidence that exclusion of the contractual alliances should not have any major implications with regard to the generalizability of the findings of this study. Nonetheless, it is suggested that future studies should include both types of alliances by following the approach suggested by Lavie and Rosenkopf (2006), who gathered information related to alliance formation and termination from corporate announcements and press releases.

¹⁰ Following prior studies (Schilling & Phelps, 2007; Srivastava & Gnyawali, 2011), five year of duration was assumed for the contractual alliances, for which information related to termination was not available.

¹¹ Values of correlation coefficients are 0.86 and 0.79 for biased and unbiased measures of APD, respectively.