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The Effects of Convergence and Divergence Alliance Portfolio on Firm Performance

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ABSTRACT

This study emphasizes the relationship between domain learning in an alliance portfolio – convergence and divergence - and firm performance. Inter-organizational dependency is argued as the moderator for this relationship. This study empirically tests the developed hypotheses on the S&P 500 firms from 2000 to 2007. The results indicate that domain learning is positively associated with firm performance. Further results indicate that the nature of interdependencies between a firm and its partners in an alliance portfolio moderates this relationship, and specifically that a firm will generate better performance when it is less dependent on its partners. The above findings have important implications both for academics and professional alliance portfolio managers.

JEL Classifications: *G340, D74*

Keywords: *convergence/divergence learning mode; firm performance; alliance portfolio; interdependencies*

I. INTRODUCTION

More than eighty percent of Fortune 1000 CEOs in 2007-2008 agreed that 26% of their companies' revenues were associated with their alliance portfolios, as reported by Partner Alliances (Kale, Singh, and Bell, 2009). An alliance portfolio is a firm's collection of direct alliances with partners (Hoffmann, 2007; Lavie, 2007; Lavie and Miller, 2008), and such collections increased on average from four to 30 alliances during the 1990s (Lavie, 2007). In trying to determine performance effects, previous studies have focused extensively on the configuration of alliance portfolios. For example, types of alliance learning activities (e.g., Anand and Khanna, 2000; Lin, Yang, and Demirkan, 2007), types of capabilities on managing portfolio (e.g., Sarkar, Aulakh, and Madhok, 2009; Schreiner, Kale, and Corsten, 2009), alliance portfolio configurations (e.g., Andrevski, Brass, and Ferrier, 2014; Wuyts and Dutta, 2012), partners' country of origin (Lavie and Miller, 2008), types of governance mechanisms (e.g., Heimeriks, Duysters, and Vanhaverbeke, 2007; Hoetker and Mellewigt, 2009), types of legitimacy (e.g., Baum, Calabrese, and Silverman, 2000; Stuart, 2000), number of alliances and partners (e.g., Ahuja, 2000), types of networks (e.g., Gulati, 1998; Powell, Koput, and Smith-Doerr, 1996), and types of resources (e.g., Lavie, 2007; Luo and Deng, 2009) from an alliance portfolio have been related to firm outcomes.

This study focuses on how learning in an alliance portfolio contributes to firm performance. Interorganizational learning enables a firm to access new knowledge residing outside the firm's boundaries and collaboratively leverage existing knowledge with partners (e.g., Sukoco, 2015; Yamakawa, Yang, and Lin, 2011). Previous studies approach alliance learning from the function, structure, and other peripheral attributes involved in the alliance (Lavie and Rosenkopf, 2006; Lin et al., 2007), or consider process-based learning inside the alliance (Heimeriks et al., 2007; Schreiner et al., 2009) and how it relates to firm performance. Despite the rapid progress in this research stream, previous studies mostly undermines the fact that a firm may also learn by forming an alliance that is different from its core business.

Prior studies (Mowery, Oxley, and Silverman, 1996; Nakamura, Shaver, and Yeung, 1996) report that converging or diverging resources and capabilities toward partners imply interfirm knowledge transfer inside alliances. However, these studies address the issue mainly from the overlap of technological capabilities of the allied firms. In contrast, this study addresses the question of whether or not configuring an alliance portfolio within-domain leads to better firm performance relative to across-domain configurations. Based on organizational learning theory, this study proposes that domain learning in alliance portfolio consists of divergence and convergence modes (Sukoco, 2015). The divergence learning mode refers to a firm that configures its alliance portfolio further away from its industry domain, thereby facilitating experimentation in capabilities and knowledge in different domains (March, 1991). On the other hand, when the focal firm configures their alliance portfolio close to its own business – the convergence learning mode – the firm facilitates the use of existing capabilities and knowledge (Levinthal and March, 1993). This study further argues why these two learning activities produce varying levels of firm performance.

Although learning activities are crucial for firm performance, this study also investigates under what conditions these activities deliver higher or lower firm performance. The nature of the relationships – interdependencies (Pfeffer and Salancik,

1978) between a focal firm and its partners in the portfolio could also magnify the relationship between alliance learning and firm performance. Configuring an alliance portfolio with partners that are more vs. less dependent compared to those that are equally dependent on a focal firm could produce different effects on firm performance (e.g., Vandaie and Zaheer, 2014, Ozmel and Guler, 2014).

The contributions of this study are as follows: First, this study introduces the concept of convergence/divergence learning modes as an extension of the exploitation/exploration concept of March (1991), which is largely ignored in the alliance literature and therefore lacks sufficient empirical testing for viability. Second, this study extends the RBV (Barney, 1991; Lavie, 2006) to organizational learning (Levinthal and March, 1993) by relating a firm's resources with its alliance portfolio. Finally, this study extends the resource dependence theory (Pfeffer and Salancik, 1978) by asserting that differential dependencies have different effects on the relationship between alliance learning and firm performance.

II. THEORETICAL BACKGROUND

A. Alliance Learning

Scholars have proposed different conceptions of how to learn in a strategic alliance, but the essence of the learning process itself is mostly rooted in the dichotomy of exploitation and exploration (March, 1991), which is also adopted in this study. The exploration-exploitation framework distinguishes two broad patterns of learning behavior. March defined them as follows: "Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation. Exploitation includes such things as "refinement, choice, production, efficiency, selection, implementation, and execution" (1991: 71). Levinthal and March added that exploration involves "a pursuit of new knowledge," whereas exploitation involves "the use and development of things already known" (1993: 105). To operationalize this dichotomy, prior alliance studies categorize it into three distinct forms (Lavie and Rosenkopf, 2006): function-based, which mainly looks at the content of alliance formation (e.g., Anand and Khanna, 2000; Lin et al., 2007); structure-based, which looks at the positions of a firm's partners in a broader network (e.g., Powell et al., 1996; Ahuja, 2000), and an attribute-based dimension (e.g., Dussauge, Garrette, and Mitchell, 2000; Luo and Deng, 2009).

In addition, the focal firm's decision to form an alliance, either within- or across-domain, also involves learning processes that are critical to firm performance. This study defines domain learning as representing the learning processes by forming an alliance which is close to or further away from a firm's business domain. Additionally, exploration is defined as the extent to which the focal firm composes their alliance portfolio further away from their own domain, which is termed divergence learning. Exploitation refers to the extent to which a focal firm configures their alliance portfolio closer to its own domain, and is termed convergence learning. Divergence learning enables a focal firm to discover new opportunities and build new competencies (Koza and Lewin, 1998) by composing an alliance portfolio in different industries. Convergence learning enables a focal firm to leverage existing capabilities and join existing competencies (Rothaermel and Deeds, 2004) with their partners in the industry where they operate. This definition is consistent with previous operationalization, such as search scope – in which a focal firm explores new knowledge, and search depth – in which a focal firm reuses their existing knowledge (Katila and Ahuja, 2002), and knowledge generation and knowledge application (Spender, 1992), among others. Moreover, this study regards convergence and divergence as two ends of the same continuum, because of the incompatibility of both with respect to a firm's scarce resources and different types of capabilities and knowledge to execute (March, 1991).

The resource-based theory posits that a firm accesses other firm's critical resources by establishing a strategic alliance (Das and Teng, 2000; Lavie, 2006) and creating value by pursuing the potential synergy between both partners (Wang and Zajac, 2007). When the alliance is in the same industry as the focal firm, the duplication of resources and capabilities are in place, facilitating the use of existing knowledge (Levinthal and March, 1993), engaging in refinement processes (March, 1991), and pursuing greater efficiency (Dussauge et al., 2000). Moreover, the use of the convergence learning mode decreases the information asymmetry between a focal firm and their alliance portfolio due to similar usage of resources and capabilities (Mitsuhashi and Greve, 2009), and thus, convergence learning contributes to firm performance.

Similarly, the configuration of alliance portfolio which is different from the core business of the focal firm also has a positive relationship with firm performance. Even though new areas increase the problem of information asymmetry (Balakrishnan and Koza, 1993), the benefits of the divergence learning mode offset it. For example, configuring an alliance portfolio across different industries increases the prospects of new value creation due to access to diverse information and capabilities (Baum et al., 2000; Dussauge et al., 2000). Moreover, the divergence learning mode enables the discovery of new opportunities (new markets) and the building of new competencies that will facilitate the focal firm's adaptation to a changing environment (Koza and Lewin, 1998) and increase market performance (Sarkar, Echambadi, and Harrison, 2001). As a result, the divergence learning mode in an alliance portfolio is also positively associated with firm performance. Therefore,

H_1: There will be a positive relationship between domain learning and firm performance.

As defined by Pfeffer and Salancik (1978), interdependencies between two organizations exist when one party's interests cannot be achieved without the other party's resources, and when an alliance is necessary to achieve the desired goals. The concept of interdependence has received considerable attention from scholars studying interorganizational relations. Much of the early research on organizations considered interdependence between actors to be a liability that needed to be managed (e.g., Pfeffer and Nowak, 1976), because unequal dependence would cause power imbalances and likely be detrimental for the weaker actor (e.g., Dyer, Singh, and Kale, 2008; Thompson, 1967).

Many studies propose that constraint absorption among interdependent actors has been grounded in the interrelated notions of power (e.g., Casciaro and Piskorski, 2005, Gulati and Sytch, 2007). The concept of interdependence with power is closely linked to the theory of power-dependence relations (Emerson, 1962). Prior studies suggest that the power resides in the availability of alternative sources (e.g., Brass, 1984; Kumar, Scheer, and Steenkamp, 1998), the concentration of exchange (e.g., Burt, 1982; Casciaro and Piskorski, 2005), or the social status of the exchange parties (e.g., Lin, Yang, and Arya, 2009; Stuart, 2000). The theory further posits that there are two types of interdependencies, dependence asymmetry and balance dependence (Emerson, 1962). Dependence asymmetry refers to the power differences between one party and the other, or the difference between two parties' dependencies (Casciaro and Piskorski, 2005; Gulati and Sytch, 2007), in which a focal firm could be more or less dependent on its partners in the alliance portfolio. Balance dependency refers to the situation with equal dependencies between the focal firm and its partners in the alliance portfolio.

This study posits that the nature of the relationship between a focal firm and its partners in an alliance portfolio, either balance or asymmetric, moderates the relationship between domain learning and firm performance. Specifically, when the focal firm is less dependent on its partners, it can appropriate greater private benefits from the alliance due to its relatively greater power (Dyer et al., 2008). Even though the convergence learning mode generally has a modest positive relationship with firm performance, the similar bases of resources between a focal firm and their alliance portfolio enables them to assess and appropriate private benefits as well as with the use of the divergence learning mode. Consequently, a less dependent firm tends to accrue greater firm performance than with any other conditions of interdependency. On the other hand, a highly dependent firm has low bargaining power relative to its stronger partners, and thus has less ability to appropriate private benefits from the alliance. The capability to appropriate private benefits is even smaller when the configuration of an alliance portfolio is dominated by the convergence learning mode, which is due to the awareness by the firm of its weaker position. On the other hand, the use of the divergence learning mode could offset a firm's dependency on a stronger partner by enriching alternative sources of power (e.g., Brass, 1984; Kumar et al., 1998) or distributing an exchange concentration (e.g., Burt, 1982; Casciaro and Piskorski, 2005). Consequently, a highly dependent firm would receive better payoffs when it employs the divergence learning mode. For example, Stuart (2000) reported that young and small firms benefit more when they diversify and ally with stronger ones. Similarly, Kim, Hoskisson, and Wan (2004) reported that weaker keiretsu member firms increase their ROA when they broaden their business spectrum. In summary, asymmetry dependencies lead to greater competition than cooperation in an alliance by focusing more on enlarging private benefits (Khanna, 1998; Khanna, Gulati, and Nohria, 1998), and greater benefits (firm performance) accrue to less dependent firms.

In a balance dependent condition, the creation of common benefits will be facilitated by the greater cooperation between a focal firm and its partners (Khanna, 1998; Khanna et al., 1998). Equal dependencies also influence the distribution of common benefits, in which each party appropriates proportional value from the alliance (Dyer et al., 2008), based on their contributed resources. Consequently, firm performance for the balance dependent condition will be in between that for the less and highly dependent conditions, for both convergence and divergence learning modes. Therefore,

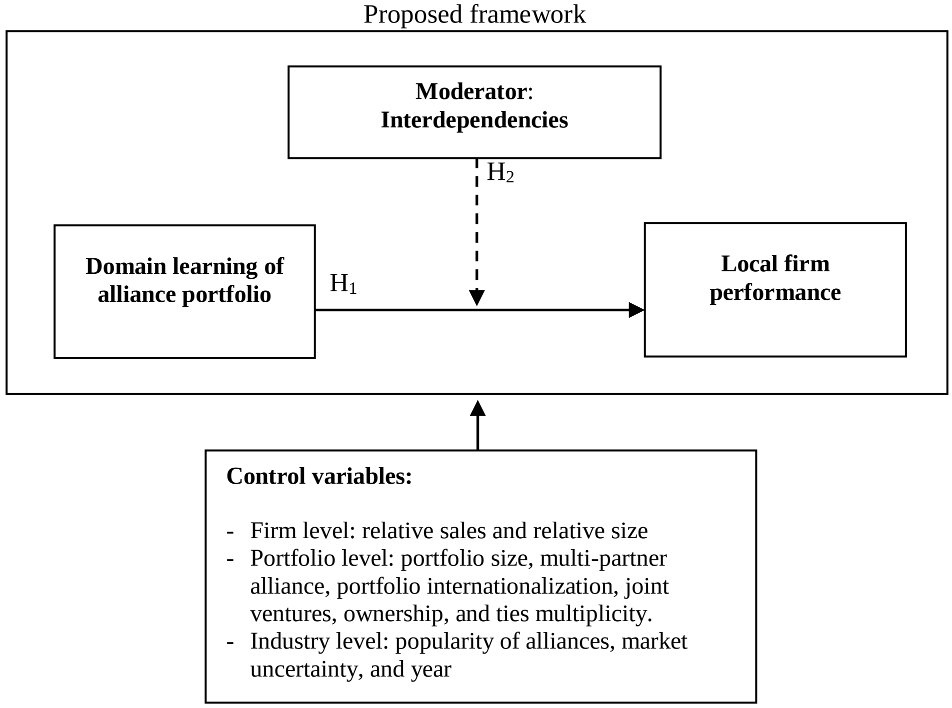
H_2: Interdependencies will interact with domain learning such that for a focal firm that dominantly configures an alliance portfolio with convergence learning, less dependency on partners will generate greater firm performance than any other condition.

III. RESEARCH METHOD

A. Empirical Setting

The sample companies are firms that are in high and low velocity industries (Fine, 1998) and which were listed on the S&P 500 from 2000-2007. This study includes these firms in order to examine the effects of within- and across-industry alliances, as prior studies mainly emphasize a single industry, such as biotechnology firms (e.g., George, Zahra, et al., 2001; Luo and Deng, 2009), the computer software industry (Lavie, 2007; Lavie and Miller, 2008; Lavie and Rosenkopf, 2006), semiconductors (Stuart, 2000), or the steel industry (Koka and Prescott, 2008). By employing these data sets, this study can approximate the interdependencies of these firms with their partners. Moreover, the alliance portfolios formed and managed by these large companies are critical for sustaining daily economic life (Perrow, 1986), and their strategic behaviors have considerable legitimacy, which inspires others to conform to them (DiMaggio and Powell, 1983; Dacin, Oliver, Roy, 2007). These firms are also active in investing large amounts of capital in managing their alliance portfolios, and the data related to their alliance activities is readily available in press releases from various sources. In addition, the sample is highly representative, since these 500 firms consistently accounted for about 11.40% of the market capitalization of the firms listed on the New York Stock Exchange (NYSE) from 2000-2007. Figure 1 presents the research model of this study.

Figure 1
Proposed framework



B. Sample and Data

This study includes only those S&P 500 firms with at least 70 percent business in one sector. Diversified firms are excluded because the strategic consideration of the resource combination of these firms is considerably more complex and more likely to be at the business level rather than the corporate one (Wang and Zajac, 2007). Since this study focuses at the corporate level, it is desirable to focus on those firms with one dominant business. If a firm is acquired or went out of the S&P 500 list during the sampling period (2000 – 2007), it is dropped out of the sample in the following year.

This study selects this period because of the so-called alliance wave of 2000, when companies significantly increased their numbers of alliance partner (Lavie, 2007). Moreover, as prior studies mainly used the data prior to the year 2000, they lack the recency that this study can provide. This time also allows this study a reasonably long period for studying these activities, while also having a five-year period to control for the history of the alliance activities of these firms. All alliance activities conducted by these firms from 1995 to 2007 are collected from the SDC Platinum Database. Any ambiguities are resolved by consulting alternative sources, such as Lexis/Nexis and corporate web sites. The dates of the announcements of alliance formations are used to record the occurrence of these events. Firm-specific financial data were collected from COMPUSTAT.

Following the procedure used by Casciaro and Piskorski (2005), which wass inspired by Burt (1982, 1983), this study operationalizes the notion of dependence between firms in different industries based on input-output patterns of transactions across economic sectors. The data is generated from the Benchmark Input-Output (I-O) accounts for the U.S. economy developed by the Bureau of Economic Analysis (BEA) which is released every five years. Moreover, this study matches the four digits of the Standard Industrial Classification (SIC) codes which are used in SDC with six-digit I-O codes from BEA. This study identifies the four largest firms in each sector, sums their sales, and divides the sum by the total volumes of sales for the sector reported in the input-output table (Casciaro and Piskorski, 2005). To obtain annual measures of exchanges between industries for the period 2000-2007, this study linearly extrapolates the measures over the three available accounts for 1997, 2002, and 2007. In addition, there are not any significant effects on annual measures or the regression results due to the slight changes over any five-year period (Burt, 1983).

C. Measures

Dependent variables: Market-based performance. Compared to other variables, such as return on sales or Tobin's q, market-based performance has stronger explanatory power (Lavie, 2007). The measurement captures the annual change in a firm's common share market value, and calculated by averaging the 12 end-of-month daily values due to the high volatility. Further, this study adjusts the measure by dividing the ratio of the compound S&P 500 market value at year t to the compound S&P 500 market value (in millions of US dollars) at the base year to control stock market fluctuations and temporal trends. The following is the adjusted market value of firm i's common shares at time t+1 (Lavie, 2007):

$$\text{Market value}_{i,t+1} = \frac{(\text{S \& P 500 market value 2000})}{(\text{S \& P 500 market value}_{t+1})} \times \frac{\sum_{m=1}^{12} (\text{Stock price}_{i,t+1} \times \text{Oustanding shares}_{i,t+1,m})}{12}$$

(1)

This study calculates the annual change in market value by dividing the adjusted market value at year t+1 by the adjusted market value at year t in order to control for past performance and enable the interpretation of causal effects of the independent variables. Moreover, in order to produce efficient and unbiased estimation, this study log-transforms this ratio to generate the change in market value (Lavie, 2007; Stuart, 2000), as follows:

$$\ln(\text{Market value}_{i,t+1}) = \alpha \ln(\text{Market value}_{i,t}) + \pi' x_{i,t} + e_{i,t+1} \quad (2)$$

where $x_{i,t}$ is a covariate matrix. All variables are annually updated and lagged by one year relative to the dependent variable.

Independent variable: Domain learning. This study employs Standard Industrial Classification (SIC) codes. Even though the SIC approach has some limitations (Robins and Wiersema, 1995), it is considered an effective way to map out the relatedness between firms (e.g., Villalonga and McGahan, 2005). This study sets divergence learning as when all four digits of the SIC code between the allying firms are dissimilar to the focal firm's SIC code and gives a categorical 1, 0.75 if the first digit of the SIC code between the focal firm and its partners is the same, 0.5 if the first two digits of the focal firm and alliance firm are the same, 0.25 if the alliance partners share the first three digits, and 0 if all four SIC codes are identical. High values indicate divergence, whereas low values indicate convergence learning mode.

Moderating variable: Interdependency is measured following Casciaro and Piskorski (2005), which is based on the economic exchange (I-O accounts) of inter-industry flows. z_{ij}, expressed as the total dollar value of goods and services sold by industry i to industry j. Subsequently, dependence of industry i on industry j, which is high to the extent that industry i sells a significant proportion of its goods and services to industry j, s_{ij}, or it buys a significant proportion of its goods and services from industry j, p_{ij}. To convert the measure of the interdependencies of industry i on industry j, this study multiplies the dependence measure by four-firm concentration ratios in industry j, Rj. Therefore, the measure of dependence of firms in industry i on firms in industry j, as $E_{j\rightarrow i}$ (Burt, 1983):

$$E_{j\rightarrow i} = (p_{ij} + s_{ij})R_j, \text{ where } p_{ij} = \left(\frac{z_{ji}}{\sum_q z_{qi}}\right) \text{ and } s_{ij} = \left(\frac{z_{ij}}{\sum_q z_{iq}}\right) \quad (3)$$

According to Pfeffer (1987), interdependencies should be based on across- rather than within-industry alliances. The above measures consistently support this notion that the use of industry-level data has sounder theoretical bases than the use of firm-to-firm transactions (Casciaro and Piskorski, 2005). When the unit of analysis is shifted to a dyad of business units in industries i and j, the dyad can be characterized by two constraint measures $E_{j\rightarrow i}$ and $E_{i\rightarrow j}$, defined as: $E_{i\rightarrow j} = (p_{ji} + s_{ji})R_i$. The bi-directional nature of the measurement implies that the constraint values of a business unit in industry i on a business unit in industry j or vice versa might not be the same. Further, this study constructs a dyadic measure of interdependencies between business units in industry i and business units in industry j as follows: $\text{Interdependencies}_{i\leftrightarrow j} = \left| E_{j\rightarrow i} - E_{i\rightarrow j} \right|$. The dependencies of industry i on their partners in an alliance portfolio will be: $\text{Interdependencies}_{i\leftrightarrow j} = \left| \sum_{t=1}^{n} E_{jkm\rightarrow i} - E_{i\rightarrow jkm} \right|$, where n refers to the number of partners related to a firm in industry i, j refers to partners of a firm in industry i, k refers to partners related to a firm in industry i, m refers to each partner of the firm, and t refers to the year of the alliance being formed. Differing from Casciaro and Piskorski (2005), this study regards the value of zero as representing mutual dependence between partners and this is coded as zero (0), negative value indicates that a focal firm is less dependent on partners and is coded as minus one (-1), and a positive value shows that a focal firm is highly dependent on partners and this is coded as positive one (1).

Control Variables. Even though this study has been controlled for inter-temporal trends and shocks by standardizing the dependent variable by the S&P 500 stock market index, some variables might confound the expected results. Therefore, this study controls fourteen variables that are categorized into firm-, portfolio-, and industry-level. The details are as follows:

Firm-level: First, relative size has been found to be a significant factor that affects alliance formation and performance (Gulati, 1998). As suggested by Wang and Zajac (2007), the relative size of the focal firm with their partners could predict alliance performance. A large firm tends to have greater probability of success in managing their alliance portfolio, because their available resources facilitate this (Lavie, 2007). This study controls the relative size of a focal firm by taking a natural log of their total assets divided by the industry's total assets. Second, the industry concentration index of firms may affect a focal firm's power to exchange with others. Resource dependence theory (Pfeffer and Salancik, 1978) argues that firms with more power tend to generate greater benefits in inter-organizational relationships. To calculate the industry concentration index for each firm, this study uses COMPUSTAT sales data from 2000 through 2007. Each industry's concentration index for each year is calculated by following Wang and Zajac (2007), as follows: $\sum (S_i^2 / S^2)$, where S is the total sales of all firms in one specific industry defined by two-digit NAICS code, and S_i is the sales of firm i.

Portfolio-level: First, functional learning could influence firm performance (Lin et al., 2007). Following Lavie and Rosenkopf (2006), this study codes a categorical indicator of whether each alliance involved a knowledge generating R&D agreement (coded 1); an agreement based on existing knowledge involving joint marketing and service, OEM/VAR, licensing, production, or supply (coded 0); or a combination of R&D and other agreements (coded 0.5). Second, portfolio size may positively affect firm performance (Ahuja, 2000; Baum et al., 2000; Stuart et al., 1999), and is measured by dividing the total number of alliances of a focal firm in a given year by its total assets. Third, societal-status of partners is measured as the social status of partners (based on S&P 500 and Fortune 500 lists) in the alliance portfolio with regard to the focal firm, which might also influence firm performance (Lin et al., 2009). This study codes as one (1) when the focal firm has high status and zero (0) when the firm status is balanced. There is no low social status for the sample of this study. Fourth, multi-partner alliance is measured by the average number of partners involved in each of the firm's alliances, assuming that multi-partner alliances entail more complex management (Lavie, 2007). Fifth, tie multiplicity is controlled for another relational aspects by measuring the number of sequential partnerships held by a focal firm and a particular firm and uses a five-year window (Ahuja, 2000), in which repeated partners are coded as one (1) and first-time partners as zero (0). Sixth, portfolio internationalization is measured by the percentage of foreign partners in the alliance portfolio, assuming that high proportions of foreign partners may be more difficult to manage because of geographical and cultural distance (Lavie and Miller, 2008), in which foreign partners are coded as one (1) and domestic partners are coded as zero (0). Seventh, location refers to the notion of where the alliances are operated relative to domestic ones, whereby USA located alliances are coded as zero (0) and non-USA alliances are coded as one (1). Eighth, joint venture is measured by the proportion of equity-based joint ventures out of the total number of alliances in the firm's portfolio, with JV coded as one (1) and non-JV coded as zero (0), in order to control for the governance mode of alliances (Lavie, 2007). Finally, ownership is measured by the equity contribution that a focal firm committed to a particular alliance (Reuer and Ragozzino, 2006).

Industry-level: First, market uncertainty is measured by the volatility of net sales of firms in the focal industry (Lin et al., 2007), which is operationalized by dividing the standard deviation of net sales of firms in the focal industry with the industry's average. Second, it is possible that firms choose to engage in alliances because other firms in the same industry are doing so (Wang and Zajac, 2007). This study measures popularity of alliances in the industry to which each firm belongs by dividing the actual number of alliances in a focal firm's portfolio by the total number of alliances in the industry. Finally, year is controlled for any time-specific variations and consists of seven dummy variables for each year (using year 2000 as a base). All the research variables are presented in Table 1.

D. Descriptive

Following Anand and Khanna (2000), this study compiles records of alliances formed by each focal firm in the S&P 500 from 1995 to 2007 from the SDC Platinum database. In order to ensure the correctness of the data, the Lexis/Nexis database and company websites are also used. Most alliance announcements were cross-validated, and additional corrections are made based on a corporate history search that tracked name changes, mergers, acquisitions, and spin-offs involving each focal firm and its respective identified partners. This study includes the alliances when the status was completed, signed or extended, while status pending, letter of intent, and rumored alliances were excluded. In total, 15,276 alliances were retrieved, and only 1,792 alliances are reported and valid between years 2000 and 2007.

Table 1
Variables and measurement

Control Variables	Empirical Measurement
Firm level:	
- Industry concentration	- A natural log of a firm's total assets relative to industry's assets (t)
- Relative size	- A natural log of a firm's total sales relative to industry's assets (t)
Portfolio level:	
- Functional learning	- Scope of alliance activities (t)
- Portfolio size	- Total number of a firm's alliances relative to total assets (t)
- Partner's social status	- Social-status of partners toward a focal firm (t)
- Multi-partner alliance	- Average number of partners involved in each alliance (t)
- Prior partnerships	- Sequential partnership with a particular partner (t-5 → t-1)
- Nation of participants	- Percentage of foreign partners of a firm's alliance portfolio (t)
- Location	- Proportion of alliances are operated relative to domestic ones (t)
- Joint ventures	- Proportion of equity-based alliance relative to total portfolio (t)
- Ownership	- Equity contribution made by a focal firm for the entire portfolio (t)
Industry level:	
- Popularity of alliances	- A firm's alliance portfolio relative to total number of alliances in the industry (t)
- Market uncertainty	- Volatility of net sales of a firm relative to the industry (t)
- Year	- A dummy variable for each year
Independent variables	
- Domain learning	- Similarity between a firm's industry with the formed alliance (t)
Moderating variables	
- Interdependencies	- Industry's input-output exchange between a firm and partners (t)
Dependent variables	
- Market performance	- Market value relative to the base year (2000) (t+1)

For each alliance, this study retrieved the information related to the date of announcement, pre-specified duration or termination date (most were unavailable), number of participating partners, partners' names, public status and countries of origin, whether the alliance is a joint venture (JV), amount of equity contribution (if it is a JV), classification of agreement (R&D, sales, licensing, marketing and so on). This study also extracted firm-specific data, such as historical SIC code, total assets, total sales, and price-close monthly of the stock price from the COMPUSTAT database for the years 1999 to 2007.

By regarding firm-year as the operational unit of analysis, this study pooled the data on 1,792 alliances across all alliances in each focal firm's portfolio in a given year, producing 453 firm-year observations. This sample excluded pre-2000 records, which were eliminated because of the time frame setting and the lagging of a control variable (firm uncertainty) by one year relative to the dependent variable. A focal firm participated in 3.956 alliances on average during the time frame of the study, and engaged with 1.275 partners. The biggest alliance portfolio was managed by Microsoft (212 alliances), followed by IBM (194 alliances) and Hewlett Packard (82 alliances). There are 235 firms (51.88%) belonging to high velocity industries, in which computer software dominated (110 firms, 24.28%), followed by semiconductors (57 firms, 12.58%), personal computers (56 firms, 12.36%), cosmetics (11 firms, 2.43%), toys and games (seven firms, 1.55%), and athletic footwear (three firms, 0.66%). On average, a focal firm had $16,937 million in assets and had $21,095 million in sales.

The correlation matrix also indicates that the results provide validation for the proposed hypotheses, and thus domain learning has a positive correlation with firm performance. Moreover, interdependency has a significant and negative relationship with regard to a firm's market performance.

IV. RESULTS

This study tests the models using hierarchical regression (Table 2). As proposed by Hypothesis 1, domain learning has a positive relationship with the market performance of a focal firm. The results indicate that domain learning consistently and positively influences the market performance ($\beta = 0.101$, $p = 0.006$, M1; $\beta = 0.101$, $p = 0.007$, M2; $\beta = 0.118$, $p = 0.001$, M3), and thus supports H_1. Hypothesis 2 posits that interdependencies moderate the positive relationship between domain learning and market performance, in which a firm appropriates greater market value when they are less dependent on their partners compared to any other condition. As expected, there is a significant moderating effect ($\beta = -0.222$, $p = 0.011$; $\Delta R^2 = 0.006$, $\Delta F = 6.230$), and thus H_2 is supported.

Following the procedure of Aiken and West (1991), Figure 2 depicts these moderating effects on the relationship between domain learning in an alliance portfolio and market performance. The figure shows that, in general, configuring an alliance portfolio predominantly by the divergence mode produces better market performance than the convergence mode. As expected, less dependencies enable a focal firm to appropriate market performance greater than the average ($\overline{X} = 0.350$) compared to the condition when they are balance ($\overline{X} = 0.150$) and highly dependent ($\overline{X} = -0.050$) for the divergence learning mode. When a company composes its alliance portfolio by the convergence mode, high dependencies generates market performance that is far below the average ($\overline{X} = -0.666$). A focal firm with less dependency toward its partners in an alliance portfolio has roughly equal market performance for both convergence and divergence learning modes ($\overline{X} = 0.366$), while mutual dependency produces market performance slightly below the industry's average ($\overline{X} = -0.150$).

V. DISCUSSION AND CONCLUSIONS

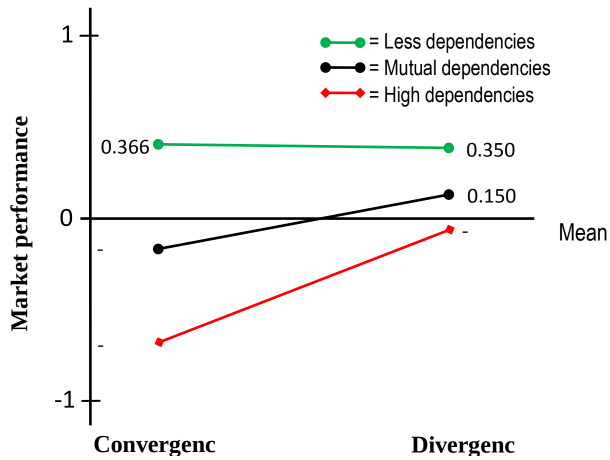
The findings indicate that domain learning has a positive relationship with firm performance, in which the divergence learning mode generates higher returns than the convergence one. This is in line with the notion that participating in alliances in different domains could broaden a firm's current networks (Baum et al., 2000; Gulati, 1998), in order to better adapt in a changing environment (Hoffmann, 2007; Koza and Lewin, 1998) by exploring new knowledge and capabilities (Sarkar et al., 2009) and market opportunities (e.g., D'Aveni, 2004). Consequently, the market performance of a focal firm will increase. Further results indicate that the use of the convergence learning mode generates less firm performance, although it leverages existing resources and capabilities. The reason is that convergence learning increases the value-claiming concerns between a focal firm and the alliance itself (Wang and Zajac, 2007). Specifically, the convergence learning mode creates overlapping business due to similar resource bases in the environment (i.e., input resources, technologies, and markets), and thus induces conflicts (Bleeke and Ernst, 1995) and coopetition (Brandenburger and Nalebuff, 1996; Park and Ungson, 2001). As a result, the divergence learning mode contributes to greater firm performance than the convergence mode.

Table 2
The effects of domain learning and moderators on market value

Research variables	Dependent Variable: Market Performance			
	M0	M1	M2	M3
Control variables				
Industry concentration	0.666^{***}	0.683^{***}	0.683^{***}	0.680^{***}
Relative size	0.020	0.006	0.006	0.004
Functional learning	-0.002	-0.009	-0.008	-0.006
Portfolio size	-0.178^{+}	-0.132	-0.127	-0.130
Multi-partner alliance	0.027	0.020	0.020	0.018
Partner’s social status	0.039	0.026	0.026	0.019
Prior partnership	-0.016	-0.023	-0.020	-0.020
Nation of participants	-0.005	-0.008	-0.011	-0.006
Location	0.046	0.045	0.044	0.040
JV	0.079	0.113	0.116	0.096
Ownership	-0.141^{+}	-0.149^{+}	-0.154^{+}	-0.134
Popularity of alliances	0.260^{**}	0.224^{*}	0.220^{*}	0.215^{*}
Market uncertainty	0.000	0.044	0.047	0.040
Year 1	0.016	0.005	0.005	-0.005
Year 2	-0.068^{+}	-0.062	-0.063	-0.064
Year 3	-0.007	-0.011	-0.011	-0.008
Year 4	0.013	0.012	0.012	0.006
Year 5	-0.023	-0.012	-0.007	-0.011
Year 6	-0.062	-0.040	-0.035	-0.041
Year 7	-0.089^{*}	-0.074	-0.074	-0.070
Main effects				
Domain learning		0.101^{**}	0.101^{**}	0.118^{***}
Interdependencies			-0.070	0.195^{*}
Moderating effect				
Domain learning x Interdependencies				-0.222^{*}
R^2	0.592	0.592	0.592	0.599
ΔR^2		0.007	0.007	0.006
ΔF	30.926	7.604	3.842	6.230
p	0.000	0.006	0.022	0.013

Note: $^{+}$ represents $p < .10$, * represents $p < 0.05$; ** represents $p < 0.01$, *** represents $p < .001$

Figure 2
The moderating effects of interdependencies



Further, this study demonstrates that less dependent parties generate better market performance than balance or highly dependent ones, as having greater bargaining power facilitates their ability to appropriate higher private benefits (Dyer et al., 2008). Interestingly, this study also indicates that less dependent parties generate similar levels of market performance when they predominantly compose their alliance by using the convergence learning mode. Even though convergence exposes firms to the dangers of imitation (e.g., Ahuja, 2000; Westphal and Zajac, 1997) or increased competition (e.g., Khanna et al., 1998; Park and Ungson, 2001), but stronger partners can appropriate more private benefits due to their lower levels of dependence. The industry relatedness toward an alliance portfolio enables the focal firm to assess and negotiate with partners for greater shared private benefits (Coff, 1999), which is contingent upon importance of the resources contributed. Resource dependence theory posits that the more critical the resources that are contributed, the greater the bargaining power available to appropriate higher private benefits prior to alliance formation (Pfeffer and Salancik, 1978). For example, Dyer (1996) reports that Toyota generates greater private benefits than its suppliers, which are within- domain, due to its bargaining power. As a result, a less dependent firm could generate higher firm performance.

In contrast, a firm with high dependency appropriates smaller private benefits due to the unavailability of alternative sources (e.g., Brass, 1984; Kumar et al., 1998) or the magnitude of exchange (e.g., Burt, 1982; Casciaro and Piskorski, 2005), forcing it to accept an unfavorable exchange arrangement. This study reveals that employing the divergence learning mode in an alliance portfolio enables a highly dependent firm to access alternative resources and manages the magnitude of exchange. Consequently, a highly dependent firm could have higher market performance when it employs the divergence rather than convergence learning mode in its alliance portfolio. This finding is consistent with the report of Kim et al. (2004) that weaker members of keiretsu have better firm performance when they broaden their business spectrum. In both situations, lesser or higher dependency, competition rather than cooperation will be facilitated (Khanna et al., 1998) and value-claiming concerns are heightened (Wang and Zajac, 2007). Differing from that, balance dependence refers to equal power between a focal firm and its partners in terms of economic exchange (Burt, 1982; Casciaro and Piskorski, 2005). Since the focus is on collaboratively creating value (Khanna et al., 1998), they thus need to share the benefits generated in the alliance equally. The findings indicate that the market performance for a balance dependence condition is in between that for the condition of less and high dependence, which reflects the shared relational rents (Lavie, 2006).

The above findings have important implications for alliance managers. First, configuring an alliance portfolio which is divergent from existing business generates greater market performance than a convergent one. This implies that firms should actively increase their business sphere to gather new opportunities and build new competencies (Koza and Lewin, 1998), and at the same time increase their competitiveness by protecting their business core, out maneuver weaker rivals, and prepare for future revenue sources (D'Aveni, 2004). Second, this study shows that composing an alliance portfolio in which a focal firm has less dependency toward their partners is a necessary condition to appropriate greater private benefits (i.e., increased firm performance). Although mutual dependence is conducive to engender trust and intensify knowledge sharing among partners, it is better for a focal firm to have partnerships with parties that are heavily dependent on a focal firm to appropriate greater value (Dyer et al., 2008). Moreover, for firms with high dependencies toward their partners, configuring an alliance portfolio which is divergent from their core business could mitigate the negative effect of their dependencies compared to the use of the convergence mode.

Besides these managerial implications, this study has several theoretical implications. First, this study extends the organizational learning literature by introducing the concept of domain learning and the convergence/divergence learning modes. Even though many extensions have been made following the concept of exploitation/exploration in March (1991), the issue of alliances which converge or diverge from the focal firm's domain is relatively little explored, particularly in the context of an alliance portfolio. Second, this study also empirically tests the conditions that could leverage the distribution of private benefits (Dyer et al., 2008) or the inbound spillover rent of an alliance portfolio (Lavie, 2006) by extending the logic of RBV. Third, this study extends the resource dependence theory literature (Pfeffer and Salancik, 1978), which is rich in theoretical discussion but relatively less empirically tested (Pfeffer and Salancik, 2003). Finally, this study also answers the call of Wassmer (2010) to expand the literature related to alliance portfolios and focal firm performance.

Despite some compelling arguments, this study has several inherent limitations. First, this study mainly discusses the convergence/divergence issue from the focal firm's perspective. By investigating the convergence/divergence issue from a dyadic perspective, future studies could address the issues of rent distribution, and private and common benefits between a focal firm and its partners (e.g., Dyer et al., 2008; Wang and Zajac, 2007). Second, this study mainly examines the domain learning simply whether the differences exist between a firm's business and alliances. Future studies could further examine whether the alliance is part of a firm's strategy to orchestrating its network resources vertically or horizontally (e.g., Gulati, 1998; Villalonga and

McGahan, 2005). Third, this study operationalizes interdependencies from the industry level (Burt, 1982, 1983; Casciaro and Piskorski, 2005), which might not represent the true I/O exchange between a focal firm and their partners. Approaching interdependencies from the corporate or business unit level could overcome this limitation. Fourth, even though this study has controlled the temporal effects, it does not emphasize how the co-evolution of an alliance portfolio (Hoffmann, 2007) relates to firm performance. Finally, this study does not consider the network resources which are embedded in an alliance portfolio, and integrating the network perspective (e.g., Ahuja, 2000; Koka and Prescott, 2008) could complement the results of this study.

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