INTERNATIONAL JOURNAL OF BUSINESS, 20(2), 2015 ISSN: 1083-4346

Interrelatedness, Interdependencies, and Domain Learning in Alliance Portfolios

Badri Munir Sukoco
Senior Lecturer, Department of Management, Airlangga University
Surabaya, Indonesia 60286
badri@feb.unair.ac.id

ABSTRACT

This study examines why firms configure their alliance portfolio within (convergence) or across industry (divergence). This study argues that greater similarity with partners leads firms to employ convergence learning, while greater diversity leads to the use of divergence learning. Further arguments justify the use of convergence learning when dependencies are asymmetrical, but divergence learning when dependencies are balanced. This study further integrates the two perspectives on the configuration of domain learning. The developed hypotheses are tested on S&P 500 firms' alliances from 2000 to 2007. The results indicate that greater similarity and asymmetry of dependencies leads to the use of convergence learning, while greater diversity and balance leads to the use of divergence learning. Further results show that less dependent firms with greater similarity to their partners employ convergence learning, while more dependent firms configure their alliance portfolio divergently to avoid misappropriation from stronger partners. Firms with balanced dependencies configure their alliance portfolios ambidextrously when relatedness to partners is high.

JEL Classifications: G340, D74

Keywords: interrelatedness; interdependencies; ambidextrous; domain learning; alliance portfolios

I. RESEARCH BACKGROUND

IBM generated more than one-third of its revenues through their alliance portfolio (Feder, 2001; Parise and Casher, 2003). Heimeriks, Klijn, and Reuer (2009) also report that Cisco's alliance portfolio generated more than 13 percent of its total business activity in the 2000s. An alliance portfolio is a firm's collection of direct alliances with partners (e.g., Hoffmann, 2007; Lavie and Miller, 2008), and the collection averagely increased from four to more than thirty partners over the 1990s (Lavie, 2007).

One of the primary activities of an alliance portfolio is learning, which enables a firm to access and acquire new knowledge residing outside its boundaries and to collaboratively leverage existing knowledge with partners (e.g., Beckman, Haunschild, and Philips, 2004). Previous studies approach such learning from the function, structure, and other peripheral attributes involved in the alliance (Lavie and Rosenkopf, 2006; Lin, Yang, and Demirkan, 2007), or by examining process-based learning inside the alliance (e.g., Kale and Singh, 2007). There has been rapid progress in the study of the interorganizational learning, and most research undermines the fact that a firm may also learn by forming alliance that is different from or similar to its core business – domain learning.

This study argues that domain learning is the learning strategy of a firm to maintain an alliance portfolio to conform the relatedness and dependencies toward partners' resources. The resource-based theory (Barney, 1991; Das and Teng, 2000) suggests that greater relatedness leads to convergence learning due to similar bases of knowledge (e.g., Makri, Hitt, and Lane, 2010), while less relatedness leads to divergence learning due to less-redundant knowledge (e.g., Baum, Calabrese, and Silverman, 2000). Another perspective suggests that it is difficult for similar partners to work together within one domain, because their use of similar resources can make them compete against each other (e.g., Chen, 1996) and offer less new skills and knowledge for the other party to learn (e.g., Wang and Zajac, 2007).

This study further argues that these inconsistencies can be resolved by considering the nature of relationships between a firm and its partners in an alliance portfolio. Resource dependence theory (Emerson, 1962; Pfeffer and Salancik, 1978) suggests that the level of interdependence toward partners could explain firm behavior. Specifically, convergence learning is adopted by a firm when there are asymmetrical dependencies toward partners in an alliance portfolio in order to access and exploit partners' knowledge (Grant and Baden-Fuller, 2004). In contrast, a firm tends to employ divergence learning when there are balanced dependencies toward partners, as greater incentives to exchange valuable resources exist (Casciaro and Piskorski, 2005), and there is a stronger relational orientation (Gulati and Sytch, 2007), which stimulates a firm to experiment with its existing capabilities in different industries. In addition, this study proposes that the interaction between these perspectives could explain when the ambidextrous learning mode, rather than divergence or convergence, is chosen.

The contributions of this study are as follows: First, this study introduces the concept of convergence/divergence learning as an extension of the exploitation/ exploration concept of March (1991), and empirically tests the viability of this concept. Second, this study extends RBV (Barney, 1991; Das and Teng, 2000) to organizational learning (Levinthal and March, 1993) by relating a firm's resources with the alliance portfolio that they have. Third, this study extends resource dependence theory (Pfeffer

and Salancik, 1978) by asserting that differential dependencies determine a firm's learning decisions. Fourth, this study enriches the ambidexterity hypothesis (e.g., He and Wong, 2004) by integrating the arguments of resource-based and resource dependence theory.

II. THEORETICAL BACKGROUND

A. Alliance Learning

Organizational learning theory (March, 1991; Levinthal and March, 1993) posits that the goal of strategic alliances is to acquire the knowledge of partners that firms do not possess. This perspective has been integrated by Grant and Baden-Fuller (2004) into the idea that learning activities in alliances are rooted in two activities: accessing and acquiring knowledge. Accessing knowledge refers to alliance activities that deploy existing knowledge to create value (Grant and Baden-Fuller, 2004), which is similar to the March's (1991) concept of "exploration." Acquiring knowledge refers to alliance activities that pursue new knowledge (Grant and Baden-Fuller, 2004), in which March (1991) termed "exploration."

Domain learning represents learning activities that are undertaken by configuring an alliance portfolio that is similar to or different from firm's domain. Firms could acquire new knowledge by composing their alliance portfolio further away from their own domain, termed as divergence learning. Divergence learning enables a focal firm to discover new opportunities and build new competencies (Koza and Lewin, 1998; Nooteboom, 1999) by composing an alliance portfolio in different industries. In contrast, firms could access partners' knowledge by configuring their portfolio closer to their own domain, and termed as convergence learning. 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 study regards that convergence and divergence are two ends of a continuum, because of the incompatibility of both with respect to a firm's scarce resources and the different types of capabilities and knowledge that each requires (March, 1991). In addition, this study adopts ambidexterity as learning capability to simultaneously configure an alliance portfolio convergently and divergently with equal dexterity (Lubatkin, Simsek, Ling, and Veiga, 2006).

B. Resource-based View on Alliances

RBV is firm focused and concerned with the management of internal resources for achieving competitive advantage (Barney, 1991). The resource-based view posits that a firm accesses another firm's critical resources by establishing a strategic alliance (Das and Teng, 2000) and creating value by pursuing the potential synergy between them (Wang and Zajac, 2007). Synergy refers to the condition where the combination of two firms' resources is potentially more efficient than that of either firm operating independently (St John and Harrison, 1999). When a partner's business is highly related to the focal firm, the resources are highly similar due to similarities in products, markets, and technologies (Wang and Zajac, 2007).

Similar firms typically have greater duplication in assets and operations, and by

eliminating these redundancies the combined firm is likely to be more efficient (Wernerfelt, 1984; Dussauge, Garrette, and Mitchell, 2000). By configuring an alliance portfolio convergently, a firm has less redundancy (e.g., Makri et al., 2010), greater absorptive capacity (Cohen and Levinthal, 1990), tends to engage in a refinement process (March, 1991) and pursue greater efficiency (Dussauge et al., 2000). As reported by Mowery, Oxley, and Silverman (1996), firms tend to form alliances within-domain when there are significant similarities in technological capabilities due to their greater absorptive capacities. Therefore:

H_{1a}: The higher resource relatedness between a focal firm and its partners in an alliance portfolio, the greater the likelihood of the convergence learning mode being used.

As noted by Balakrishnan and Koza (1993), diverse resources among partners increases information asymmetry, making it difficult to assess the value of the resources that each contributes in an alliance. In this situation, Inkpen (2002) argues that the ratio of private to common benefits is higher, and this induces more competitive behavior from partners. Consequently, it is best for a firm to configure its alliance portfolio divergently to avoid being contested by the formed alliance – coopetition (e.g., Brandenburger and Nalebuff, 1996). By doing so, a firm could generate new knowledge (Grant and Baden-Fuller, 2004) and maintain parity with competitors (Garcia-Pont and Nohria, 1999). Moreover, the divergence learning mode provides non-redundant sources – structural holes - that enable a firm to access new markets and knowledge (Burt, 2004) and exploit opportunities brought by less similar partners (D'Aveni, 2004). Therefore:

H_{1b}: The lower resource relatedness between a focal firm and its partners in an alliance portfolio, the greater the likelihood of the divergence learning mode being used.

C. Resource Dependence Perspective on Alliances

Interdependencies between two organizations exist when one party's interests cannot be achieved without the other party's resources, and an alliance is necessary to achieve their desired goals (Pfeffer and Salancik, 1978). Many studies consider that constraint absorption among interdependent actors is grounded in the interrelated notion of power (e.g., Casciaro and Piskorski, 2005, Gulati and Sytch, 2007), which is closely linked to the theory of power-dependence relations (Emerson, 1962). The theory posits that there are two types of interdependencies, asymmetrical and balanced (Emerson, 1962). Dependence asymmetry refers to power differences of one party over the other or the difference between two parties' dependencies (Casciaro and Piskorski, 2005), in which a focal firm could be more or less dependent toward partners in the alliance portfolio. Balanced dependence refers to the equal dependencies between a focal firm and its partners in the alliance portfolio.

As discussed by Wang and Zajac (2007), a pair of firms heightens their value-claiming concerns when there are asymmetries of information and incompatible economic interests between them. The more dependent firm in an asymmetrically dependent alliance portfolio tends to stabilize their alliance processes and utilize network resources as optimal as they can, since their partnerships might easily be dissolved by their more powerful partners (Casciaro and Piskorski, 2005). Although the

benefits of a highly dependent firm might be misappropriated by its partners (e.g., Katila, Rosenberger, and Eisenhardt, 2008), the advantages of being endorsed by having an alliance with stronger partners still outweigh the disadvantages (e.g., Castellucci and Ertug, 2010). On the other hand, a more powerful firm tends to utilize convergence learning to appropriate higher private benefits relative to its partners (Dyer, Singh, and Kale, 2008). The reason is that a firm's particular power resides only in its own industry, and this power is not of equal magnitude in other industries. Therefore:

H_{2a}: The greater asymmetrical dependencies between a focal firm and its partners in an alliance portfolio, the greater the likelihood of the convergence learning mode being used.

An alliance has collective strengths and joint power when the two allied firms are equally dependent on each other (Gulati and Sytch, 2007). Collective strengths provide opportunities for partners to experiment and create new products (Lavie and Rosenkopf, 2006). As discussed by Casciaro and Piskorski (2005), a balanced dependency between two allied firms provides substantial incentives for each to exchange their valuable resources and develop innovative products. Moreover, the interaction between the two parties in a strategic alliance has a higher interaction level when their dependencies are equal, which leads to a stronger relational orientation and engenders greater trust (e.g., Gulati and Sytch, 2007). Balanced dependencies also may generate a higher level of commitment to the alliance and, as a result, a long-term relationship orientation can be expected while the immediate fulfillment of self-interest will be reduced (Rusbult, Verette, Whitney, and Slovik, 1991). Therefore:

H_{2b}: The more balanced dependencies between a focal firm and its partners in an alliance portfolio, the greater the likelihood of the divergence learning mode being used.

D. Toward Theoretical Integration

Prior studies show that the sources of greater bargaining power in an alliance are rooted in the unavailability of alternative resources or less replaceability of a partner (e.g., Brass, 1984). This power remains in place when a firm configures its alliance convergently, since in any particular industry there may not be many alternatives available to ally with. Moreover, a less dependent firm can easily dissolve current partnerships and form new alliances with others in the same industry (Casciaro and Piskorski, 2005). Thus, for a less dependent firm configuring an alliance portfolio convergently is part of isolating the power mechanism to maintain dominance over its partners.

To reduce misappropriation from a highly dependent and less related partner, a less dependent firm tends to broaden its alliance portfolio by using ambidextrous learning. Moreover, broadening an alliance portfolio allows a less dependent firm to avoid being contested in its own domain by a less related partner. As reported by Castellucci and Ertug (2010), a highly dependent partner obtains status spillover and endorsement benefits by partnering with a less dependent firm. The effect is even higher when the alliance is formed in the industry where the less dependent firm belongs. Consequently, configuring an alliance portfolio ambidextrously when the partners are less related is the optimal choice for a less dependent partner if it wants to avoid being contested by its counterparts in the future. By doing so, a less dependent

firm remains able to appropriate greater value from the within-domain alliances and at the same time access new market opportunities that are easily entered (Khanna, Gulati, and Nohria, 1998; Jensen, 2003). Therefore:

H_3: Interrelatedness will interact with interdependencies such that for a focal firm that is less dependent on its partners, high relatedness increases the likelihood of the convergence learning mode and low relatedness increases the likelihood of the ambidextrous learning mode being used in an alliance portfolio.

Having relationships with less-related partners engenders inter-partner learning (Inkpen, 2002) in which each party competes to learn and acquire knowledge asymmetrically. Khanna et al. (1998) suggest that having alliances with less related partners increases the ratio of private to common benefits, and induces competitive behavior. But these consequences imply when the alliance is formed in the focal firm's industry, and the tension could be minimize by configuring an alliance portfolio divergently. Although forming alliances in different industries is risky due to unfamiliarity and different knowledge bases, balance dependencies create situations conducive to the exchange of valuable resources (Casciaro and Piskorski, 2005) and avoid learning competition and asymmetric alliance outcomes (Dussauge, Garrette, and Mitchell, 2004).

Balanced dependencies lead to a stronger relational orientation (e.g., Gulati and Sytch, 2007) and minimize the immediate fulfillment of self-interest (Rusbult et al., 1991). However, the potential value creation will not be at the optimal level when alliance portfolio activities mostly configure divergently, since a firm needs sometime to understand every aspect of an alliance portfolio that is different from their competencies. By configuring alliance portfolio ambidextrously, a firm is able to simultaneously engage in different learning modes based on the relatedness of the resources. As suggested by Benner and Tushman (2003), structurally independent units with different learning modes, one to acquire knowledge and one to apply it, could optimize the opportunities embedded in a balanced dependency situation. Therefore:

H_4: Interrelatedness will interact with interdependencies such that for a focal firm that is balanced dependent with regard to its partners, high relatedness increases the likelihood of the ambidextrous learning mode and low relatedness increases the likelihood of the divergence learning mode being used in an alliance portfolio.

Resource dependence theorists (Pfeffer and Salancik, 1978) suggest that a firm will be highly dependent on its partners due to the unavailability of alternative resources (e.g., Brass, 1984). In order to offset this, a firm may choose to broaden its alternatives as part of its defense mechanisms (Katila et al., 2008). The divergence learning mode can also reduce the magnitude of exchange between a highly dependent firm and its stronger partners. Previous studies noted that a greater magnitude of exchange toward partners weakens the bargaining power of a firm (e.g., Burt, 1982; Casciaro and Piskorski, 2005), since its exchanges are mostly related to a particular partner. In order to alleviate this, a firm may compose its alliance portfolio in diverse industries to reduce the risk of misappropriation by stronger partners (e.g., Bae and Gargiulo, 2004).

The capabilities of a stronger partner to appropriate tend to be modest when the resources are less related. In this situation, a highly dependent firm should employ

ambidextrous learning to maintain an excessive cognitive distance (Nooteboom, 1999) when composing an alliance portfolio divergently with less related partners. Moreover, configuring an alliance portfolio ambidextrously maintains the coordination costs due to unrelated resources (Goerzen, 2005). As discussed previously, less relatedness reduces the absorptive capacity (Cohen and Levinthal, 1990), and it thus needs frequent interactions and comprehensive assessment methods to ensure alliance learning activities perform as expected. Therefore:

H_5: Interrelatedness will interact with interdependencies such that for a focal firm that is highly dependent on its partners, high relatedness increases the likelihood of the ambidextrous learning mode and low relatedness increases the likelihood of the divergence learning mode being used in an alliance portfolio.

III. RESEARCH METHODS

A. Empirical Setting

The sample companies are 500 firms that appeared in the S&P 500 from 2000-2008 to examine the effects of within- and across industry, as prior studies mainly emphasize within a single industry (e.g., Rothaermel and Deeds, 2004; Lavie and Miller, 2008). The data sets can also approximate the interdependencies of these enlisted firms with their partners. Moreover, the alliance portfolios formed and managed by these large companies have greater legitimacy for others to conform to (DiMaggio and Powell, 1983). In addition, the sample is highly representative, since these 500 firms consistently accounted for about 11.40% of the market capitalization of the companies listed on the New York Stock Exchange (NYSE) from 2000-2007.

B. Sample and Data

This study includes only those firms with at least 70 percent of their business in one sector. Diversified firms are excluded because the strategic consideration of these companies is considerably more complex and more likely to be at the business level rather than the corporate one (Wang and Zajac, 2007). 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 sampling period because of the so-called alliance wave of the early 2000s, in which most companies increased their number of alliance partners (Lavie, 2007). Moreover, prior studies mainly use data prior 2000, and thus lack of recency, which this study can provide. This period also allows this study a reasonably long time to examine these activities, while also having a five-year period to control for the history of the alliance activities of the firms. All alliance activities conducted by these firms from 1995 to 2007 are collected from the SDC Platinum Database. Any ambiguities were resolved by consulting alternative sources, such as Lexis/Nexis and other reliable sources (e.g., corporate web sites). Firm-specific financial data were collected from COMPUSTAT.

Following the procedure used by Casciaro and Piskorski (2005), which was 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 are released every five years. Moreover, this study matches four digits of the Standard Industrial Classification (SIC) codes that 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, and this does not have any significant effect on the annual measures or regression results due to the only slight changes over any five-year period (Burt, 1983).

C. Measures

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

Independent variables. First, interrelatedness of resources. Following prior studies (e.g., Lavie, 2007; Lin et al., 2009), this study employs the SIC code. This study sets business similarity of two firms as 1 if the first four digits of the two firms' SIC codes are identical, 0.75 if the first three digits are the same, 0.5 if the first two digits are similar, 0.25 if the first digit is the same, and 0 if the first digit are different. Second, interdependencies. Following Casciaro and Piskorski (2005), this study measures interdependencies based on the economic exchange (I-O accounts) of interindustry flows. The dependencies of industry i on its 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 was formed. In contrast to Casciaro and Piskorski (2005), this study regards a value of zero (0) as representing balanced dependence between partners, while a negative value indicates that a focal firm has less dependence on its partner(s) and this is coded as minus one (-1), and a positive value shows that a focal firm is highly dependent on its partner(s) and this is coded as positive one (1).

D. Control Variables

This study controls sixteen variables that might confound the expected results and categorizes into firm-, portfolio-, and industry levels. The measurement of each variable is presented on Table 1.

Table 1
Variables and measurement

Variables	Empirical Measurement	Sources
Control variables		
Firm level:		
Industry concentration	A natural log of a firm's total assets relative to industry's asset (t)	Wang and Zajac (2007)
Relative size	A natural log of a firm's total sales relative to industry's assets (t)	Lavie (2007)
Firm uncertainty	Stock price volatility relative to mean (t-1)	Baker (1984), Beckman et al. (2004)
Portfolio level:		
Functional learning	Scope of alliance activities (t)	Lavie and Rosenkopf (2006)
Portfolio size	Total number of a firm's alliances relative to total assets (t)	Ahuja (2000), Baum et al. (2000)
Partner's social status	Social-status of partners relative to a focal firm (t)	Lin et al. (2009)
Multi-partner alliance	Average number of partners involved in each alliance (t)	Lavie (2007)
Prior partnerships	Sequential partnerships with a particular partner (t-5 → t-1)	Ahuja (2000)
Nation of participants	Percentage of foreign partners in a firm's alliance portfolio (t)	Lavie and Miller (2008)
Location	Proportion of foreign alliances that are operated relative to domestic ones (t)	Lavie and Miller (2008)
Joint ventures	Proportion of equity-based alliances relative to total portfolio (t)	Lavie (2007)
Ownership	Equity contribution made by a focal firm for the entire portfolio (t)	Reuer and Ragozino (2006)
Industry level:		
Popularity of alliances	A firm's number of alliances relative to the total number of alliances in the industry (t)	Wang and Zajac (2007)
Market uncertainty	Volatility of net sales of a firm relative to the industry (t)	Lin et al. (2007)
Industry sector	A dummy variable for each industry (t)	Wang and Zajac (2007)
Year	A dummy variable for each year (t)	Wang and Zajac (2007)
Independent variables		
Interrelatedness	Similarity between a firm and its partners in an alliance portfolio (t)	Lavie (2007), Lin et al. (2009)
Interdependencies	Dependencies between a firm and its partners in an alliance portfolio (t)	Casciaro and Piskorski (2005)
Dependent variables		
Domain learning	Similarity between a firm's industry with alliance formed (t)	Developed in this study

E. Descriptive

For each alliance, this study retrieves 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 was a joint venture (JV), amount of equity contribution (if it was a JV), and classification of agreement (R&D, sales, licensing, marketing and so on). This study extracts firm-specific data, such as historical SIC code, total assets, total sales, and price-close monthly of the stock price from Compustat database for the years 1999 to 2007.

By regarding firm-year as the operational unit of analysis, this study pools the data on the 1,792 alliances in each focal firm's portfolio in a given year, producing 453 firm-year observations. This sample excludes pre-2000 records, which are 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. Most of the firms in this sample operated in the manufacturing industry (50.5%), followed by financial services (150 firms, 13%) and information industry (149 firms, 12.9%) (see Table 1). There are no significant differences among years use in this study, in which ranging from 119 (2004, 10.2%) to 176 firm-year observations (2007, 15.2%). On average, a focal firm owned $35,730 million in assets and had $61,781 million in sales. The correlation matrix also indicates that the results provide validation for the proposed hypotheses. Interrelatedness and interdependencies have a negative correlation with regard to domain learning, while functional learning has a significantly positive correlation with domain learning.

IV. RESULTS

This study tests the models using hierarchical regression (Table 2). The first hypothesis posits that interrelatedness has a negative relationship with domain learning, in which greater relatedness leads to the use of the convergence learning mode and less relatedness leads to the use of divergence learning. The regression results reveal that interrelatedness is negatively related to domain learning, as expected ($\beta = -0.269$, $p < 0.001$, M1; $\beta = -0.265$, $p < 0.001$, M3; and $\beta = -0.268$, $p < 0.001$, M4). Specifically, the results indicate that higher relatedness has a positive relationship with the convergence learning mode, while lower relatedness has a positive relationship with divergence learning. Thus, H_{1a} and H_{1b} are supported. The second hypothesis predicts that interdependencies have a negative relationship with domain learning in which greater asymmetry leads a firm to employ convergence learning, while balanced dependencies lead to the use of divergence learning. The regression results give the expected results ($\beta = -0.092$, $p < 0.001$, M2; $\beta = -0.081$, $p < 0.01$, M3; and $\beta = -0.244$, $p < 0.001$, M4). Specifically, the results indicate that asymmetry dependencies have a significant positive relationship with convergence learning, while balanced dependencies are positively and significantly related to the decision to employ the divergence learning mode in an alliance portfolio. Therefore, H_{2a} and H_{2b} are supported. Hypotheses 3 to 6 posit that interrelatedness and interdependencies interact, and the regression results indicate that the interaction of these variables is significant ($\beta = -0.177$, $p = 0.008$; $\Delta R^2 = 0.005$, $\Delta F = 7.102$).

Table 2
Interrelatedness and interdependencies on domain learning

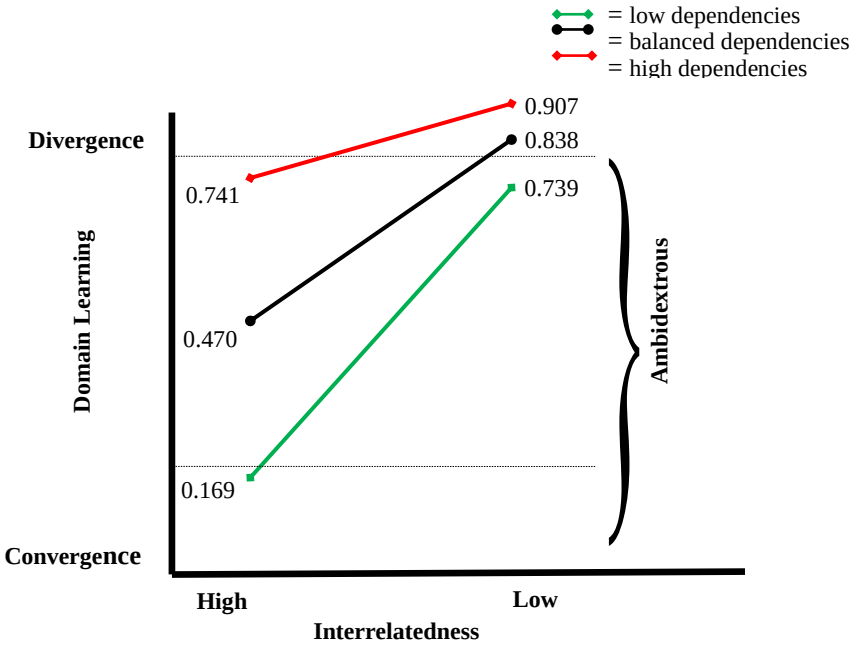
Research Variables	Dependent Variable: Domain Learning				
	M 0	M 1	M 2	M 3	M 4
		Control variables			
Relative assets	0.444**	0.375*	0.443**	0.375*	0.369*
Relative sales	-0.416**	-0.353*	-0.417**	-0.354*	-0.349*
Firm uncertainty	-0.033	-0.041	-0.022	-0.032	-0.032
Functional learning	0.041	0.056*	0.041	0.056*	0.058*
Portfolio size	-0.056	-0.053	-0.046	-0.045	-0.041
Multi-partner alliance	0.009	0.010	0.007	0.008	0.008
Partners' social status	0.054+	0.050+	0.057*	0.052+	0.049+
Prior partnership	0.059*	0.051+	0.064*	0.055*	0.057*
Nation of participants	0.026	0.013	0.031	0.018	0.022
Location	-0.065	-0.037	-0.068+	-0.040	-0.044
JV	-0.104	-0.093	-0.104	-0.093	-0.092
Ownership	-0.105	-0.084	-0.108	-0.086	-0.087
Popularity of alliances	0.037	0.026	0.038	0.027	0.027
Market uncertainty	-0.054	-0.061	-0.049	-0.056	-0.055
Industry 1	-0.184***	-0.158***	-0.180***	-0.154***	-0.155***
Industry 2	-0.049	-0.058	-0.045	-0.055	-0.054
Industry 3	-0.020	-0.049	0.001	-0.031	-0.035
Industry 4	-0.071*	-0.070*	-0.062+	-0.061+	-0.060+
Industry 5	-0.075+	-0.093*	-0.062	-0.082*	-0.082*
Industry 6	-0.229***	-0.210***	-0.240***	-0.219***	-0.222***
Industry 7	-0.089*	-0.127***	-0.094*	-0.131***	-0.130***
Industry 8	-0.130***	-0.122***	-0.128***	-0.120***	-0.119***
Industry 9	-0.048	-0.049	-0.043	-0.045	-0.045
Industry 10	-0.065*	-0.084**	-0.056+	-0.077*	-0.079*
Industry 11	-0.035	-0.040	-0.037	-0.041	-0.042
Year 1	0.048	0.052	0.044	0.049	0.049
Year 2	-0.076*	-0.063+	-0.073*	-0.060+	-0.061+
Year 3	0.020	0.028	0.022	0.029	0.031
Year 4	0.039	0.060+	0.037	0.058+	0.061+
Year 5	-0.038	-0.020	-0.035	-0.017	-0.015
Year 6	-0.077+	-0.054	-0.075+	-0.053	-0.049
Year 7	-0.091*	-0.063	-0.090*	-0.063	-0.060
		Main effects			
Interrelatedness		-0.269***		-0.265***	-0.268***
Interdependencies			-0.092***	-0.081**	-0.244***
		Interaction effects			
Interrelatedness x Interdependencies					-0.177**
R^2	0.177	0.177	0.177	0.177	0.245
ΔR^2		0.065	0.008	0.071	0.005
ΔF	7.452	94.760	10.198	52.012	7.102
p	0.000	0.000	0.001	0.000	0.008

Note: + represents p < .10, * represents p < 0.05; ** represents p < 0.01, *** represents p < .001

Further results indicate that some control variables are significantly related to domain learning. Specifically, relative sales negatively relate to domain learning, which indicates that greater sales lead firms to employ convergence learning to exploit current market opportunities. Moreover, some industries prefer to configure their alliance portfolio within-domain, such as natural resources and mining, transportation, information, financial services, professional and business services, and the leisure and hospitality industry. In contrast, greater relative assets, more prior partnerships, and higher societal status relative to partners positively relate to the decision to configure an alliance portfolio divergently.

Following the procedure of Aiken and West (1991), Figure 1 depicts these interaction effects. This study adopts the operationalization of Lin et al. (2007) that learning activities categorized as exploitation when the score is below 0.200, above 0.800 is categorized as exploration, and ambidextrous learning ranges from 0.200 to 0.800. Hypothesis 3 posits that a firm with low dependencies tends to employ convergence learning when its business is highly related to its partners, but turns ambidextrous learning when its business is less related to its partners. The results indicate that less dependencies with high relatedness lead to convergence learning ($\overline{X}$ = 0.169), while ambidextrous learning is used when the resources have low relatedness ($\overline{X}$ = 0.739), which is supports H_3. Hypothesis 4 predicts that a firm tends to compose its alliance portfolio ambidextrously when the resources are highly related to its partners, and configure it divergently when the relatedness is low. The results show that

Figure 1
The interaction between interrelatedness and interdependencies



ambidextrous learning is adopted by a firm when its dependencies are balanced and resources are highly related to its partners ($\overline{X}$ = 0.470), becoming divergent when the resources are less related ($\overline{X}$ = 0.838), which supports H_4. Finally, Hypothesis 5 suggests that a firm with high dependencies tends to compose its alliance portfolio ambidextrously when its resources are highly related, and employs divergence learning when its resources are less related. The results indicate that low relatedness leads a firm to employ divergence learning under high dependence situations ($\overline{X}$ = 0. 907), and ambidextrous learning when its resources are highly related to its partners ($\overline{X}$ = 0. 741), thus supporting H_5.

V. DISCUSSION AND CONCLUSIONS

The findings indicate that greater resources relatedness between a firm and its partners in an alliance portfolio increases the likelihood of the convergence learning mode being used. This is in line with the arguments of resource-based theory (Barney, 1991; Das and Teng, 2000) that similar resources facilitate the synergy of highly related firms by engaging them in activities that focus on refinement processes – exploitation (March, 1991) and pursuing greater efficiency (Dussauge et al. 2000). Moreover, the decision to configure an alliance portfolio convergently increases a firm's absorptive capacity (Cohen and Levinthal, 1990), due to the similar knowledge bases. In contrast, less resources relatedness leads firms to configure an alliance portfolio divergently. High information asymmetry (Balakrishnan and Koza, 1993) of diverse resources increases the difficulty of assessing the contributed resources. At the same time, convergence learning increases the tendency of unrelated partners becoming future competitors (e.g., Brandenburger and Nalebuff, 1996). By configuring the alliance portfolio divergently, a firm thus avoids future competition and at the same time has greater opportunities to access new markets (D'Aveni, 2004).

The second finding is that different interdependencies explain different domain learning modes employed by a firm. Based on resource dependence theory (Pfeffer and Salancik, 1978), this study shows that asymmetric dependencies lead a firm to configure an alliance portfolio convergently. For a highly dependent firm, the need for resources and lack of alternative sources encourage it to stay in the alliance (Gulati and Sytch, 2007), although they increase the opportunities of the firm's benefits being misappropriated by a stronger partner (e.g., Katila et al., 2008). For a less dependent firm, configuring an alliance portfolio in its own domain means that it can retain power over its partners and has greater abilities to appropriate higher private benefits from the weaker firms (Dyer et al., 2008). In contrast, balanced dependencies give a firm greater confidence that its partners contribute equally valuable resources (Casciaro and Piskorski, 2005) and this engenders trust (e.g., Gulati and Sytch, 2007). Consequently, a firm has a greater tendency to configure its alliance portfolio divergently by experimenting existing with its knowledge and capabilities in different domains.

The third finding is that a less dependent firm should employ isolating mechanisms to retain their comparative advantage over partners by configuring a convergent alliance portfolio. Fewer alternative sources (e.g., Brass, 1984) and greater magnitude of economic exchange (e.g., Pfeffer and Salancik, 1978) remain the power sources when the industry is the same, since these sources are highly embedded in a particular industry. Therefore, convergence learning is the rational choice for a less

dependent firm and provides greater abilities to appropriate higher private benefits due to similar resource bases (Dyer et al., 2008). However, when the partners' resources are less related, a less dependent firm should employ an ambidextrous learning mode. By doing so, a firm could minimize the chance of their partners becoming competitors in the future, and at the same time retain power over them.

The fourth finding suggests that a highly dependent firm should employ defense mechanisms to counter the misappropriation behaviors of stronger partners. When the stronger partners' resources are highly related, configuring an alliance portfolio divergently could minimize their comparative advantage. In addition, broadening an alliance portfolio in different industries increases the alternative sources (Katila et al., 2008) and minimizes the magnitude of exchange with stronger partners (Casciaro and Piskorski, 2005). When the partners' resources are less related, configuring an alliance portfolio ambidextrously is the best choice, as minimizing the coordination costs due to diverse partners is the main concern (Goerzen, 2005), although an excessive cognitive distance can endanger the appropriation capabilities of the focal firm (Nooteboom, 1999).

Finally, balanced dependencies offer greater confidence to partners, and lead a firm to configure its alliance portfolio divergently when the resources are less related. Although diverse resources induce competitive behavior (Dussauge et al., 2000, 2004), equal power could mitigate the negative effects of the competition, increase the learning from partners and open up opportunities in new markets (D'Aveni, 2004). When the resources are highly related, a firm could employ ambidextrous learning learn with partners (Inkpen, 2002), ad could configure some alliances within-domain to leverage existing knowledge, while also operating some alliances in different industries to explore new opportunities – i.e., utilize structural ambidexterity (Benner and Tushman, 2003).

These findings have important implications for alliance managers. First, the decision to configure an alliance portfolio within- or across-domain should not be based solely on the interrelatedness of resources with partners. By better understanding the nature of relationships with partners, managers can select the type of domain learning that will minimize the costs and at the same time offer new opportunities for their firm. Second, managers can apply isolating mechanisms by configuring an alliance portfolio convergently when their firm's position is less dependent and partners' resources are highly related. However, when the partners' resources are less related, managers can configure an alliance portfolio ambidextrously to maintain their superior position toward highly related partners and thus access new capabilities and the markets of unrelated partners. Third, when the position of a focal firm is highly dependent, composing an alliance portfolio divergently is the defense mechanism to counter misappropriation behaviors from a stronger partner. In addition, ambidextrous domain learning should be chosen when partners' resources are less related to reduce high coordination costs. Finally, balanced dependencies provide better opportunities for a firm to configure its alliance portfolio divergently to acquire new knowledge and capabilities with less misappropriation when the partners' resources are less related. However, when the relatedness is high, ambidextrous learning is the best choice for managers to optimize the learning outcomes of an alliance portfolio. This study examines also the antecedents of particular modes of domain learning chosen by a firm, but many other aspects should also be considered. In other words, simply applying

divergence learning per se in an alliance portfolio may not produce the expected value, unless the focal firm has the capabilities to manage it effectively (Hoffmann, 2007).

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. Even though many extensions have been made following the concepts of exploitation/exploration presented in March (1991), the issue of forming alliance which converges or diverges from the focal firm's domain has received relatively little attention, particularly in the context of alliance portfolios. Second, this study also empirically tests how the degree of resource relatedness between a firm and its partners (Barney, 1991; Das and Teng, 2000) can determine the learning type chosen by extending the logic of RBV. Third, this study extends the resource dependence theory literature that is rich in theoretical discussion but lacking in empirical testing (Pfeffer and Salancik, 2003). Finally, this study also extends the ambidexterity hypothesis that mostly relates to internal or external dynamisms (e.g., Lavie and Rosenkopf, 2006; Lin et al., 2007) by integrating the concepts of interrelatedness and interdependencies in an alliance portfolio.

Despite some compelling arguments, this study has several inherent limitations. First, this study focuses on large companies that are part of the S&P 500. Although these firms' strategic behaviors are critical (Perrow, 1986), the findings are highly contextualized in this sample. Due to their size, such firms do not need resources as much as smaller firms. Second, this study mainly examines domain learning simply by considering the differences that exist between a firm's business and its alliance partners. Future studies could further examine whether alliances are part of a firm's strategy to orchestrate its network resources vertically or horizontally (e.g., Gulati, 1998; Villalonga and McGahan, 2005). Finally, this study operationalizes interdependencies at the industry level (Burt, 1982, 1983; Casciaro and Piskorski, 2005), which might not represent the true I/O exchange between a focal firm and its partners. Approaching interdependencies from the corporate or business unit level could overcome this limitation.

REFERENCES

Ahuja, G., 2000, "Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study", *Administrative Science Quarterly,* 45(3), 425–455.

Aiken, L.S., and S.G. West, 1991, *Multiple Regressions: Testing and Interpreting Interactions,* Newbury Park, CA: Sage.

Bae, J., and M. Gargiulo, 2004, "Partner Substitutability, Alliance Network Structure, and Firm Profitability in the Telecommunications Industry", *Academy of Management Journal,* 47(6), 843–859.

Baker, W., 1984, "The Social Structure of A National Securities Market", *American Journal of Sociology,* 89(4), 775–811.

Balakrishnan, S., and M.P. Koza, 1993, "Information Asymmetry, Adverse Selection and Joint Ventures", *Journal of Economic Behavior and Organization,* 20(1), 99–117.

Barney, J., 1991, "Firm Resources and Sustained Competitive Advantage", *Journal of Management,* 17(1), 99–120.

Baum, J.A.C., T. Calabrese, and B.S. Silverman, 2000, "Don't Go It Alone: Alliance

Network Composition and Startups' Performance in Canadian Biotechnology", *Strategic Management Journal*, 21(3), 267–294.

Beckman, C.M., P.R. Haunschild, and D.J. Philips, 2004, "Friends or Strangers? Firm-specific Uncertainty, Market Uncertainty, and Network Partner Selection", *Organization Science*, 15(3), 259-275.

Benner, M.J., and M.L. Tushman, 2003, "Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited", *Academy of Management Review,* 28(2), 238-256.

Brandenburger, A., and B.J. Nalebuff, 1996, *Co-opetition*, Doubleday: New York.

D.J. Brass, 1984, "Being in the Right Place: A Structural Analysis of Individual Influence in An Organization", *Administrative Science Quarterly,* 29(4), 518–539.

Burt, R.S., 1982, *Toward a Structural Theory of Action: Network Models of Social Structure, Perception, and Action*, New York: Academic Press.

Burt, R.S., 1983, *Corporate Profits and Cooptation: Networks of Market Constraints and Directorate Ties in the American Economy,* New York: Academic Press.

Burt, R.S., 2004, "Structural Holes and Good Ideas", *American Journal of Sociology,* 110(2), 349-399.

Casciaro, T., and M.J. Piskorski, 2005, "Power Imbalance, Mutual Dependence, and Constraint Absorption: A Closer Look at Resource Dependence Theory", *Administrative Science Quarterly,* 50(2), 167–199.

Castellucci, F., and G. Ertug, 2010, "What's in It for Them? Advantages of Higher Status Partners in Exchange Relationships", *Academy of Management Journal*, 53(1), 149-166.

Chen, M.J., 1996, "Competitor Analysis and Inter-firm Rivalry: Toward a Theoretical Integration", *Academy of Management Review*, 21(1), 100-134.

Cohen, M.W., and D.A. Levinthal, 1990, "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly,* 35(1), 128–152.

D'Aveni, R.A., 2004, "Corporate Spheres of Influence", *MIT Sloan Management Review,* 45(4), 38-46.

Das, T.K., and B.S. Teng, 2000, "A Resource-based Theory of Strategic Alliances", *Journal of Management*, 26(1), 31-61.

DiMaggio, P.J., and W.W. Powell, 1983, "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields", *American Sociological Review*, 48(2), 147-160.

Dussauge, P., B. Garrette, and W. Mitchell, 2000, "Learning From Competing Partners: Outcomes and Durations of Scale and Link Alliances in Europe, North America, and Asia", *Strategic Management Journal,* 21(2), 99–126.

Dussauge, P., B. Garrette, and W. Mitchell, 2004, "Asymmetric Performance: The Market Share Impact of Scale and Link Alliances in the Global Auto Industry", *Strategic Management Journal*, 25(7), 701–711.

Dyer, J.H., H. Singh, and P. Kale, 2008, "Splitting the Pie: Rent Distribution in Alliances and Networks", *Managerial and Decision Economics*, 29(2), 137-148.

Emerson, R., 1962, "Power-dependence Relations", *American Sociological Review,* 27 (1), 31–41.

Feder, B.J., 2001, "Retrenchment, Not Retreat", *New York Times*, 24 January.

Garcia-Pont, C., and N. Nohria, 1998, "Local Versus Global: The Dynamics of Alliance Formation in the Automobile Industry", *Strategic Management Journal*, 23(4), 307-

321.
Goerzen, A., 2005, "Managing Alliance Networks: Emerging Practices of Multinational Corporations", *Academy of Management Executive*, 19(2), 94-107.
Grant, R.M., and C. Baden-Fuller, 2004, "A Knowledge Accessing Theory of Strategic Alliances", *Journal of Management Studies*, 41(1), 61-84.
Gulati, R., 1998, "Alliances and Networks", *Strategic Management Journal*, 19(4), 293–317.
Gulati, R., and M. Sytch, 2007, "Dependence Asymmetry and Joint Dependence in Interorganizational Relationships: Effects of Embeddedness on A Manufacturer's Performance in Procurement Relationships", *Administrative Science Quarterly,* 52(1), 32-69.
He, Z., and Wong P-K, 2004, "Exploration and Exploitation: An Empirical Test of the Ambidextrous Hypothesis", *Organization Science,* 15(4), 481–96.
Heimeriks,, K.H., E. Klijn, and J.J. Reuer, 2009, "Building Capabilities for Alliance Portfolios", *Long Range Planning*, 42(1), 96–114.
Hoffmann, W.H., 2007, "Strategies for Managing A Portfolio of Alliances", *Strategic Management Journal*, 28(8), 827-856.
Inkpen, A.C., 2002, "Learning, Knowledge Management, and Strategic Alliances: So Many Studies, So Many Unanswered Questions", in Contractor, F.J., and Lorange, P. (Eds.) *Cooperative Strategies and Alliances*, Pergamon: Amsterdam, 267–289.
Jensen, M., 2003, "The Role of Network Resources in Market Entry: Commercial Banks' Entry into Investment Banking, 1991-1997", *Administrative Science Quarterly*, 48(3), 466-497.
Kale, P., and H. Singh, 2007, "Building Firm Capabilities through Learning: The Role of the Alliance Learning Process in Alliance Capability and Firm-level Alliance Success", *Strategic Management Journal*, 28(10), 981-1000.
Katila, R., J.D. Rosenberger, and K.M. Eisenhardt, 2008, "Swimming with Sharks: Technology Ventures, Defense Mechanisms and Corporate Relationships", *Administrative Science Quarterly*, 53(2), 295-332.
Khanna, T., R. Gulati, and N. Nohria, 1998, "The Dynamics of Learning Alliances: Competition, Cooperation, and Relative Scope", *Strategic Management Journal, 1*9(3), 193–210.
Koza, M.P., and A.Y. Lewin, 1998, "The Co-evolution of Strategic Alliances", *Organization Science*, 9(3), 255–264.
Lavie, D., 2007, "Alliance Portfolios and Firm Performance: A Study of Value Creation and Appropriation in the U.S. Software Industry*", Strategic Management Journal*, 28(12), 1187–1212.
Lavie, D., and S.R. Miller, 2008, "Alliance Portfolio Internationalization and Firm Performance", *Organization Science*, 19(4), 623-646.
Lavie, D., and L. Rosenkopf, 2006, "Balancing Exploration and Exploitation in Alliance Formation", *Academy of Management Journal*, 49(4), 797–818.
Levinthal, D.A., and J.G. March, 1993, "The Myopia of Learning", *Strategic Management Journal*, 14(Special Issue), 95–112.
Lin, Z., H. Yang, and I. Demirkan, (2007), "The Performance Consequences of Ambidexterity in Strategic Alliance Formations: Empirical Investigation and Computational theorizing", *Management Science*, 53(10), 1645–1658.
Lin, Z., H. Yang, and B. Arya, 2009, "Alliance Partners and Firm Performance:

Resource Complementarity and Status Association", *Strategic Management Journal*, 30(9), 921-940.

Lubatkin, M.H., Z. Simsek, Y. Ling, and J.F. Veiga, 2006, "Ambidexterity and Performance in Small- to Medium-sized Firms: The Pivotal Role of Top Management Team Behavioral Integration", *Journal of Management*, 32(6), 646–672.

Makri, M., M. A. Hitt, and P.J. Lane, 2010, "Complementary Technologies, Knowledge Relatedness, and Invention Outcomes in High Technology Mergers and Acquisitions", *Strategic Management Journal*, 31(6), 602-628.

March, J.G., 1991, "Exploration and Exploitation in Organizational Learning", *Organization Science*, 2(1), 71–86.

Mowery, D.C., J.E. Oxley, and B.S. Silverman, 1996, "Strategic Alliances and Interfirm Knowledge Transfer", *Strategic Management Journal*, 17(Special Issue), 77-91.

Nooteboom, B., 1999, *Inter-firm Alliances: Analysis and Design*, Routledge: London.

Parise, S., and A. Casher, 2003, "Alliance Portfolios: Designing and Managing Your Network of Business-Partner Relationships", *Academy of Management Executive*, 17(4), 25-39.

Perrow, C., 1986, *Complex Organizations: A Critical Essay*, Random House: New York.

Pfeffer, J, and G.R. Salancik, 1978, *The External Control of Organizations: A Resource Dependence Perspective*, Harper & Row: New York.

Reuer, J.J., and R. Ragozino, 2006, "Agency Hazards and Alliance Portfolios", *Strategic Management Journal*, 27(1), 27-43.

Robins, J., and M.F. Wiersema, 1995, "A Resource-based Approach to the Multibusiness Firm: Empirical Analysis of Portfolio Interrelationships and Corporate Financial Performance", *Strategic Management Journal*, 16(4), 277-299.

Rothaermel, F.T., and D.L. Deeds, 2004, "Exploration and Exploitation Alliances in Biotechnology: A System of New Product Development", *Strategic Management Journal*, 25(3), 201-221.

Rusbult, C.E., J. Verette, G.A. Whitney, and L.F. Slovik, 1991, "Accommodation Processes in Close Relationships: Theory and Preliminary Empirical Evidence", *Journal of Personality and Social Psychology*, 60(1), 53–78.

St. John, C.H., and J.S. Harrison, 1999, "Manufacturing-based Relatedness, Synergy, and Coordination", *Strategic Management Journal*, 20(2), 129–145.

Villalonga, B., and A.M. McGahan, 2005, "The Choice among Acquisitions, Alliances, and Divestitures", *Strategic Management Journal*, 26(13), 1183-1208.

Wang, L., and E.J. Zajac, 2007, "Alliance or Acquisition? A Dyadic Perspective on Interfirm Resource Combinations", *Strategic Management Journal*, 28(13), 1291-1317.

Wernerfelt, B., 1984, "A Resource-based View of the Firm", *Strategic Management Journal*, 5(2), 171–180.