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ALLIANCE PORTFOLIOS AND FIRM PERFORMANCE: A STUDY OF VALUE CREATION AND APPROPRIATION IN THE U.S. SOFTWARE INDUSTRY

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This study reveals the multifaceted contribution of alliance portfolios to firms' market performance. Extending prior research that has stressed the value-creation effect of network resources, it uncovers how prominent partners may undermine a firm's capacity to appropriate value from its alliance portfolio. Analysis of a comprehensive panel dataset of 367 software firms and their 20,779 alliances suggests that the contribution of network resources to value creation varies with the complementarity of those resources. Furthermore, the relative bargaining power of partners in the alliance portfolio constrains the firm's appropriation capacity, especially when many of these partners compete in the focal firm's industry. In turn, the firm's market performance improves with the intensity of competition among partners in its alliance portfolio. These findings advance network research by highlighting the trade-offs that alliance portfolios impose on firms that seek to manage and leverage their alliances. Copyright © 2007 John Wiley & Sons, Ltd.

INTRODUCTION

How does an alliance portfolio contribute to firm performance? Despite the recent surge in the number of interfirm alliances (henceforth termed alliances), the accumulated alliance research offers only limited insights into this phenomenon. Prior studies either investigate the performance implications of individual alliances or concentrate on relational and structural properties of alliance networks. More recently, scholars studying alliance portfolios have begun to recognize the role of partners' resources in value creation. Nevertheless, they have tended to neglect the appropriation hazards that partners impose. The current study bridges these gaps in the literature by simultaneously incorporating value creation and appropriation mechanisms and taking into account the resources and competitive positions of partners in the alliance portfolio. Thus, it sheds light on the means by which an alliance portfolio can influence firm performance.

An alliance is a voluntary arrangement among independent firms to exchange or share resources and engage in the co-development or provision of products, services, or technologies (Gulati, 1998). Alliances take different forms, including joint ventures, collaborative R&D, and joint marketing. Traditionally, alliances had been conceived of as *ad hoc* arrangements serving specific needs, but more recently firms have begun to engage extensively in multiple simultaneous alliances. For example, in the U.S. software industry, the percentage of publicly traded firms that engage in alliances has increased from 32 percent to 95 percent, and the average number of alliances per

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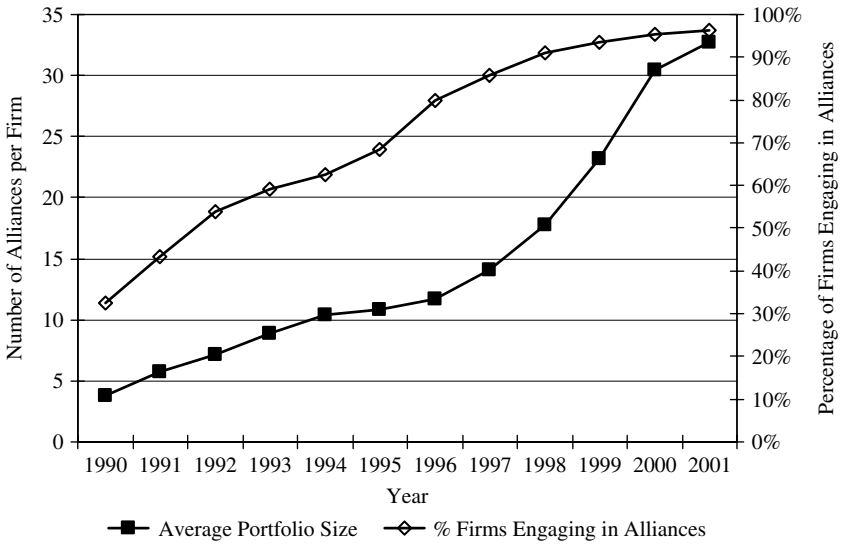

Figure 1. The evolution of alliance portfolios in the U.S. software industry, 1990–2001. This figure presents the percentage of publicly traded firms in the U.S. software industry that engage in alliances and their corresponding alliance portfolio size, measured in terms of number of alliances

firm rose from four to more than 30 during the 1990s (see Figure 1). Not only has the number of alliances increased, but their scope has also been extended. Whereas firms historically formed alliances to perform relatively simple peripheral activities, alliances are now employed at various stages of the value chain (Powell, Koput, and Smith-Doerr, 1996). An alliance portfolio refers to a firm's collection of direct alliances with partners. It is akin to the notion of the egocentric network, which encompasses the focal firm (ego), its set of partners (alters), and their connecting ties (Wasserman and Faust, 1994). The challenge of coordinating multiple simultaneous alliances has prompted firms to establish dedicated alliance functions and formalize their alliance programs (Kale, Dyer, and Singh, 2002). However, scholars and practitioners still debate the desirable properties of alliance portfolios.

Considering the potential advantages that alliances may provide, such as cost sharing, risk reduction, and flexibility (Hagedoorn, 1993; Harrigan, 1988; Kogut and Kulatilaka, 1993; Ohmae, 1989; Powell *et al*., 1996), practitioners and scholars often assume that alliance portfolios will enhance corporate performance. Surprisingly, this assumption received only limited support in early research. A multi-industry study by Berg, Duncan, and Friedman (1982) that examined the impact of a firm's joint venturing activity on its profitability found short-term negative effects in the chemicals and mechanical engineering industries, but no long-term performance effects. Similarly, Hagedoorn and Schakenraad (1994) found no direct effect of technology alliance portfolios on firm profitability.

The limited evidence on the contribution of alliance portfolios to firm performance is understandable given the empirical challenges inherent in measuring such a complex phenomenon (Gulati, 1998). For example, firms rarely report formal quantitative measures of alliance operations and outcomes in their financial statements. In addition, the performance contribution of alliances is often confounded with that of the firm's internal operations. Recent research has made some progress toward overcoming these challenges by shifting from the study of dyadic alliances to the examination of network structures, the nature of alliance relationships, and the attributes of partner firms (Baum, Calabrese, and Silverman, 2000; Rothaermel, 2001; Stuart, 2000; Stuart, Hoang, and Hybels, 1999; Zaheer and Bell, 2005). This work suggests that 'large firms and those that possess leading-edge technological resources are posited to be the most valuable associates' (Stuart, 2000: 791).

In the current study, I qualify this assertion by noting that although some complementary network resources create value, alliances with well-

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endowed partners may in fact undermine the market performance of firms. By distinguishing value creation from value appropriation mechanisms, this study elucidates why the nurturing of alliance portfolios rich in prominent partners serves as a double-edged sword. It sheds further light on the implications of alliance portfolios by taking into account the nature of relationships between the focal firm and its partners, as well as among partners in its alliance portfolio. These ideas are tested empirically with a pooled time-series analysis of the alliance portfolios of 367 U.S. software firms during the period 1990–2001. The findings confirm that enhancements of a firm's market value are related to the availability of both marketing and financial network resources, as well as to the prominence of partners in its alliance portfolio, but not to the availability of technology and human network resources. To the extent, however, that partners in a firm's alliance portfolio are more profitable and gain access to more alliances than the focal firm, the firm's market value will decline. Finally, bilateral competition between the firm and its partners exacerbates some of these negative effects, while multilateral competition among partners in the alliance portfolio attenuates them. Thus, this study advances alliance portfolio research by juxtaposing value creation and appropriation mechanisms and accounting for interdependencies across alliances in the firm's alliance portfolio.

LITERATURE REVIEW

Alliance research has evolved in four streams: (1) the strategic alliance literature; (2) studies of stock market returns following alliance announcements; (3) social network theory applications; and (4) the emerging research on strategic networks. These research streams enhance our understanding of alliances and networks but fall short of fully accounting for the contribution of alliance portfolios to firm performance.[1]

When considering performance implications, a distinction should be made between alliance performance and the impact of alliances on firm performance. Alliance performance has been associated with interfirm trust, strategic and organizational compatibility, knowledge exchange, adaptive governance, conflict resolution mechanisms, and dedicated alliance personnel (Dussauge, Garrette, and Mitchell, 2000; Dyer and Nobeoka, 2000; Dyer and Singh, 1998; Gulati, 1995a; Inkpen and Beamish, 1997; Kale *et al*., 2002; Kale, Singh, and Perlmutter, 2000; Khanna, Gulati, and Nohria, 1998; Kumar and Nti, 1998; Madhok and Tallman, 1998; Parkhe, 1993; Saxton, 1997; Zaheer, McEvily, and Perrone, 1998). Hence, the strategic alliance literature has offered a rich perspective on why some alliances are more successful than others. However, this perspective may not fully explain the impact of alliances on firm performance, for several reasons. First, the analysis has often been conducted at the dyadic level, with each alliance considered as an isolated event rather than as an interdependent element in a portfolio of alliances. Second, there is no immediate way to infer alliance contributions to firm performance from alliance success because of asymmetry in the value appropriated by the partners involved in the alliance (Khanna *et al*., 1998). Finally, most alliance studies have relied on alliance stability, alliance longevity, or qualitative managerial assessments, rather than on financial measures of corporate performance.

Originating in the finance discipline, research on abnormal stock market returns overcomes the last limitation by studying residual changes in firms' stock prices during various event windows surrounding their alliance announcements (McConnell and Nantell, 1985). This research stream has provided solid evidence regarding the expected performance implications of individual alliances. According to this research, firms typically enjoy significant positive abnormal stock market returns following alliance announcements. The heterogeneity of market returns has been ascribed, for instance, to the type of alliance, the relative size of partners, their partnering experience, and the relatedness of their businesses (Anand and Khanna, 2000a; Balakrishnan and Koza, 1993; Beck, Larson, and Pinegar, 1996; Chan *et al*., 1997; Das, Sen, and Sengupta, 1998; Koh and Venkatraman, 1991; Lee and Wyatt, 1990; McConnell and Nantell, 1985; Merchant and

[1] Since my focus is limited to relevant implications for firm performance, I do not review the general alliance literature, except as it relates to performance implications. More thorough reviews of this literature can be found elsewhere (Gulati, 1998; Koza and Lewin, 1998; Osborn and Hagedoorn, 1997).

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Schendel, 2000; Park and Kim, 1997; Reuer and Koza, 2000; Woolridge and Snow, 1990). Some studies have found significant correlation between these abnormal stock market returns and subjective managerial assessments of alliance performance (Kale *et al*., 2002; Koh and Venkatraman, 1991). Nevertheless, this research offers only limited evidence of the performance implications of alliance portfolios, because the majority of findings refer to joint ventures rather than to the more common non-equity alliances. More importantly, the analysis of residual market returns considers only the marginal contribution of individual alliances and neglects the simultaneous and interdependent effects of other alliances in the focal firm's portfolio. Finally, whereas these studies typically report significant positive market returns, such returns are relatively small and are recorded for only half of the alliance participants, thus leaving considerable unexplained heterogeneity in the contribution of alliance portfolios to a given firm's market performance.

The social network literature, in turn, overcomes the alliance independence assumption by focusing on enduring patterns of relationships among interacting social actors. Social network perspectives conceive of actors (such as firms) as interdependent, and place emphasis on the social, economic, or political network structures of ties that provide actors with opportunities and constraints. Actors can enjoy certain benefits, referred to as social capital, by virtue of their membership in social networks (Portes, 1998). These benefits derive from closed network structures that bond actors (Coleman, 1988) or from brokerage positions that bridge disconnected actors (Burt, 1992). Social capital may contribute to firm performance by enhancing innovation (Ahuja, 2000; Tsai and Ghoshal, 1998), knowledge transfer (Burt, 1992; Inkpen and Tsang, 2005; Koka and Prescott, 2002), intellectual capital (Nahapiet and Ghoshal, 1998), and efficiency (Baker, 1990; Burt, 2000). In addition, social network studies emphasize either structural or relational aspects of networks (Granovetter, 1985). Structural embeddedness studies highlight actors' positions in the overall network structure by considering properties such as structural holes (Burt, 1992), centrality (Bonacich, 1987; Freeman, 1979; Ibarra, 1993; Podolny, 1993), structural equivalence (Burt, 1987), and density (Coleman, 1988). Relational embeddedness studies, in turn, examine the nature of dyadic relationships, considering, for instance, the strength of ties and the evolving trust between actors (Granovetter, 1973; Podolny, 1994; Powell, 1990; Uzzi, 1996). Nevertheless, the social network literature offers only a partial account of the performance implications of alliance portfolios because it focuses on network ties while assuming away differences in the inherent attributes of actors. In addition, it partially relies on an interpersonal reasoning involving emotional intensity and intimacy, which is not applicable for interfirm alliances (Rowley, Behrens, and Krackhardt, 2000).

Recently, scholars have begun to apply social network theories in studies of the performance implications of strategic networks (Gulati, Nohria, and Zaheer, 2000). Several studies have examined how the number of alliances, and network properties such as density and structural holes, affect firms' innovation output, new product development, revenue growth, market share, market value, or profitability (Ahuja, 2000; Baum *et al*., 2000; Rothaermel, 2001; Rowley *et al*., 2000; Stuart *et al*., 1999; Zaheer and Bell, 2005). Some studies have considered the composition of partners in the network (Baum *et al*., 2000; Goerzen and Beamish, 2005), their innovativeness, and prominence (Gulati and Higgins, 2003; Rothaermel, 2001; Saxton, 1997; Stuart, 2000; Stuart *et al*., 1999; Zaheer and Bell, 2005). In particular, Saxton (1997) found that firms benefit from their partners' reputation. Stuart *et al*. (1999) found that the technological and commercial prominence of partners affect the IPO performance of startup firms. Similarly, Gulati and Higgins (2003) demonstrated that relationships with prestigious venture capital firms and underwriters contribute to IPO performance. Rothaermel (2001) showed that biopharmaceutical firms facilitate new product development by leveraging their partners' assets. Finally, Stuart (2000) found that the technological innovativeness of partners contributes to the sales growth and innovation rates of semiconductor firms. This stream of research deviates from traditional social network analysis by focusing on the attributes of partners, rather than on the quality of ties or the properties of the network structure. It adheres to the notion that alliance portfolios provide the focal firm with access to network resources (Gulati, 1999) that extend its opportunity set and potentially enhance its performance.

Although this research advances an understanding of the role of alliance portfolios, the empirical

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evidence on the contribution of partners' resources has been generally limited to startup firms and intermediate outcomes, such as innovation output and revenue growth. Moreover, this research has concentrated on the contributions of partners to value creation, concluding that firms would benefit from alliances with prominent and well-endowed partners that endorse or otherwise support the focal firm. For example, Stuart concluded that 'both from a resource access and reputation standpoint, large and innovative firms are likely to be the most valuable associates' (Stuart, 2000: 808). The current study cautions, however, that firms that follow this advice may suffer a decline in market performance insofar as dominant partners that contribute to joint value creation may also be well positioned to appropriate a larger share of this value at the focal firm's expense. It extends recent research that has suggested that the costs of forming alliances with critical resource-rich partners may outweigh the benefits of this partnering strategy (Bae and Gargiulo, 2004) by distinguishing between the network resources that the alliance portfolio provides and the bargaining power of partners in that portfolio. By simultaneously considering value creation and appropriation mechanisms, this study offers a more nuanced account of the impact of alliance portfolios on firms' market performance.

THEORY AND HYPOTHESES

To untangle the impact of alliance portfolios on firms' market performance, this study moves beyond prior research that has emphasized relational or structural aspects of network ties, and underscores instead the contribution of network resources (Gulati, 2007; Lavie, 2006), which more directly captures the characteristics and endowments of partners in the firm's alliance portfolio. The emphasis shifts from the ties that serve as channels for transferring resources among firms to the resources themselves. In addition, this study concurrently incorporates aspects of value creation and appropriation mechanisms. Value-creation mechanisms enhance the focal firm's ability to generate value from its relationships with partners as they collectively pursue shared objectives and extend the range of value chain activities that contribute to the overall value of the alliance portfolio. These mechanisms produce relational rents that cannot be generated independently by individual participants in alliances (Dyer and Singh, 1998). In turn, value appropriation mechanisms do not create new value but instead determine the relative share of relational rents that the focal firm can appropriate (Gulati and Wang, 2003; Hamel, 1991; Khanna *et al*., 1998). Value appropriation mechanisms often elicit co-opetition (Brandenburger and Nalebuff, 1996), in which partners competitively pursue self-interested objectives in an attempt to increase their share of appropriated relational rent. The disparity between value creation and value appropriation is akin to the distinction between common and private benefits (Khanna *et al*., 1998). Value-creation mechanisms are collective processes that generate common benefits that are shared by all partners in an alliance, whereas value appropriation mechanisms determine the distribution of these common benefits to individual partners as well as the capacity of partners to unilaterally extract private benefits that are unavailable to other partners. The combination of value creation and appropriation mechanisms accounts for the contribution of the alliance portfolio to firm performance.

Value creation in alliance portfolios

The resource-based view (Barney, 1991; Penrose, 1959; Peteraf, 1993; Wernerfelt, 1984) has traditionally analyzed the value-creating contributions of a firm's internal resources and capabilities. When the firm becomes embedded in a network of alliances, a distinction can be made between the internal resources that it owns or controls (Barney, 1991), and the network resources that are owned by its partners yet can be potentially accessed by the focal firm through its ties to these partners (Gnyawali and Madhavan, 2001; Gulati, 1999; Lavie, 2006). Network resources encompass partners' tangible and intangible assets, including their human resources, financial assets, marketing efforts, R&D investments, and reputation. A firm may enhance its performance by leveraging these resources through three value-creation mechanisms.

First, a focal firm can use network resources to directly extend and enrich its value-creation opportunities. In particular, alliance partners can provide immediate access to complementary assets that support the commercialization of the focal firm's products or enhance its service offerings (Koh and Venkatraman, 1991; Mowery, Oxley,

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and Silverman, 1998; Pisano, 1990; Rothaermel, 2001). The firm can rely on its partners' salespeople as a secondary marketing channel, gain access to new customers by leveraging its partners' marketing investments, facilitate product introductions by incorporating partners' technologies, or use partners' funding to support its own R&D activities. In this sense, network resources contribute directly to firm performance by supplementing the firm's resources with resources that may be otherwise unavailable internally, and by making available a wider range of strategic opportunities (Barney, 1991). Although the firm may invest in internal development of resources or acquire external resources in the factor market, the assumption is that some network resources are specialized (Teece, 1986) and, because of their scarcity and the presence of isolating mechanisms such as causal ambiguity (Barney, 1991; Dierickx and Cool, 1989), more costly to develop internally or acquire. For instance, the firm may flexibly target specific resources of partners instead of engaging in corporate acquisitions and paying a premium to own redundant resources that do not directly contribute to value creation.

Second, a focal firm can generate value from resource combinations. According to the relational view (Dyer and Singh, 1998), the firm can generate synergies by combining network resources with its internal resources. The bundles of network resources and the firm's internal resources may be richer relative to bundles comprising internal resources exclusively. Besides the increase in the range of available resource combinations, the focal firm enjoys the flexibility of drawing network resources as needed while limiting its investments to the maintenance of relationships. Moreover, the firm may create value by combining network resources of distinct partners, and thus enjoy synergies that are unavailable to individual partners in its alliance portfolio. For example, a firm that specializes in systems integration may combine the hardware platforms of one partner with the software development expertise of another partner in the course of system implementation projects.

Finally, the focal firm can indirectly benefit from network resources that enhance the value of its internal resources or provide it with opportunities to internalize external resources (Lavie, 2006). In particular, resource-rich partners offer intangible assets that enhance the firm's legitimacy and capacity to acquire additional resources (Weigelt and Camerer, 1988). The alliance portfolio can also facilitate the accumulation of external knowledge and new skills (Balakrishnan and Koza, 1993; Kogut, 2000) through imitation, learning, and acquisition of network resources (Hamel, 1991; Kale *et al*., 2000). Thus, the focal firm can benefit from network resources that enrich its internal set of resources or enable it to develop new resources and capabilities. This is illustrated, for example, by the demonstrated link between startup firms' revenue growth and innovation rates and the innovativeness and prominence of partners in their alliance portfolios (Stuart, 2000).

In sum, alliances with well-endowed partners that can endorse the firm and provide technological, financial, marketing, and human resources are expected to contribute to value creation, and thus enhance the market performance of the focal firm. The richer the firm's alliance portfolio in valuable network resources, the better its expected performance will be.

Hypothesis 1: The focal firm's market performance will be positively associated with the network resources possessed by partners in its alliance portfolio.

Value appropriation in alliance portfolios

The proliferating research on strategic networks has focused almost exclusively on the value-creation effects of alliances while overlooking value appropriation considerations. Scholars have long acknowledged that interfirm collaboration creates value by generating relational rents (Dyer and Singh, 1998), but only recently have they considered how these relational rents are appropriated by individual alliance partners (Dyer, Kale, and Singh, forthcoming; Lavie, 2006). Prior research that analyzed the asymmetric distribution of common and private benefits in alliances (Khanna *et al*., 1998) has underscored the incentives that such benefits provide for continued collaboration, but paid less attention to the antecedents of value appropriation. Similarly, empirical research that reveals asymmetry in the market returns of partners following alliance announcements has been conducted at the dyad level only (e.g., Gulati and Wang, 2003), and thus falls short of fully explaining value appropriation in alliance portfolios. The capacity of the focal firm to appropriate value

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from its alliance portfolio depends not only on the attributes of its partners, but also on the nature of the firm's relationships with these partners and the characteristics of the alliance portfolio as a whole. A firm whose alliance portfolio comprises a set of powerful partners may be unable to appropriate the benefits that its alliances produce (Bae and Gargiulo, 2004). The paradox is that prominent partners that stand to make a significant contribution to joint value creation may also be able to restrict the appropriation capacity of the focal firm, and consequently undermine its market performance.

The appropriation capacity of the focal firm depends in part on its relative bargaining power *vis-à-vis* partners in its alliance portfolio. Bargaining power is defined as the ability to favorably change the terms of agreements, to obtain accommodations from partners, and to influence the outcomes of negotiations (Yan and Gray, 1994). Because of the quasi-formal nature of alliances and the inherent incompleteness of alliance agreements, bargaining power matters not only at the alliance formation stage but also throughout the alliance life cycle, when market conditions change or underspecified agreement terms need to be renegotiated. Asymmetric rent appropriation can therefore be ascribed to partners' attempts to leverage their bargaining power *vis-à-vis* the focal firm and to extract a disproportional share of relational rents. The relative bargaining power of partners thus affects the distribution of rents in alliances (Hamel, 1991) and can reduce the focal firm's share of common benefits relative to its share in joint investments (Khanna *et al*., 1998). An alliance portfolio composed of partners with strong relative bargaining power increases the focal firm's investments while reducing its share of relational rents, thus negatively affecting its market performance.

Bargaining power derives from the interdependence between the focal firm and its partners (Pfeffer and Salancik, 1978). According to bargaining power theory (Bacharach and Lawler, 1984), bargaining power is based on two dimensions of interdependence: the stakes of the parties involved in the negotiation; and the availability of alternatives. In alliances, relative bargaining power derives from partners' stakes in the alliance portfolio and the availability of alternative alliances.

First, to the extent that the outcomes of alliances are more critical to the performance of the focal firm than to the performance of its partners, the partners enjoy strong bargaining positions. When the focal firm has a weaker bargaining position relative to partners in its alliance portfolio, this increases the stakes for the focal firm, which becomes more dependent on its alliances and their outcomes (Yan and Gray, 1994). According to Porter, 'the bargaining relationship with buyers and suppliers is reflected in both the configuration of a firm's value chain and how margins are divided with buyers, suppliers, and coalition partners' (Porter, 1985: 58). Consequently, the relative bargaining position of partners is manifested in their profit margins. Hence, high-margin partners can leverage their flexibility to negotiate favorable terms with the focal firm and attenuate its appropriation capacity, leading to negative performance implications for the focal firm.

Hypothesis 2a: The focal firm's market performance will be negatively associated with the relative profitability of partners in its alliance portfolio.

Second, the relative bargaining power of partners in the alliance portfolio derives from the set of alternatives available to them. To the extent that partners enjoy better access to alternative alliances than the focal firm does, they can obtain greater benefits outside the scope of their joint alliances with the firm. The option of reaching alternative arrangements for pursuing similar objectives with other firms improves partners' positions in negotiations with the focal firm. According to Yan and Gray (1994), the lower switching costs of such partners reduce their dependence on the firm and enhance their relative bargaining power *vis-à-vis* the firm. This idea is akin to Burt's (1983) notion of structural autonomy, wherein firms that face intense competition in their industry and transact with partners that operate in more concentrated industries are subject to constraints when pursuing their interests. This logic, while originally referring to the dynamics of bargaining among exchange partners, may also apply in the case of alliances, where the relative availability of alternatives determines the extent to which the firm depends on its partners. Hence, a firm with fewer alternative alliances relative to partners in its alliance portfolio enjoys less bargaining power and consequently

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weaker appropriation capacity, resulting in negative performance implications.

Hypothesis 2b: The focal firm's market performance will be negatively associated with the relative availability of alternative alliances to partners in its alliance portfolio.

The focal firm's appropriation capacity is expected to diminish with partners' attempts to leverage their relative bargaining power in negotiations with the firm. Hence, the negative performance implications of these attempts depend not only on the extent to which partners enjoy superior bargaining positions but also on their motivation to increase their relative share of relational rents. The motivation of partners to compete away the focal firm's share of relational rents derives from the level of bilateral competition in the alliance portfolio, that is, the extent to which partners can be considered competitors of the focal firm. An alliance portfolio featuring a high proportion of the firm's competitors is characterized by opportunistic and co-opetitive behavior (Brandenburger and Nalebuff, 1996), disputes, and considerable risk of undesirable leakage of resources, which may lead to spillover rents (Lavie, 2006). Bilateral competition encourages partners to increase their residual claims for relational rents instead of focusing on collaborative rent generation. Accordingly, prior research notes that competition between the focal firm and its partners increases the ratio of unilateral private benefits to collaborative common benefits (Khanna *et al*., 1998) and prompts partners to internalize the focal firm's intangible assets and improve their competitive positions *vis-à-vis* the firm (Hamel, 1991). Thus, bilateral competition stimulates partners' attempts to compete away the focal firm's share of relational rents.

Nevertheless, studies that have analyzed the performance implications of bilateral competition report mixed findings. Some note that bilateral competition increases alliance failure rates (Park and Russo, 1996) and reduces partners' revenues (Baum *et al*., 2000) and market returns (Balakrishnan and Koza, 1993; Chang and Chen, 2002), while others report positive effects on market returns (Koh and Venkatraman, 1991; Park and Kim, 1997). This perplexity can be resolved by acknowledging that bilateral competition provides the motivation, but not the capacity, for disproportional rent appropriation. An increase in the likelihood of disproportional rent appropriation in alliances does not reveal which party has the upper hand, and thus can extract a larger share of relational rent. This notion follows the fundamental psychology of relations (Heider, 1958), which recognizes that in addition to motivation ('try'), power and ability ('can') are required for action. Hence, even when partners in the alliance portfolio have incentives to compete away the focal firm's rents, they may lack the capacity to do so. If, however, they enjoy a strong relative bargaining power by virtue of their relative profitability or available alternatives, bilateral competition may impel them to leverage their bargaining positions and attenuate the firm's appropriation capacity. Alliance partners may have an inherent inclination to maximize their payoffs irrespective of bilateral competition (Khanna *et al*., 1998), but bilateral competition induces the motivation to restrict the firm's share of relational rents because it impels partners to view the bargaining situation as a zero-sum game rather than a positive-sum game. Thus, bilateral competition intensifies the negative performance implications of relative profitability and relative availability of alternatives to partners in the alliance portfolio.

Hypothesis 3a: The negative association between the focal firm's market performance and the relative profitability of partners in its alliance portfolio will intensify with increases in the level of bilateral competition.

Hypothesis 3b: The negative association between the focal firm's market performance and the relative availability of alternative alliances to partners in its alliance portfolio will intensify with increases in the level of bilateral competition.

Notwithstanding the above, competition in the alliance portfolio can enhance the focal firm's appropriation capacity insofar as it emerges among partners rather than between the firm and its partners. This is illustrated in the following statement of an alliance manager whom I interviewed:

> I am working with IBM, BEA and Microsoft. Each one of them has a lead product in this interactive development environment. All compete head-to-head with each other, and we work with all three of them as strategic partners. This brings greater value to us.

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The extent to which partners in the alliance portfolio are considered direct competitors of each other can be referred to as *multilateral competition*.[2] Multilateral competition evolves when the focal firm allies with multiple partners that operate in the same product markets or offer similar services, and thus play a similar role in its alliance portfolio. Prior research has indicated that an alliance portfolio that provides access to redundant partners is inefficient and may therefore limit the focal firm's growth prospects (Baum *et al.*, 2000). This approach, however, is strictly concerned with value creation. While multilateral competition may introduce redundancies to the alliance portfolio, it can also enhance the firm's value appropriation capacity by producing brokerage benefits and attenuating opportunistic behavior of partners.

Specifically, multilateral competition leads partners to compete for the focal firm's business, resources, and attention, enabling the firm to arbitrate among partners and control the flow of assets and information in its alliance portfolio. This is somewhat akin to Burt's (1992) notion of brokerage benefits, except that the broker in this case does not foster mediated transactions between disconnected partners, but instead can play partners against each other. Multilateral competition allows the focal firm discretion in allocating resources to competing alliances and in choosing partners for pursuing particular collaborative initiatives. The flexibility to juggle among competing partners enables the firm to exercise control and focus on those alliances that provide more favorable terms, and consequently increase its relative share of relational rents.

Additionally, multilateral competition reduces the likelihood that partners will behave opportunistically. Prior research has shown that opportunistic behavior by partners negatively affects alliance performance (Parkhe, 1993). However, the presence of multiple competing partners in the focal firm's alliance portfolio establishes a large-numbers exchange condition that attenuates the hazards of opportunistic behavior (Williamson, 1975). This condition ensures that partners' opportunistic behavior would not pay off, since the focal firm's other partners can offer similar benefits, thus creating viable alliance exit options for the firm. Taken together, the brokerage benefits and the favorable exchange conditions entailed by multilateral competition enable the focal firm to appropriate a larger share of relational rents from its alliance portfolio. Hence, at higher levels of multilateral competition in the alliance portfolio, the focal firm enjoys a stronger appropriation capacity that may contribute to its market performance.

Hypothesis 4: The focal firm's market performance will be positively associated with the level of multilateral competition among partners in its alliance portfolio.

Nevertheless, the firm's favorable position in an alliance portfolio rich in competing partners does not necessarily warrant that the firm *will* leverage this competitive situation. For example, a vice president of corporate alliances, whom I interviewed, noted:

> For us to position ourselves to play multiple partners against each other where we are not the market leader would cause unrecallable damage to our reputation as a partner. We cannot afford to do that just to win tactical engagements.

Hence the firm's tendency to leverage multilateral competition depends, at least in part, on its status and relative bargaining power. In the same vein, the negative performance implications of partners' relative bargaining power can be attenuated by leveraging multilateral competition.

As previously noted, to the extent that partners are more profitable than the focal firm, they are less dependent on their joint alliances with that firm (Yan and Gray, 1994). Relative profitability provides partners with favorable bargaining positions in negotiations with the firm, yet when the firm allies with multiple partners in the same industry the competition among these partners increases their dependence on their alliances with the focal firm. Thus multilateral competition can attenuate the negative performance implications of the firm's dependence on relatively profitable partners.

[2] The notion of multilateral competition differs from relative bargaining power. Relative bargaining power derives from the dyadic bargaining situation between the focal firm and each of its partners. In contrast, multilateral competition does not entail direct negotiations with the firm and is conceptualized instead based on the similarity in industry focus of partners, irrespective of the firm's position. In addition, multilateral competition differs from the notion of structural equivalence (Burt, 1976), which refers to similarity in partners' market transactions with actors in other industry sectors. Whereas structural equivalence considers whom partners are tied to, multilateral competition takes into account the industries in which partners compete, regardless of their ties to other partners.

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In addition, multilateral competition influences the value of alternative alliances. By definition, the relative availability of alternative alliances to a partner is negatively related to the number of other partners in the focal firm's alliance portfolio. However, when these other partners operate in industries different from that of the partner in question, the firm's capacity to leverage its multiple alliances in negotiations with that partner is limited. The question of interest here concerns the extent to which the available alliances are indeed substitutes. The various alliances in the focal firm's portfolio are more likely to substitute for each other when they are formed with partners that operate in the same industries. Thus, from the perspective of the focal firm, multilateral competition increases the opportunity value of its other alliances. The substitution among the focal firm's alliances, which derives from multilateral competition, can therefore compensate for the limited number of alternative alliances available to the firm relative to the number of alternative alliances available to its partners. In sum, multilateral competition can restrict the decline in market performance attributed to the relative bargaining power of partners in the firm's alliance portfolio.

Hypothesis 5a: The negative association between the focal firm's market performance and the relative profitability of partners in its alliance portfolio will be weakened with increases in the level of multilateral competition.

Hypothesis 5b: The negative association between the focal firm's market performance and the relative availability of alternative alliances to partners in its alliance portfolio will be weakened with increases in the level of multilateral competition.

RESEARCH METHODS

Research setting and sample

The theoretical framework is summarized in Figure 2. The hypotheses were tested with comprehensive panel data on the alliance portfolios of firms operating in the U.S. software industry (SICs 7371 through 7374). I selected this setting for several reasons. First, the software industry has experienced dynamic and extensive alliance activity (see Figure 1). The practice of engaging in multiple simultaneous alliances in this industry enhances the meaningfulness, reliability, and variance of alliance portfolio variables. Second, this industry features a high proportion of publicly traded firms with accessible financial data, thus increasing the representativeness of the sample and reducing potential size- and age-related biases that can emerge when young and small firms are underrepresented. Finally, the sample is highly representative, since U.S. firms account for nearly half of the worldwide software market (Rudy, 2000).

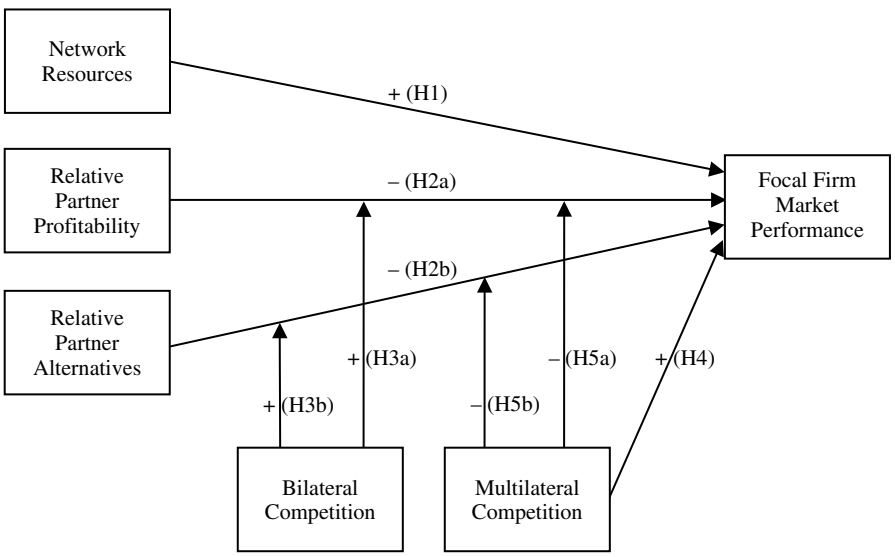

Figure 2. Theoretical framework and hypotheses

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I designed the study as a pooled time-series analysis spanning the years 1990–2001, yet tracked historical alliances back to the year 1985 in order to ensure the coverage of active alliances. This 5-year window followed conventional assumptions in alliance network research (Stuart, 2000). The sample included the 367 U.S.-based software firms that were listed as publicly traded in 2001 and that had at least five annual records in the Compustat database. The exclusion of firms with fewer than five records during the study's time frame is justified by the longitudinal nature of the analysis. Specifically, the inclusion of firm fixed effects in this analysis is essential to control for unobserved heterogeneity and potential endogeneity in the panel data, but it can produce biased estimates when the sample period is too short (Gulati, 1995b; Hsiao, 1986). Therefore, a minimum number of observations per firm is required. Nevertheless, I found no significant differences between the 367 sampled firms and the remaining 297 publicly traded firms in this industry that had less than five years of records, were inactive in 2001, or were headquartered in foreign countries.[3] In addition, since five firms had no alliances during the study's time frame and certain firms had no active alliances in certain years, I tested the implications of self-selection bias in firms' decisions to engage in alliances with a two-stage Heckman procedure, which produced results that were consistent with the reported findings. Furthermore, survivor bias is unlikely given the poor performance of the sampled firms. For example, their return on assets monotonically declined by 35 percent annually on average between 1990 and 2001. In addition, 52 percent of the sampled firms divested parts of their business or were acquired between 2001 and 2005. Hence, there is no reason to believe that the sampled firms were better performing or differed significantly from other firms in their industry.

Data collection

Following Anand and Khanna (2000b), I first compiled records of alliances formed by each focal firm between 1985 and 2001 from the SDC Platinum database. In order to ensure complete coverage of publicly announced alliances, I complemented and corrected the SDC data by searching alliance announcements and status reports in the Factiva database (over 8,000 news sources worldwide), press releases, and alliance listings posted on corporate web sites, as well as SEC filings accessed via the Edgar database. Most alliance announcements were cross-validated by at least two independent sources. Following this corroboration, I added, eliminated, or corrected alliance records and made additional corrections based on a corporate history search that tracked name changes, mergers, acquisitions, and spin-offs involving each focal firm and its identified partners. In total, I identified 20,779 alliances, of which only 5,135 were reported in SDC. The identified alliances involved 8,801 unique partners, with 2,884 publicly traded partners accounting for 66 percent of the alliances.[4] A focal firm participated in 56.70 alliances on average during the time frame of the study.

For each alliance, I coded the date of announcement, pre-specified duration or termination date,[5] number of participating partners, partners' names, public status and countries of origin, indication of the strategic significance of the alliance, whether

[3] For example, no significant differences were found in terms of total assets ($t = 1.430$, $p = 0.152$), net sales ($t = 0.525$, $p = 0.600$), number of employees ($t = 0.274$, $p = 0.785$), net income ($t = 1.481$, $p = 0.139$), cash ($t = 1.505$, $p = 0.133$), long-term debt ($t = 0.066$, $p = 0.947$), stock price ($t = 1.273$, $p = 0.204$), and other indicators.

[4] Whereas the lack of financial information for privately held partners did not affect variables that measured the type of alliance, the size of the alliance portfolio, and network structure, variables that relied on financial measures could be calculated more accurately for firms with higher proportions of publicly traded partners in their alliance portfolios. However, this potential effect was controlled for by including a measure of the percentage of publicly traded partners in the portfolio. In order to assess the differences between the public partners and private partners, I empirically contrasted these two subsamples, finding that, compared with private partners, public partners engaged in more strategic long-term alliances and favored joint ventures and technology alliances rather than marketing alliances.

[5] Alliance termination dates were unavailable for many alliances, since firms rarely announce alliance termination and occasionally maintain inactive alliances. To the extent that the date of alliance termination was unavailable from archival sources, it was calculated based on alliance extension announcements and reports of active alliance status in a given year. Remaining alliances were assumed to have a 3-year duration based on the average specified duration of other alliances in the sample as well as assessments of industry experts whom I interviewed. Alliance termination dates were imputed for 67 percent of the alliances. The imputation of alliance termination dates is a conventional practice in alliance research. For example, Stuart (2000) imputed 5-year duration for all alliances using a linear depreciating weighting for alliances with an earlier date of formation. In this study, I was able to reduce the use of imputation by searching alliance status reports and recording alliance termination dates when available. The impact of the age of alliances in the portfolio was measured separately with a control variable.

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the alliance was a joint venture, and its classification to agreement types: licensing, manufacturing, sales and service, OEM and value-added resale, R&D, royalties, and supply. A given alliance could involve more than one type of agreement.

I extracted firm-specific and partner-specific data, such as historical SIC code, number of employees, total assets, long-term debt, R&D expenses, and net income, annually from Compustat for the years 1990–2001. I converted all the financial data to billion U.S. dollar units. I further extracted data on common shares outstanding and stock prices from the joint CRSP database and data on S&P 500 stock market value from the CRSP Indices database.

Since the firm-year was considered the operational unit of analysis, I pooled the data on the 20,779 alliances across all alliances in each focal firm's portfolio in a given year, producing 2,595 firm-year observations. This sample excluded pre-1990 and year-2001 records, which were eliminated because of the time frame setting and the lagging of independent variables by one year relative to the dependent variable. This one-year lag was necessary in order to allow for causal interpretation of the findings (Stuart, 2000). The final sample included 1,822 observations after listwise deletion was applied to treat missing values. Missing values occurred, for instance, because firms were not required by SEC regulations to report R&D and advertising investments and because stock market prices were available only for the years in which firms were publicly traded.

Most of the firms in this sample operated in the pre-packaged software segment (SIC 7372, 68.7%) or the computer integrated system design segment (SIC 7373, 23.5%), with a few firms engaging in computer processing and data preparation services (SIC 7374, 4.7%) or computer programming services (SIC 7374, 3.1%). On average, a focal firm owned $412 million in assets, had $304 million in annual sales, employed 1,730 employees, and spent $38.4 million annually on R&D and $8.5 million on advertising. In addition, it had $58 million in cash, and achieved a −24 percent return on assets with a $1,068 million market value. On average, focal firms were in business for 14 years and maintained a network of 15.7 partners. Partners came primarily from the business services industry (SIC 73, 52.3%), the industrial, commercial, and computer equipment industry (SIC 35, 18.1%), electronics (SIC 36, 9.4%), or communications (SIC 48, 4.1%), or from 56 other industries. On average, a partner owned $4,749 million in assets, had $2,252 million in annual sales, employed 8,500 employees, spent $60 million annually on R&D and $36 million on advertising, and had $210 million in cash.

Dependent variable: Market performance

I used market performance as the dependent variable to overcome the recognized limitations of accounting measures of performance. These measures often discount firms' intangible assets (Brush, Bromiley, and Hendrickx, 2000), which are pervasive in the software industry. Indeed, the mean Tobin's q—a proxy for intangible assets—of the sampled firms reached 2.9, with values higher than 1 indicating a high proportion of intangible assets. In addition, accounting performance measures are somewhat distant from alliance activities because of potential intervening and confounding firm-level factors, which may account for the insignificant direct effects of alliances on firm profitability observed in some prior studies (Berg *et al*., 1982; Hagedoorn, 1993). Finally, my auxiliary analyses revealed that market performance models have stronger explanatory power than alternative models based on dependent variables such as return on sales and Tobin's q.

I calculated the market performance measure for each focal firm, capturing the annual change in the market value of the firm's common shares. This is a financial measure based on investors' expectations about the future performance of the firm. The market value is typically calculated by multiplying the firm's stock price by the number of common shares outstanding. Because of the high volatility of this measure, I calculated the annual market value by averaging the 12 end-of-month daily values of the relevant calendar year. In order to control for stock market fluctuations and temporal trends (see Figure 3), I adjusted the measure by dividing it by the ratio of the compound S&P 500 market value at year t to the compound S&P 500 market value at the year 1990.[6] Thus, the adjusted market value of firm i's common shares at time $t + 1$ took the following form:

[6] An alternative model that incorporated the compound software industry market value index (SICs 7371–7374) instead of the compound S&P 500 index generated similar results.

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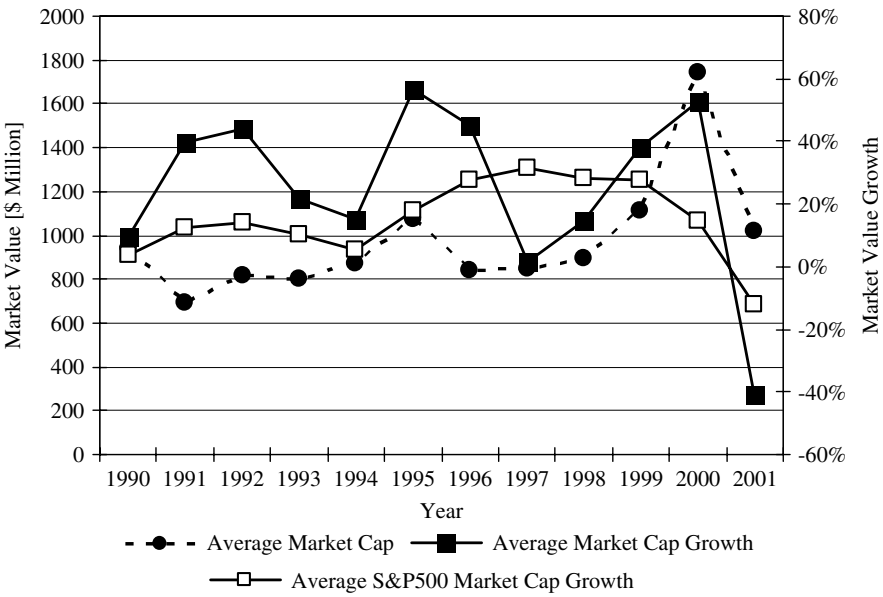

Figure 3. Market performance of firms in the U.S. software industry, 1990–2001

$$\text{Market value}_{i,t+1} = (\text{S\&P 500 market value}_{1990}/\text{S\&P 500 market value}_{t+1}) \times \left(\sum_{m=1}^{12} \text{Stock price}_{i,t+1,m} \times \text{Outstanding shares}_{i,t+1,m}/12\right)$$

I calculated the annual change in market value by dividing the adjusted market value at year $t + 1$ by the adjusted market value at year t. Following prior research (Brush *et al*., 2000; Podolny, Stuart, and Hannan, 1996; Stuart, 2000), I log-transformed this ratio to achieve the desirable statistical properties under the linearity, homoskedasticity, and independence assumptions. Hence, if $\mathbf{x}_{i,t}$ is a covariate matrix, then the change in market value can be expressed by the following power function:

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

In this model, all variables are annually updated and lagged by one year relative to the dependent variable. When estimated with OLS regression, this model produces efficient and unbiased estimates. Another advantage of this specification is the embedded control for past performance, which enables the interpretation of causal effects of the independent variables on market performance.

Independent variables and moderators

Network resources

A set of five variables measured the network resources of partners in the alliance portfolio. *Technology network resources* were measured as the mean value of R&D investments of partners in the focal firm's alliance portfolio. Similarly, *marketing network resources* were proxied by the mean value of advertising investments of partners, *financial network resources* were calculated based on the mean value of cash funds available to partners, and *human network resources* indicated the mean number of employees of partner organizations (reported in 100Ks). The underlying assumption is that even if these resources are not fully shared with the focal firm, they may be accessible through the firm's ties to its partners (Lavie, 2006). The incorporation of the number of employees as an independent variable also controls for the size of partners in the firm's alliance portfolio. Finally, I measured *network prominence* as the percentage of publicly traded partners in the focal firm's alliance portfolio. Publicly traded partners typically play the role of prominent endorsers that are well known to, and frequently appreciated by, the investor community, suppliers, and customers.

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Relative profitability

The relative profitability variable measured the mean difference between the return on assets (ROA) of partners in the alliance portfolio and the focal firm's ROA in a given year, using the formula:

$$[\sum_{j=1}^{K_{i,t}}(\mathrm{ROA}_{j,t}/K_{i,t})] - \mathrm{ROA}_{i,t}$$

where $K_{i,t}$ is the number of partners in firm i's portfolio in year t. This variable represents the relative bargaining power of partners based on the profitability of partners relative to the profitability of the focal firm. Higher values of this variable suggest that partners in firm i's alliance portfolio are less dependent on the outcomes of alliances relative to that firm.[7]

Relative alternatives

The relative alternatives variable captures the structural dependence of the focal firm on its alliance portfolio, under the assumption that partners with many alternative ties to other firms in the software industry hold strong bargaining positions. I calculated this variable as a function of the ratio of each partner's number of alliances with other focal firms to the number of alliances that each focal firm had with other partners, averaged across partners in the firm's alliance portfolio in a given year:

$$\sum_{j=1}^{K_{i,t}} \ln\left(\frac{K_{j,t} - K_{i,t,j}}{K_{i,t} - K_{i,t,j}}\right)/K_{i,t}$$

where $K_{j,t}$ is the total number of alliances between partner j and all the focal firms in year t, and $K_{i,t,j}$ is the number of alliances between focal firm i and partner j in year t. Higher values of this variable suggest that partners in the alliance portfolio have relatively more alternatives than the focal firm.

Bilateral competition

I calculated the level of competition between the focal firm and partners in its alliance portfolio as the percentage of matches between the firm's primary industry segment (four-digit SIC) and the primary industry segments of its partners, taking the form $\sum_{j=1}^{K_{i,t}} m_{i,t,j}/K_{i,t}$, where $m_{i,t,j}$ is a dummy receiving a value of 1 when the SIC of firm i matches that of partner j in year t.

Multilateral competition

Assuming that competition among partners intensifies with the degree of similarity in their business portfolios, this variable was operationalized as the sum of squared proportions of partners' sales in each industry segment. This is a concentration measure that resembles the inversed Berry–Herfindahl diversification index (Montgomery, 1982), except that it is based on the sales distributions of partners rather than on those of the focal firm. It takes the form:

$$\sum_{c=1}^{C_{i,t}} p_{i,t,c}^2, \text{ with } p_{i,t,c} = \sum_{j=1}^{K_{i,t,}} s_{j,t,c} / \sum_{j=1}^{K_{i,t,}} \sum_{c} s_{j,t,c}$$

where $s_{j,t,c}$ measures partner j's sales in four-digit primary SIC code c in year t. For instance, if all of the firm's partners generate their sales in the same industry, this measure receives a value of 1, and if each partner specializes and therefore extracts equivalent revenues from a unique industry, this measure becomes proportional to the inverse of the number of industries in which partners compete.

Control variables

I controlled for interindustry variation by focusing on the analysis of a single industry and for inter-temporal trends and shocks by standardizing the dependent variable by the S&P 500 stock market index. The remaining controls included firm-level and portfolio-level variables that I lagged by

[7] An alternative measure of bargaining power based on the relative size of the focal firm and its partners was abandoned since it cannot discriminate between the value-creation effect of network resources and the value-appropriation effect of bargaining power. Moreover, software firms are typically specialized and rely on intangible assets that are not captured in conventional organizational size measures (as indicated by the high value of Tobin's q). This may introduce a systematic bias when relative size is used as a proxy for bargaining power. For example, the mean value of the total assets of partners was more than ten times that of the focal firms, and clearly does not reflect the relatively strong bargaining position of software firms. Moreover, according to Porter (1980: 24, 1985: 6), bargaining power in exchange transactions derives from a variety of factors, one of which is the volume of the transaction relative to the overall sales of the seller or the overall purchases of the buyer. This is not equivalent to the relative size of the partners involved in the bargaining situation, but instead captures their mutual dependence, which more directly derives from the perceived importance of the transaction and the availability of alternatives.

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one year relative to the dependent variable. Annually updated, firm-level controls included *firm size*, measured as the focal firm's total asset value, and *firm R&D intensity*, measured as the firm's R&D investments divided by its net sales. I controlled for all remaining interfirm heterogeneity by including firm fixed effects, thus separating the impact of alliance portfolios from other firm activities that may influence market performance.

I controlled for the size of the alliance portfolio, which may positively affect firm performance (Ahuja, 2000; Baum *et al*., 2000; Stuart *et al*., 1999). Because of the correlation between the number of alliances and firm size ($r = 0.73$, $p < 0.001$) and the inherent association between these two variables (Hagedoorn and Schakenraad, 1994), I adjusted the *portfolio size* variable by taking the logarithm of the number of alliances divided by the total assets of the focal firm. Additional controls included *portfolio age*, measured as the average age of alliances in the firm's alliance portfolio, which I introduced in order to control for the alliance life cycle. *Multi-partner alliance* measured the average number of partners involved in each of the firm's alliances, assuming that multi-partner alliances entail more complex management. *Portfolio internationalization* measured 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 and language and time zone differences, or because of the increased possibility of government intervention.

Another set of variables controlled for relational aspects of the firm's ties with partners in its alliance portfolio (Granovetter, 1985; Uzzi, 1996). *Technology agreements* measured the proportion of R&D and manufacturing agreements with partners, while *marketing agreements* captured the proportion of joint sales and service, OEM, value-added resale, and supply agreements with partners. The assumption is that the former type of agreements entail greater interdependence and interaction with partners than the latter (Rowley *et al*., 2000). *Tie multiplicity* controlled for another relational aspect by measuring the average standardized number of simultaneous categories of agreements signed in a given alliance. *Joint ventures* measured the proportion of equity-based joint ventures out of the total number of alliances in the firm's portfolio, in order to control for the governance mode of alliances. Finally, the *strategic status* control measured the proportion of alliances that were referred to as 'strategic' in press releases, and to which the firm may be inclined to commit more resources.

A final set of variables controlled for structural aspects of the alliance portfolio. Since information about possible ties among the 8,479 non-focal partners was unavailable, I considered the subset network of ties among the 367 focal firms when calculating these measures. *Structural holes* controlled for the resource access and brokerage benefits derived from a sparse network structure, in which the focal firm bridges otherwise disconnected partners (Burt, 1992). This measure was computed as the inverse of the network constraint measure using the structural holes procedure in UCINET (Borgatti, Everett, and Freeman, 2002; Zaheer and Bell, 2005). *Network closure* controlled for the social norms and sanctions that may enforce collaboration in dense network structures (Coleman, 1988, 1990). I computed this measure using the ego network density procedure in UCINET (Bae and Gargiulo, 2004; Borgatti *et al*., 2002), which provides the ratio of observed to maximum alliances possible among firms in the network.

Analysis

I report descriptive statistics in Table 1, which details the means, standard deviations, and pairwise correlations of the variables. Variance inflation factors were considerably lower than the critical value, ruling out potential multicollinearity. Analysis of the unbalanced panel data was carried out using cross-section time-series regressions with firm fixed effects. Fixed-effects models incorporate superior controls for time-invariant variables and are thus preferred to random-effects models that may produce biased estimates (Mundlak, 1978). The inclusion of fixed effects suggests that the reported models explain within-firm variation in firm performance over time, rather than interfirm variation in performance. I treated potential autocorrelation by incorporating first-order autoregressive errors in the models, assuming correlation of errors across adjacent years. I also tested contemporaneous correlation across firms in the panel data and ruled it out because of insignificance. Thus, the models took the form:

$$\begin{aligned} \boldsymbol{y}_{i,t} &= \alpha + \beta \boldsymbol{x}_{i,t} + u_i + \varepsilon_{i,t}, \text{ with } \varepsilon_{i,t} \\ &= \rho \varepsilon_{i,t-1} + \mu_{i,t} \text{ and } -1 < \rho < 1 \end{aligned}$$

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Table 1. Sample statistics and correlation matrix

Variable name	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
1. Log adj. market value$_{t+1}$	1.00																							
2. Log adj. market value$_t$	0.94	1.00																						
3. Firm size	0.41	0.45	1.00																					
4. Firm R&D intensity	−0.06	−0.05	−0.02	1.00																				
5. Portfolio size	−0.56	−0.64	−0.29	0.11	1.00																			
6. Portfolio age	−0.07	−0.07	0.03	−0.05	−0.09	1.00																		
7. Multi-partner alliance	0.26	0.27	0.13	−0.02	−0.07	−0.02	1.00																	
8. Portfolio internationalization	−0.02	−0.01	0.00	−0.01	−0.02	0.03	0.02	1.00																
9. Technology agreements	0.16	0.16	0.02	0.03	0.01	−0.02	0.10	−0.04	1.00															
10. Marketing agreements	−0.11	−0.12	−0.04	−0.05	−0.01	−0.03	−0.07	0.03	−0.71	1.00														
11. Tie multiplicity	0.06	0.05	−0.01	0.01	−0.04	0.03	0.03	0.09	0.39	0.12	1.00													
12. Joint ventures	0.03	0.03	0.06	−0.02	−0.07	0.12	0.11	0.17	0.00	0.06	0.04	1.00												
13. Strategic status	0.25	0.26	0.11	−0.01	−0.11	−0.01	0.15	−0.01	0.18	−0.07	0.28	−0.08	1.00											
14. Structural holes	0.02	0.02	−0.01	0.04	0.12	−0.05	−0.06	−0.03	−0.01	0.00	−0.06	−0.07	−0.11	1.00										
15. Network closure	0.01	0.01	0.00	0.05	0.04	−0.03	−0.04	−0.02	0.00	0.01	−0.02	−0.02	−0.07	0.42	1.00									
16. Technology network resources	−0.08	−0.09	−0.04	0.01	0.03	0.11	−0.02	0.07	0.01	−0.05	−0.04	−0.04	−0.09	−0.02	0.00	1.00								
17. Marketing network resources	−0.10	−0.10	−0.03	−0.01	−0.10	0.21	−0.03	0.18	0.01	−0.04	0.04	−0.06	−0.09	−0.03	0.00	0.43	1.00							
18. Financial network resources	0.00	−0.02	0.02	−0.01	−0.02	0.12	0.00	0.14	0.00	−0.02	0.00	−0.02	−0.08	−0.02	−0.01	0.79	0.42	1.00						
19. Human network resources	−0.03	−0.05	−0.01	−0.01	0.04	0.07	0.01	0.11	0.02	−0.03	0.00	−0.02	0.00	−0.04	−0.01	0.87	0.38	0.70	1.00					
20. Network prominence	0.05	0.03	0.01	−0.01	0.06	−0.03	0.02	−0.10	0.11	−0.04	0.14	0.06	0.08	−0.02	0.00	0.08	−0.01	0.05	0.13	1.00				
21. Relative profitability	−0.34	−0.32	−0.09	0.19	0.43	−0.03	−0.06	0.04	−0.05	0.03	−0.02	0.00	−0.05	0.05	0.01	0.01	0.00	0.02	−0.03	−0.05	1.00			
22. Relative alternatives	−0.12	−0.15	−0.10	−0.01	0.12	−0.05	−0.07	−0.19	0.07	−0.04	0.02	−0.05	0.03	0.01	0.03	0.30	0.06	0.22	0.29	0.59	−0.03	1.00		
23. Bilateral competition	0.09	0.11	−0.02	0.02	0.08	−0.06	−0.01	−0.11	0.14	−0.08	0.03	−0.12	0.01	0.04	0.03	−0.22	−0.12	−0.15	−0.24	−0.10	−0.06	−0.01	1.00	
24. Multilateral competition	−0.33	−0.38	−0.23	0.03	0.19	−0.09	−0.19	−0.15	−0.05	0.06	−0.01	0.02	−0.03	0.01	0.00	0.01	−0.08	−0.03	0.04	0.15	0.06	0.34	0.01	1.00
N	2226	2056	2310	2068	2595	2595	2595	2593	2595	2595	2595	2595	2595	2595	2595	2291	1829	2387	2360	2595	2133	2595	2445	2389
Mean	3.74	3.85	0.41	0.39	−0.83	1.82	2.15	0.17	0.48	0.70	0.06	0.04	0.31	0.26	0.11	0.97	0.45	1.19	0.54	0.75	0.18	−2.09	0.25	0.63
Standard deviation	2.10	1.99	2.01	1.89	3.29	0.63	0.59	0.21	0.32	0.28	0.06	0.14	0.3	0.34	0.25	1.01	0.51	1.30	0.63	0.21	0.66	3.80	0.30	0.34

Coefficients larger than 0.045 in absolute value are significant at the 5% level.

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where u_i represents the firm fixed effects and ρ is the autoregressive AR(1) parameter that has a zero mean, homoskedastic and serially uncorrelated error term $\mu_{i,t}$. I tested the models using the MIXED procedure in SAS, which relies on maximum likelihood estimation. The lag structure, the control for past performance, and the incorporation of firm fixed effects and a first-order autoregressive coefficient in the model increase confidence in the causal interpretation of the findings.

The analysis followed a hierarchical approach in which I introduced independent variables and moderators in subsequent models. I based hypothesis testing on the results of the full model (Model 7). Missing values were treated with listwise deletion, which accounts for the variation in sample sizes across models. I used log-likelihood ratio tests to assess the improvement in model fit by comparing each model to the adjusted baseline model, which included only the controls and fixed effects, discarding the observations missing in the partial or full models.

RESULTS

I report the findings in Table 2. Based on the full model (Model 7), the firm's market performance declines with increases in the proportion of foreign partners in the alliance portfolio as indicated by the portfolio internationalization effect ($\beta = -0.55$, $p < 0.001$). This finding may be ascribed to cultural and organizational differences, geographical distance, or communication and learning challenges that are typical of cross-border alliances (Barkema *et al.*, 1997; Parkhe, 1991; Simonin, 1999) and may impede value creation and eventually impair the firm's market performance. Additionally, the firm's market performance is positively related to tie multiplicity ($\beta = 2.14$, $p < 0.01$), which captures the number of distinctive types of agreements signed in the course of a given alliance. This finding is consistent with the relational embeddedness perspective (Granovetter, 1985; Powell, 1990; Uzzi, 1996), wherein strong or rich ties to partners promote interfirm trust and norms of reciprocity that may facilitate the exchange of valuable knowledge and information between the firm and its partners. The structural holes and network closure controls produced no significant effects. According to recent research, however, it is possible that the effects of network structure depend on firm- or partner-specific factors (Bae and Gargiulo, 2004; Shipilov, 2006; Zaheer and Bell, 2005).[8]

Hypothesis 1 is partially supported by the results of Model 7. In accordance with this hypothesis, the marketing and financial network resources possessed by the firm's partners enhance its market performance ($\beta = 0.15$, $\beta = 0.09$ respectively, $p < 0.01$). Similarly, the prominence of partners in the alliance portfolio is positively related to market performance ($\beta = 0.48$, $p < 0.01$). However, human network resources do not enhance market performance, whereas technology network resources produce a marginally significant negative effect ($\beta = -0.09$, $p < 0.1$).

In support of Hypothesis 2, Model 7 reveals negative effects of relative partner profitability ($\beta = -0.40$, $p < 0.001$) and relative partner alternatives ($\beta = -0.09$, $p < 0.05$) on market performance. Hence, alliance portfolios that feature partners that are less dependent on the outcomes of alliances and enjoy better access to other alliances relative to the focal firm are detrimental to the firm's market performance. The negative effect of relative partner profitability intensifies with the level of competition between the focal firm and its partners as indicated by the significant moderating effect of bilateral competition ($\beta = -0.30$, $p < 0.05$). However, the moderating effect of bilateral competition on the association between relative partner alternatives and market performance is insignificant. Thus, Hypothesis 3a is supported by the data, whereas Hypothesis 3b is not.

Consistent with Hypothesis 4, the firm's market performance is enhanced with the level of multilateral competition among partners in its alliance portfolio ($\beta = 0.42$, $p < 0.01$). In addition, multilateral competition weakens the negative effects of relative partner profitability ($\beta = 0.29$, $p < 0.05$) and relative partner alternatives ($\beta = 0.07$, $p < 0.05$). Hence, in support of Hypotheses 5a and 5b,

[8] In auxiliary analysis I incorporated alternative structural holes and network closure measures corresponding to the global network of ties with both focal and non-focal partners. In this analysis, structural holes negatively affected market performance ($\beta = -0.66$, $p < 0.01$), whereas network closure had a marginal positive effect ($\beta = 0.44$, $p < 0.1$). All of the main effects and interactions remained significant in the full model with the exception of multilateral competition and its interaction with relative partner alternatives. In addition, I examined models that control for either structural holes or network closure, excluding the other measure in turn. The effects of these controls were insignificant, with all the main effects and interactions retaining their levels of significance.

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Table 2. Fixed effects panel AR(1) models for market performance

Dependent variable: Log adj. market value$_{t+1}$	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	1.76	0.39	0.32	0.35	0.37	0.23	0.04	0.51
Firm fixed effects	Included	Included	Included	Included	Included	Included	Included	Included
Log adj. market value$_t$	0.61***	0.60***	0.59***	0.59***	0.58***	0.59***	0.59***	0.58***
Firm size	−0.04†	−0.03	−0.03	−0.03	−0.03	−0.02	−0.02	−0.02
Firm R&D intensity	−0.03	−0.04*	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02
Portfolio size	−0.09***	−0.06*	−0.02	−0.02	−0.02	−0.00	−0.00	0.01
Portfolio age	−0.04	−0.07†	−0.08†	−0.08†	−0.07†	−0.05	−0.04	−0.02
Multi-partner alliance	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.05
Portfolio internationalization	−0.29**	−0.51***	−0.54***	−0.54***	−0.53***	−0.51***	−0.55***	−0.67***
Technology agreements	−0.08	−0.34†	−0.24	−0.24	−0.27	−0.26	−0.22	−0.07
Marketing agreements	−0.11	−0.40†	−0.33	−0.33	−0.33	−0.34	−0.30	−0.23
Tie multiplicity	1.16*	2.42**	2.28**	2.28**	2.21**	2.25**	2.14**	1.68*
Joint ventures	0.24	0.41	0.31	0.30	0.35	0.28	0.38	0.13
Strategic status	0.04	0.05	0.04	0.04	0.07	0.04	0.05	−0.03
Structural holes	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.06
Network closure	0.02	0.04	0.05	0.05	0.04	0.04	0.05	0.03
Technology network resources		−0.12*	−0.11†	−0.11†	−0.11†	−0.10†	−0.09†	−0.06
Marketing network resources		0.10*	0.10*	0.10*	0.11*	0.13**	0.15**	0.12*
Financial network resources		0.09**	0.09**	0.09**	0.09**	0.09**	0.09**	0.08*
Human network resources		0.11	0.13	0.12	0.12	0.10	0.12	0.10
Network prominence		0.15	0.35*	0.35*	0.38*	0.39*	0.48**	0.46**
Relative partner profitability			−0.29***	−0.29***	−0.22***	−0.22***	−0.40***	−0.40***
Relative partner alternatives			−0.02†	−0.02†	−0.02	−0.02†	−0.09*	−0.10**
Bilateral competition				0.04	−0.09	−0.09	−0.06	−0.05
Bilateral competition × Relative partner profitability					−0.33*	−0.33*	−0.30*	−0.29†
Bilateral competition × Relative partner alternatives					−0.04	−0.03	−0.03	−0.04
Multilateral competition						0.22**	0.42**	0.38**
Multilateral competition × Relative partner profitability							0.29*	0.30**
Multilateral competition × Relative partner alternatives							0.07*	0.08*
Probability of non-missing values								−0.68***
Number of firm-years	1822	1346	1343	1343	1343	1343	1343	1343
Number of firms	331	301	300	300	300	300	300	300
Autocorrelation coefficient AR(1)	−0.06	−0.141	−0.13	−0.13	−0.13	−0.13	−0.13	−0.11
−2 Log-likelihood	3251.6	2388.0	2330.1	2330.0	2323.9	2315.0	2304.6	2293.2
Adjusted $\Delta - 2LL$ ($n = 1343$)		21.3***	72.4***	72.5***	78.6***	87.5***	97.9***	109.3***
Pseudo R^2	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93

$^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

the negative performance implications of partners' sources of bargaining power are attenuated by the extent to which partners in the firm's alliance portfolio compete against each other.

Overall, the explanatory power of the full model reached 93 percent, which is typical of fixed-effects models. The contribution of value-creation variables to a firm's market performance based on the improvement in goodness of fit of Model 2 relative to Model 1 after adjusting for sample size suggests that some network resources significantly contribute to a firm's market performance ($\chi^2_{df=5} = 21.3$, $p < 0.001$). However, the contribution of value appropriation variables to the

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explanatory power of the model is even greater ($\chi^2_{df=8} = 83.4$, $p < 0.001$) as revealed by the comparison between Model 7 and Model 2. Based on Model 7, an auxiliary analysis revealed that with respect to the value-creation variables a one standard deviation increase in marketing network resources improves the firm's adjusted market value by 7.8 percent, while a similar increase in financial network resources leads to a 10.7 percent increase in adjusted market value. In addition, a one standard deviation increase in network prominence increases the adjusted market value by 9.2 percent. With respect to value appropriation variables, a one standard deviation increase in relative partner profitability reduces the firm's adjusted market value by 21.6 percent, and a similar increase in relative partner alternatives reduces the adjusted market value by 21.0 percent. Finally, an increase of one standard deviation in multilateral competition increases the adjusted market value by 14.7 percent. The moderating effects of bilateral and multilateral competition are depicted in Figure 4, in which the variables of interest are presented at their minimum and maximum values, while all remaining variables are held at their mean levels.

To test the robustness of the findings, I considered alternative specifications. For example, I tested for selection bias that may arise if values in the full model are not missing at random (Allison, 2001). For this purpose, I ran a two-stage regression analysis, where the first stage predicts the probability of non-missing values using probit analysis with robust estimates, accounting for the panel structure of the data. The results of this model (see Appendix) suggest that missing values are more likely in the years 1995–1998, and for strategic R&D agreements, but not for OEM/VAR agreements or for firms operating in SICs 7372–7373. Finally, the occurrence of missing values is minimized with increases in the number of partners in the alliance portfolio. When controlling for the probability of non-missing values (see Table 2, Model 8), the results remain

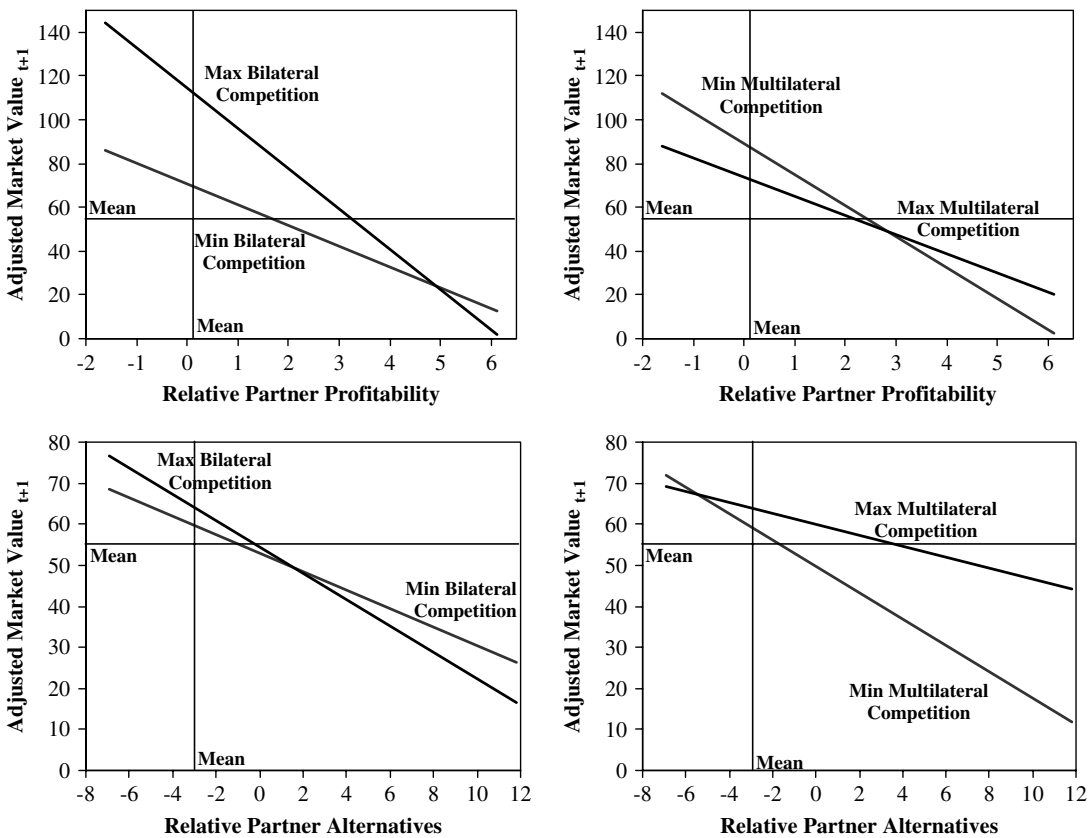

Figure 4. Predicted market value by relative network profitability/alternatives and bilateral/multilateral competition (Model 7)

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fully consistent with Model 7, although the interaction between relative partner profitability and bilateral competition becomes marginally significant ($\beta = -0.29$, $p = 0.056$).[9] Additionally, when different lag structures are considered, the goodness of fit of alternative models diminishes with increases in the lag period. For example, when the change in market value is measured over a 2-year period, R^2 declines from 0.93 to 0.89, but the effects of network prominence, multilateral competition, relative partner alternatives, and the interactions of the last with bilateral and multilateral competition remain significant.

DISCUSSION AND CONCLUSIONS

This study offers rich evidence on the contribution of alliance portfolios to firm performance. It complements the traditional focus on the implications of structural and relational embeddedness in networks with a framework of network resources that highlights the attributes of partners with whom the firm collaborates. It further advances research on alliances and networks by juxtaposing value creation and appropriation mechanisms, and thereby revealing the dual role of dominant partners in the alliance portfolio. On the one hand, prominent partners that can endorse the focal firm and endow valuable resources may enhance its market performance. On the other hand, powerful partners may leverage their bargaining power and impair the focal firm's capacity to appropriate rents from its alliance portfolio. Moreover, this study reveals how the firm's appropriation capacity is contingent on the levels of bilateral and multilateral competition in its alliance portfolio.

The findings demonstrate how the network resources furnished by partners in the alliance portfolio enhance the focal firm's market performance. This value-creation effect is ascribed to the ability of the firm to leverage these external resources, create synergies by combining them with its internal resources, and eventually internalize them through learning and imitation (Lavie, 2006). Nevertheless, not all types of network resources create value. Whereas ties to prominent partners with abundant marketing and financial resources enhance market performance, technology and human network resources fall short of creating value. This result is surprising given prior indications that partners' size and innovativeness lead to revenue growth (Stuart, 2000). This contradiction can be resolved, however, by considering the complementary nature of network resources. Specifically, Stuart studied horizontal alliances in the semiconductor industry, where the 'surest path to commercial success has been to develop new technologies' (Stuart, 2000: 796). In addition, horizontal alliances in that industry create economies of scale by sharing production facilities. These industry characteristics increase the complementary value of partners' sales volume and innovativeness. In contrast, software firms specialize in the development of intellectual property based on their proprietary technology and human assets. In the software industry, alliances enable firms to integrate complementary software components, embed them in systems, resell and implement solutions, and engage in joint marketing activities. Hence, the marketing resources of partners, their industry prominence, and financial endorsement are essential for value creation. Generalizing from these findings, the relational rents that firms can derive from their network resources depend on the complementary value of these resources from the perspective of the focal firm (Dyer and Singh, 1998). Similar alliance portfolios may contribute differently to value creation based on the extent to which partners' resources are complementary. Nevertheless, this argument should be scrutinized by future research that may directly measure the degree of complementarity of network resources.

The main contribution of this study is in distinguishing value creation from value appropriation mechanisms in alliance portfolios. Prior research has typically considered either one mechanism or the other, while focusing on dyadic alliances.

[9] In addition, when the power function of growth in market value is replaced with a dependent variable based on a linear ratio of the market value at time $t + 1$ to the market value at time t, the effects of network marketing resources, relative partner profitability, and multilateral competition remain significant. When the absolute market value at time $t + 1$ is considered as the dependent variable, the effects of network prominence, relative partner profitability, relative partner alternatives, and the interactions involving multilateral competition remain significant. These specifications, however, are inferior to the reported model for the reasons discussed in the Methods section. Some findings are also robust to the use of revenue growth instead of market value growth as a dependent variable (Stuart, 2000). Specifically, the effects of marketing and financial network resources, relative partner alternatives, and the interactions between relative partner profitability and bilateral competition as well as between relative partner alternatives and multilateral competition remain significant.

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The current findings reveal that the firm's dependence on its partners constrains its appropriation capacity, which in turn results in declining market performance. In this sense, I incorporate the private vs. common benefits logic (Khanna *et al*., 1998) and extend the relational view (Dyer and Singh, 1998), which has focused on the role of trust and knowledge sharing in joint value creation, by highlighting some of the unconstructive interdependencies between the firm and its partners. Specifically, partners in the alliance portfolio may capture stronger bargaining positions by virtue of their higher profit margins or their access to more alternative alliances relative to the focal firm. By simultaneously accounting for the nature of interdependencies in alliances and the contributions of network resources, this study demonstrates how dominant partners can facilitate joint value creation while adversely affecting firm performance as a result of excessive appropriation of that value. Hence, partners that possess the most valuable resources are not necessarily the finest associates, as suggested in prior research (e.g., Stuart, 2000). Instead, powerful partners may be well positioned to appropriate the lion's share of relational rents. For this reason, perhaps, some prior studies that focused on the value-creation effects of partners' endowments without accounting for their relative bargaining positions report insignificant contributions of network resources (e.g., Zaheer and Bell, 2005). Similarly, studies that consider the power structure of alliance portfolios without accounting for the resource endowments of partners (e.g., Bae and Gargiulo, 2004) cannot discern adverse appropriation effects from the value-creation effect of network resources. The current study juxtaposes value creation and appropriation mechanisms, thus avoiding such underspecification and clarifying the mixed implications of strong alliance portfolios for firm performance.

In addition, this study advances an alliance portfolio perspective by considering both the bilateral relationships between the focal firm and its partners and the multilateral relationships across partners in the portfolio. In particular, the findings suggest that multilateral competition among partners enhances the firm's market performance. This outcome is ascribed to the firm's ability to arbitrate among competing partners and control resource allocation decisions, which improve its appropriation capacity. Hence, by distinguishing partners' resource endowments from their industry affiliation, this study differentiates the negative consequences of resource redundancy and network inefficiency (Baum *et al*., 2000) from the positive implications of multilateral competition for the firm's appropriation capacity. Although the network resources accessible from similar partners may add limited value, multilateral competition increases the firm's relative share of that added value.

Therefore, the firm's appropriation capacity depends not only on its relative bargaining power *vis-à-vis* partners but also on the competitive tension with its partners and among partners in its alliance portfolio. Specifically, bilateral competition motivates appropriation contests whereby the firm and its partners struggle to maximize their own share of relational rent. However, unlike prior research that has predicted a direct effect of bilateral competition on firm performance and produced conflicting findings (Balakrishnan and Koza, 1993; Chang and Chen, 2002; Koh and Venkatraman, 1991; Park and Kim, 1997), this study suggests that the outcomes of these contests depend on relative bargaining power. Partners that compete with the focal firm in the same industry are encouraged to leverage their bargaining positions, which restrict the benefits that the firm can extract from its alliance portfolio. This assertion, however, receives more support with respect to the relative profitability of partners than with respect to the relative availability of alternative alliances. Perhaps relative profitability is a more immediate source of bargaining power, since relative availability of alternatives entails negotiation with other partners and thus offers weaker leverage to the firm.

Finally, the findings reveal how multilateral competition attenuates some of the negative effects of partners' bargaining power in the alliance portfolio. Although the tension among the firm's partners may rise and perhaps even limit their commitments to alliances in the presence of competitors in the alliance portfolio, the firm can leverage the competition among its partners to restrict their ability to exploit their relative bargaining positions in bilateral engagements. It can reduce its dependence on any given partner by forming alliances with that partner's competitors. In turn, the firm may face hazards when its partners engage in alliances with its competitors. Thus, this study complements prior research that noted how competitors that develop alliance portfolios can

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undermine the focal firm's competitive position irrespective of the firm's own alliances (Silverman and Baum, 2002). This study also extends the countervailing alliance perspective (Gimeno, 2005), which has focused on the tendency of firms to ally with the partners of their rivals, by providing a rationale for the counterpart strategy whereby firms attempt to ally with the rivals of their partners. For example, as Sony increases the number of competing video game developers for its PlayStation platform in its alliance portfolio, some game developers in that portfolio may try to balance Sony's enhanced bargaining position by allying with Sony's competitors and migrating their software to Microsoft's Xbox and Nintendo's GameCube platforms (Venkatraman and Lee, 2004). According to the current study, such a strategy may enable these game developers to improve their market performance. Overall, this study stresses the merits of considering the overall configuration of the alliance portfolio and the interdependencies across partners instead of envisioning alliance portfolios as mere aggregations of dyadic relationships.

Future research may extend this study in several ways. First, it may test the findings in different industry contexts. Specifically, alliances may serve different roles in industries that are less dynamic than the U.S. software industry, in which a different balance may prevail between exploration and exploitation alliances (Lavie and Rosenkopf, 2006; Rothaermel and Deeds, 2004; Rowley *et al*., 2000). Second, researchers may study the implications of alliance portfolios for various performance measures that encompass not only forward-looking measures such as growth in market value, but also accounting measures such as profitability. Because of the inherent trade-off between long-term and short-term performance objectives (Meyer, 2002), alliance portfolios may produce inconsistent effects across different performance measures. Third, there is merit in studying the evolution of alliance portfolios and considering how, for instance, the relative bargaining power of partners and the level of multilateral competition change over time (Hite and Hesterly, 2001; Koza and Lewin, 1998; Lavie, 2004). Fourth, field studies may offer more refined measures of value creation and appropriation based on primary data sources, distinguishing, for example, between partners' shared and non-shared resources, and accounting for isolating mechanisms that may potentially limit the flow of network resources (Lavie, 2006). In addition, future research may examine the potential availability of new alliances in addition to the availability of existing alternatives when assessing relative bargaining power. Finally, researchers may study additional facets of alliance portfolios and their performance implications, for example, by considering the implications of the variance in partners' network resources and bargaining positions.

In conclusion, this study contributes to the emerging research on alliance portfolios and informs the broader literature on alliance networks. Most prior research in this field of inquiry has emphasized structural properties of networks (e.g., Ahuja, 2000; Bae and Gargiulo, 2004; Rowley *et al*., 2000; Shipilov, 2006) with less attention to the role of partner attributes. The current study brings these attributes to the foreground, suggesting that the question of whom to partner with may be as critical as the question of which network structure is desirable. In fact, the number of partners, the density of the network, or the prevalence of structural holes may be less important than the nature of network resources that partners furnish to the focal firm or the nature of bilateral and multilateral interdependencies in the alliance portfolio. A careful examination of the reasoning behind the traditional focus on network structure would reveal that structural properties serve as mere proxies for more fundamental concepts. For example, the notion of structural holes (Burt, 1992) is intended to capture aspects of a firm's bargaining power *vis-à-vis* its network partners, whereas structural equivalence (Burt, 1987) implicitly assumes competition between equivalent partners. In a similar vein, the notion of embeddedness (Granovetter, 1985; Uzzi, 1996) highlights the conditions that facilitate the flow of resources in the network, but it does not shed light on the nature and availability of such network resources. Hence the current study offers theoretical arguments and evidence that invoke more direct mechanisms that drive the contribution of alliance portfolios to firm performance. It goes beyond exclusive concern with the value-creation impact of network resources (Stuart, 2000), noting that resource-rich partners are desirable as long as they do not leverage their superior bargaining positions to appropriate value at the firm's expense. The firm may accommodate such prominent partners in its alliance portfolio by avoiding direct competition with them or by

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attracting competing partners to balance its disadvantageous position and restore its appropriation capacity.

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APPENDIX

First-stage robust probit model for probability of non-missing values in model 8

	First-stage Model 8
Intercept	−1.87***
Year 1990	0.30
Year 1991	0.29
Year 1992	0.31
Year 1993	0.17
Year 1994	−0.20
Year 1995	−0.34*
Year 1996	−0.29*
Year 1997	−0.25*
Year 1998	−0.25*
Year 1999	−0.09
Year 2000	
Firm SIC 7371	0.58
Firm SIC 7372	1.25***
Firm SIC 7373	0.77*
Firm SIC 7374	
Firm size	−0.00
Firm age	0.00
Firm partnering experience	0.01†
Number of partners	0.03**
Publicly traded partnerss	0.33
Portfolio age	0.07
Portfolio internationalization	−0.36
Joint ventures	−0.48
Strategic alliances	−0.04*
Multi-partner alliances	0.09
Licensing agreements	−0.07
Manufacturing agreements	−0.06
Sales and service agreements	−0.02
OEM/VAR agreements	0.48**
R&D agreements	−1.12*
Royalties agreements	−0.75
Supply agreements	0.48
Number of observations	2049
Number of observations with non-missing values	1343
Number of firms	360
Wald χ^2 (d.f. = 30)	158.49***
Pseudo R^2	0.23

† $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

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