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Asymmetric New Product Development Alliances: Are the Gains Symmetric across the Partners?

Kartik Kalaignanam, Venkatesh Shankar, and Rajan Varadarajan

How are financial gains divided between large and small firms in R&D partnerships? Using data on 167 alliances, this study suggests that such alliances can add shareholder value for both partners.

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Report Summary

In the high-technology industry, large companies frequently seek R&D partnerships with small firms. Such alliances are critical to product innovation and typically result in changes in the partner firms' shareholder values. Here, the authors develop a model of the short-term changes in the shareholder values of the larger and smaller firms involved in NPD alliances, using data on 167 alliances in the information technology and communication industries. They examine the alliance, firm, and partner characteristics that might determine the changes in shareholder values of the partner firms after announcing the alliance.

The results suggest that both partners experience significant short-term financial gains, but there are considerable asymmetries between the larger and smaller firms with regard to the effects of alliance, partner, and firm characteristics on those gains. While a broad-scope alliance enhances the financial gains for the larger firm, a scale R&D alliance contributes positively to the financial gains for the smaller firm. While the partner experience positively influences the financial gains for the larger firm, it has no significant effect on the financial returns for the smaller firm. Further, partner innovativeness is positively associated with the financial gains for the larger firm, but partner reputation is unrelated to the financial gains of the smaller firm. Finally, the magnitude of the financial gains accruing from a firm's alliances is considerably higher for the smaller firm than for the larger firm.

The main finding from this study is that an asymmetric NPD alliance is not a win-lose partnership, but a shareholder value-adding alliance for both the larger and smaller partner firms. For a larger firm to gain from a partnership with a smaller firm, the alliance agreement needs to be broad-based, involving cooperation in more than one functional area. For a smaller firm to gain from its partnership, there must be a greater pooling of resources that will increase the opportunity for revenue sharing and reduce the possibility of exploitation by the larger company. ■

Introduction

Interorganizational alliances are widely recognized as critical to product innovation. A notable trend is the rapid growth of new product development (NPD) alliances between large, well-established firms and small, growing firms. We term these alliances involving disparately sized firms *asymmetric alliances*. In particular, in high-technology markets, approximately 2,300 asymmetric alliances were formed from 1970 to 1990 (Barley, Freeman, and Hybels 1991; Kogut and Kim 1991). Furthermore, the number of asymmetric alliances in high-technology industries increased by more than 250% during the 1990s (Cyr 2001).

In high-technology settings, larger, established firms seek R&D partnerships with smaller, growing firms because the latter are endowed with intangible resources and unique technological capabilities in niche areas (Chen and Hambrick 1995; Stuart 2000). Gomes-Casseres (1997) notes that although larger firms traditionally have been dominant players in the information technology and pharmaceutical industries, the advent of new technologies such as microelectronics and biotechnology presents unique opportunities for smaller entrepreneurial firms to pursue targeted innovation. Research on entrepreneurship (e.g., Eckhardt, Shane, and Delmar 2006) suggests that ties with larger firms are vital to the growth of smaller firms for at least two reasons. First, smaller firms, being strapped for funds, use the alliances with larger firms to infuse the needed tangible resources for commercializing their new product development efforts. Second, partnerships with prominent partners such as larger, established firms buffer smaller firms from the liability of being small, enhance their chances of survival, and boost sales growth (Baum, Calabrese, and Silverman 2000; Stuart 2000). For instance, the stock price of Net2phone, a small Internet service provider, increased by 50% following the announcement of a strategic NPD alliance with the larger firms, Compaq and Sprint (*Business Week* 1999).

The outcomes of asymmetric alliances, particularly the changes in shareholder values of partner firms, may be different across the firms. It is important to use stock market returns as an outcome measure for studying the impact of NPD alliances because shareholder value is a forward-looking metric (e.g., Bharadwaj, Bharadwaj, and Konsynski 1999; Houston and Johnson 2000; Kumar, Ramaswami, and Srivastava 2000). A small body of literature has examined changes in the shareholder values of firms in partnerships involving disparately sized firms, albeit not in the context of new product development. For instance, evidence from the mergers and acquisitions (M&A) literature suggests that the acquired firm (the smaller firm) and the acquiring firm (the larger firm) experience positive and negative short-term abnormal returns, respectively (Asquith 1983). Prior research on interfirm partnerships in general (not in the NPD context) and firm value (Alvarez and Barney 2001; Chan et al. 1997; Das, Sen, and Sengupta 1998; Koh and Venkatraman 1991; McConnell and Nantell 1985) suggests that while strategic alliances do create value for firms, there is a lack of consensus on the division of financial gains between larger and smaller partners.

In many cases, much of the economic value created between smaller or entrepreneurial firms and larger firms is appropriated by the larger partner (Alvarez and Barney 2001). Examining a sample of 60 joint ventures, McConnell and Nantell (1985) observe that the investors in the smaller firm, on average, receive larger abnormal returns, but the absolute gains in shareholder value for both partners are more or less equivalent.[1] Likewise, Chan et al. (1997) conclude that while smaller partners experience larger abnormal returns than larger partners do, the magnitudes of the absolute gains are roughly equal. In contrast, in an analysis of 60 nonequity alliances from the information technology sector, Koh and Venkatraman (1991) point out that on average, the smaller partner gains substantially more ($19.2 million) than the larger partner ($2.3 million). An analysis of

the cumulative abnormal returns of 50 firms involved in strategic alliances reveals that the gains to the smaller firm exceed those to the larger partner firm (Das, Sen, and Sengupta 1998). The divergent results in prior studies can be attributed to heterogeneity in the focus of alliance agreements (e.g., R&D or NPD, marketing, and licensing). Not much is known about how an NPD alliance affects the changes in the shareholder values of the partner firms and whether the alliance is asymmetric.

More importantly, despite the recognition that understanding the factors contributing to the financial gains in such asymmetric alliances is beneficial to scholars and managers (Koh and Venkatraman 1991; McConnell and Nantell 1985), not much is known about the drivers of the financial gains for the partner firms. In particular, little is known about differences in the drivers of financial returns to larger and smaller firms in an NPD alliance. We seek to fill this research gap.

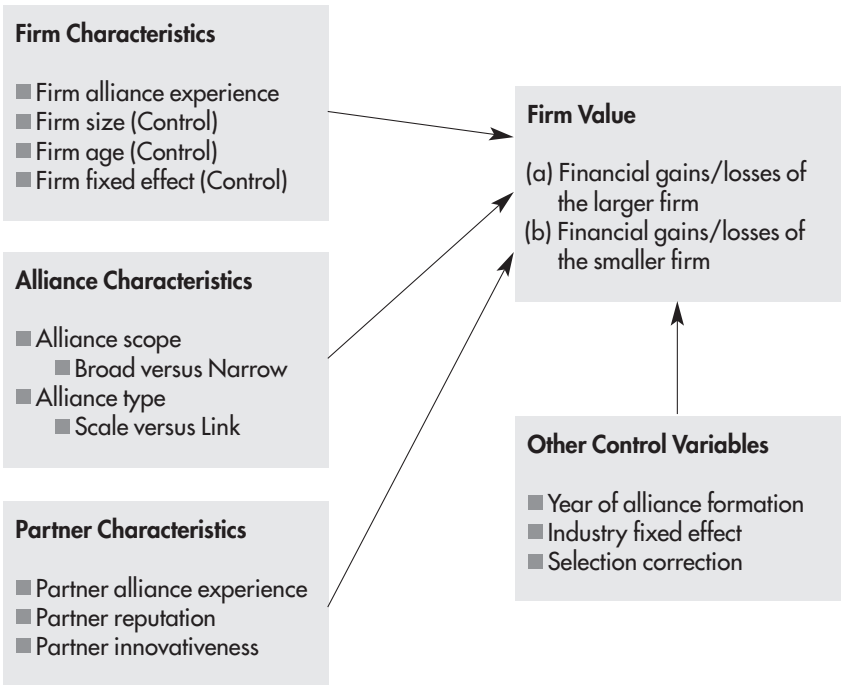
Are the changes in shareholder values of the partner firms in an asymmetric NPD alliance announcement significantly positive or negative? Are the gains in an NPD alliance between the larger and the smaller partner firms symmetric? What are the determinants of the changes in shareholder values of the partner firms in an NPD alliance? The answers to these questions are important for both larger and smaller firms in better selecting their partners, the scope and type of alliance, and the resources to be allocated for new product development. The objective of this paper is to develop and empirically test a model of factors influencing the creation or erosion of shareholder values of partner firms following the announcement of asymmetric NPD alliances.

To address these important research questions, we follow a three-step process. First, we develop a conceptual framework of the major determinants of the changes in shareholder values of partner firms in an NPD alliance. Second, we use the event study approach to determine the short-term changes to shareholder value that accrue to larger and smaller firms after an NPD alliance is announced. Third, we estimate a model comprising the effects of firm, alliance, and partner characteristics on shareholder value changes for larger and smaller firms in an NPD alliance using data from 167 asymmetric NPD alliances in the information technology and telecommunication industries.

This paper contributes to the literature on NPD alliances in at least two distinct ways. First, to our knowledge, this study is the first to examine factors affecting the financial gains of *both* larger and smaller firms in an NPD alliance. In doing so, we seek to address concerns expressed in the literature regarding the limitations of focusing on the performance of one of the two firms in a partnership (e.g., Wuyts, Dutta, and Stremersch 2004). Second, much prior empirical research examining the impact of alliances on firm performance has focused exclusively on either alliance characteristics (Bucklin and Sengupta 1993; Chan et al. 1998; Wuyts, Dutta, and Stremersch 2004), firm characteristics (Anand and Khanna 2000; Chan et al. 1998; Johnston, Sohi, and Grewal 2004), or partner characteristics (Baum, Calabrese, and Silverman 2000; Stuart 2000). We extend the literature by rigorously developing and empirically testing a model that links all three types of factors (i.e., firm, alliance, and partner characteristics) to changes in the partner firms' shareholder values in a single framework focused on NPD alliances. Our model accounts for selection correction, potential cross-correlation among the residuals from the models of firm value changes for the larger and smaller firms, and unobserved heterogeneity.

The remainder of the paper is organized as follows. In the next section, we develop the conceptual framework and hypotheses, followed by a discussion of our data and methodology. We describe the measures and the model in the subsequent section and discuss the results. We conclude by highlighting the implications and limitations and outlining directions for future research.

Figure 1
Firm Value Creation or Erosion in Asymmetric New Product Development Alliances: A Conceptual Model



Conceptual Framework and Research Hypotheses

Figure 1 presents a conceptual model delineating the factors influencing the creation or erosion of partner firms' values in asymmetric NPD alliances. An exogenous event such as the formation of an alliance is likely to alter a firm's asset price through a change in the anticipated cash flows as well as change in the discount rate associated with the firm's future cash flows (Schwert 1981). We expect firm characteristics (alliance experience), alliance characteristics (alliance scope and alliance type), and partner characteristics (partner alliance experience, partner reputation, and partner innovativeness) to be the major determinants of changes to the net present value of each partner firm in an NPD alliance.[2] We develop hypotheses about the effects of the potential drivers of shareholder value creation in an NPD alliance. Although not all hypotheses focus on asymmetries between the larger and smaller firms, our intent is to examine the differences between the partner firms in the test results of the hypotheses.

Firm characteristics

Firm Alliance Experience. A firm's alliance experience exposes it to rich combinations of processes, inputs, and outcomes and enables it to better adapt to contingencies as well as acquire new related knowledge. Previous alliance experience may enhance the stock market performance of the firm involved in an NPD alliance in at least two ways (Anand and Khanna 2000; Sampson 2005). First, firms with alliance experience learn to better manage complex new alliances through the establishment of a general alliance management capability and interorganizational routines that aid in partner selection and conflict management (Ireland, Hitt, and Vaidyanath 2002; Kale, Dyer, and Singh 2002). Second, firms accumulate valuable technological and product-market knowledge from past alliances that enable them to be more successful in a new NPD alliance.

Although alliance experience is likely to have a positive impact on the financial gains accruing to both larger and smaller firms, we expect the gains to accrue to these partner firms through different mechanisms. Because more public information is typically available for larger firms than for smaller firms, investors know more about the strategies of larger, well-established firms than about smaller firms. Therefore, while past alliances by a larger firm may not provide radically new information to investors, they provide information about the larger firm's experience in accessing intangible resources and reduce investor uncertainty about the new alliance through a decrease in the larger firm's risk profile (i.e., discount rate), resulting in a higher firm value. For a smaller firm, its past alliances with other firms provide information about its accessibility to tangible resources and social capital, which yields additional cash flows and lowers its risk profile (see Baum, Calabrese, and Silverman 2000; Stuart 2000 for reviews). The ability to work with partners is a specific competence that plays an important role in an

entrepreneur's success (Baron 2000) and thus the smaller firm's value. We summarize our arguments through the following hypothesis:

H1: The greater the alliance experience of a firm in an NPD alliance, the greater the financial gains to that firm.

Alliance characteristics

Alliance Scope (Broad vs. Narrow). The scope of the NPD alliance may influence the change in firm value. Alliance scope refers to the breadth of functional activities (e.g., R&D, manufacturing, marketing, and distribution) that the partners agree to undertake during the tenure of the alliance (Doz and Hamel 1998; Varadarajan and Cunningham 1995). Alliance scope can be construed as a proxy for the precommercial value of the alliance, which the investor community uses to estimate the future revenue streams of the firms. Broad-scope alliances are likely to generate more revenues and financial gains than narrow-scope alliances for at least two major reasons. First, an alliance that encompasses many functional areas of collaboration signals a greater financial potential than one that covers only a few areas. Second, a broad-scope alliance also indicates greater commitment by the partners to the alliance than does a narrow-scope alliance.

Despite this wisdom regarding the benefits of broad-scope NPD alliances, narrow-scope NPD alliances are quite common in high-technology industries. Firms in the information and communication equipment (ICE) industries routinely limit the scope of NPD alliances to prevent the loss of technological knowledge to partners competing in overlapping product markets (Oxley and Sampson 2004). Likewise, theory and evidence from the biopharmaceutical industry suggests that because the threat of knowledge spillovers and technology appropriation is higher in broad and complex alliances than it is in narrow-scope alliances, the larger firm (i.e., pharmaceutical partner) is likely to corner a greater proportion of the revenues than the smaller firm (i.e., biotechnology partner) (Alvarez and Barney 2001; Lerner and Merges 1998; Veugelers and Kesteloot 1996). Therefore, we expect the larger firm to benefit more from broad-scope NPD alliances than from narrow-scope NPD alliances because a broad-scope alliance provides the large firm with greater opportunity for private gains, whereas a narrow-scope alliance restricts the magnitude of such gains:

H2: The broader the scope of an NPD alliance, the greater the financial gains to the larger firm.

For the smaller firm, however, any benefit from a broad-scope alliance may be offset by the need to have a narrow and restrictive scope to protect misappropriation of R&D assets and knowledge leaks (Li et al. 2005). Therefore, we do not offer a formal hypothesis on this relationship for the smaller firm, but treat it as an empirical issue for our subsequent investigation.

Alliance Type (Scale vs. Link). Partnerships between firms in an NPD alliance involve the pooling or exchange of firm-specific resources, leading to two types of NPD alliances—scale alliance and link alliance (Hennart 1998). Scale alliances refer to partnership deals in which resources are pooled for activities in the same stage(s) of the value chain, which in the case of an NPD alliance is the R&D stage. Link alliances refer to partnership deals in which resources are exchanged for activities performed at different stages of the value chain. From the standpoint of exchange of resources, R&D and marketing are two stages that are important in the innovation process (Song and Thieme 2006).

Asymmetric alliances are somewhat unstable because they exacerbate learning asymmetries, resulting in the larger firm often "finishing" learning before the smaller firm (Doz and Hamel 1998). The extent to which firms have the opportunity to engage in learning races, however, varies by the type of alliance. Dussuage, Garrette, and Mitchell (2000) note that deals in which resources are exchanged (link) tend to produce more asymmetric outcomes than deals in which

resources are pooled (scale). In general, in link alliances involving NPD, the smaller firm contributes resources to upstream activities (e.g., R&D) and the larger firm contributes resources to downstream activities (e.g., manufacturing, marketing, distribution). Failure to gain expertise in downstream activities could be detrimental to the long-term survival of the smaller firm, as it diminishes its chances of independently commercializing its innovations in the future. The reasoning is similar to that advanced by Hitt et al. (2000) for the greater preference of complementary capabilities in alliances by developed market firms (typically larger firms) over emerging market firms (typically smaller firms). As a result, we expect the balance of power to shift toward the larger partner in link alliances.

In contrast, a scale alliance shifts the balance toward the middle because both partners agree to pool resources for R&D and possibly manufacturing and marketing, thereby providing the smaller firm greater access to resources and technical know-how. This argument is consistent with empirical evidence from the biopharmaceutical sector, which suggests that more control rights (e.g., patents) from technology alliances are assigned to the smaller firm (i.e., the R&D-intensive firm) than they are to the larger firm (i.e., the client firm) when the smaller firm is in a better bargaining position (as reflected by its strong equity market value) (Lerner and Merges 1998). Therefore, we expect the smaller firm to benefit more when it contributes greater resources to the different stages of NPD and stakes a greater claim to the residual rights from product innovation. In addition, from the smaller partner's viewpoint, the possibility of the larger partner prematurely exiting the alliance is lower in scale alliances because of the greater involvement of the larger partner in upstream NPD activities (i.e., R&D). These arguments suggest that smaller firms are likely to benefit more from scale alliances, whereas larger firms are likely to gain more from link alliances.

H3a: The financial gains to the larger firm in an NPD alliance will be greater for link alliances than they are for scale alliances.

H3b: The financial gains to the smaller firm in an NPD alliance will be greater for scale alliances than they are for link alliances.

Partner characteristics

Partner Alliance Experience. In addition to its own alliance experience, the alliance experience of its partner firm can play an important role in determining changes in the shareholder value of a firm. Consider first the changes in the value of the larger firm. In choosing its smaller partner firm, the larger firm is typically faced with an adverse selection problem because of information asymmetries with respect to the quality of smaller firms (Shane, Shankar and Aravindakshan 2006). The alliance experience of a smaller partner is likely to benefit the larger partner. Although the larger firm may not have had any previous alliance with the smaller firm, the social networks of the larger firm with prominent firms with which the smaller firm has had ties or prior experience could provide valuable insights about the quality of the smaller partner. In addition, we expect the effect to be positive in the NPD context, because the stock market is more likely to respond favorably when the larger firm partners with the smaller firm possessing greater NPD alliance experience. The partner alliance experience serves to reduce the uncertainty regarding the NPD effort. As a result, we advance the following hypothesis:

H4a: The greater the smaller firm's alliance experience, the greater the financial gains to the larger firm in a NPD alliance.

The partner's alliance experience will likely have a positive effect on the financial gains to the smaller firm as well. Alliance outcomes for a focal firm are positively impacted by learning through their direct experience as well as by the experience of their alliance partners (Sarkar, Echambadi, and Ford 2003). Thus, the smaller firms could benefit from the experience of

larger partners, which provides them the opportunity to mimic their alliance management techniques (e.g., process routines to initiate, manage, and terminate alliances [Johnson, Sohi, and Grewal 2004]). Therefore, we expect the effect to be positive because the stock market is likely to be better informed about the strategies of larger firms with higher R&D alliance experience than about larger firms with little experience in managing complex NPD alliances. As a result, we advance the following hypothesis:

H4b: The greater the larger firm's alliance experience, the greater the financial gains to the smaller firm in an NPD alliance.

Partner Reputation. Reputation refers to a global perception of the extent to which an organization is held in high esteem or regard by its key constituents on the basis of its past actions and future appeal (Fombrun and Shanley 1990). Firms contemplating alliances assess potential partners on reputation (Baum, Calabrese, and Silverman 2000; Shane, Shankar, and Aravindakshan 2006; Stuart 2000). In general, the quality (e.g., of products and management) of smaller firms is uncertain because few indicators of their key constituents (e.g., customers, suppliers, collaborators, and investors) are available to assess their track record. Partnering with reputed larger firms provides several benefits to smaller firms. First, an alliance with a larger firm generally draws the attention of the key constituents to the new venture and the smaller firm (Stuart 2000). Second, the fact that a reputed larger firm has selected a smaller and lesser-known entity over alternative firms provides a valuable endorsement for the smaller firm (Stuart 2000). Third, alliance with a reputed firm provides access to valuable skills and resources (e.g., product-market capital and social capital) that the smaller firm lacks. Because larger firms do not typically enter into asymmetric alliances with smaller firms to derive reputation benefits, we do not offer a hypothesis for the effect of partner reputation on changes in shareholder values for larger firms. Based on these arguments, we expect the performance of smaller firms to be enhanced in their alliances with reputable larger firms, leading to H5:

H5: In an NPD alliance, the financial gains to the smaller firm are greater when its larger partner firm has a higher reputation.

Partner Innovativeness. While smaller firms can benefit from the reputation of larger partner firms, larger firms can dilute their reputation by partnering with smaller, low-quality firms. Small, young firms, by definition, have little or negligible reputation, due to their relatively short track record. Yet, they are attractive alliance NPD partners for larger firms because of their expertise in niche areas of technology, especially in industries where the locus of innovation lies outside rather than inside the firm. Prior studies suggest that while larger firms are bestowed with innovation advantages in mature industries, smaller firms tend to innovate more in growing industries characterized by the absence of a standardized product. Acs and Audretsch (1988) note that while larger firms tend to be more innovative in industries with imperfect competition, smaller firms are more innovative in industries with perfect competition. Smaller firms with innovative capabilities in niche areas enable larger firms to overcome their structural inertia and technological rigidity. A larger firm can learn from a smaller firm and enhance its performance in an NPD context (Rothaermel 2001). Based on the preceding arguments, we expect the performance of larger firms in high-technology industries to be higher when partnering for NPD with innovative smaller firms than with noninnovative smaller firms. Because smaller firms do not typically enter into asymmetric alliances with larger firms to gain from the larger firm's innovativeness, we do not expect an effect of partner innovativeness on the financial gains for smaller firms. We expect the smaller firm to gain mainly through the transfer of social capital (e.g., reputation) than through their larger partner's innovativeness.

H6: In an NPD alliance, the financial gains to the larger firm will be greater when the smaller partner firm is more innovative.

In addition to these focal variables, we also expect control variables such as firm size, firm age, year of alliance announcement, and industry-specific and firm-specific characteristics to have an impact on the changes in the value of the partner firms in a NPD alliance. We subsequently discuss the operationalization of these variables and their effects on changes in firm values.

Data

We test our hypotheses in an empirical setting comprising two broad industries that exhibit several asymmetric alliances, namely, the information technology and telecommunication industries. Data on NPD alliances between firms in these industries were drawn from the joint ventures/alliances database of the Securities Data Company (SDC). Specifically, the sample comprised firms in the computer and office equipment (i.e., SIC codes 3571, 3572, 3575, 3577, 3578, and 3579), prepackaged software (i.e., SIC code 7372), and communications equipment (i.e., SIC codes 3661, 3663, and 3669) industries that entered into R&D alliances between January 1993 and September 2004.

Our selection of this time period was influenced by the observation that SDC did not track all deals by U.S. firms during the period 1990-1992 because of inadequate corporate reporting requirements (Anand and Khanna 2000). Therefore, the starting date for data collection was January 1993. Our second sampling requirement was to identify alliances in which both firms were publicly traded U.S. firms.[3] Our third sampling requirement was to include only nonequity alliances. This requirement was necessary because equity alliances could potentially be an intermediate step for the larger firm in acquiring the smaller firm, and therefore the stock market could possibly be responding to the smaller firm's potential as an acquisition target.

Table 1
Distribution of NPD Alliances by Partner Firm Size Asymmetry in the Data

Size Ratio	Number	Percentage
5.0-6.0	9	5.39
6.1-8.0	7	4.19
8.1-10.0	10	5.99
10.1 and above	141	84.43
Total	**167**	**100.00**

Our fourth sampling requirement was to identify alliances with considerable size asymmetries. The lack of prior research in this area made it necessary for us to empirically define the cutoff point for size differences. Prior research has operationalized firm size as assets, sales, or number of employees. In this study, we operationalize firm size in terms of the assets of the firm in millions of dollars.[4] To better examine asymmetry in NPD alliances, we consider only those alliances in which the ratio of the larger firm's assets to those of the smaller firm is greater than five. Table 1 provides the frequency distribution of asymmetric R&D alliances involving publicly traded firms between 1993 and 2004. There were no asymmetric alliances recorded during 1996. The size ratio exceeded 10 in approximately 85% of the alliances, reflecting considerable size asymmetries in our sample.

The sample attrition criteria yielded 222 dyadic relationships between a larger firm and a smaller firm. We checked the accuracy of the NPD alliance announcement date, the most critical aspect of the event study methodology, using LexisNexis.[5] We eliminated 19 observations because of uncertainty about the announcement date. In the remaining cases, the SDC announcement date did not differ from the announcement dates provided by LexisNexis. Additional checks for concurrent events (e.g., announcement of quarterly results, announce-

Table 2
Sample of Asymmetric NPD Alliances in the Data

Larger Firm	Smaller Firm	New Product Alliance Details
Compaq Computer Corp.	PictureTel Corp.	Development and marketing of a teleconferencing system
Microsoft Corp.	Wang Laboratories	Development and marketing of Windows NT versions of imaging and workflow server products
Oracle Corp.	i2 Technologies	Joint development of a supply chain optimization solution
International Business Machines (IBM)	Xylan Corp.	Development, manufacturing, and marketing of network switches
Motorola Corp.	Shiva Corp.	Development of an enhanced version of Motorola 925 system for the remote access market
Hewlett-Packard	Skytel Corp.	Development and marketing of wireless marketing solutions for palm-top computers
Digital Equipment Corp.	Spire Technologies	Joint development and marketing of an application programming interface software
Lucent Technologies	Novatel Wireless	Development of next generation multi-mode, multi-band wireless data products
Microsoft Corp.	Documentum, Inc.	Development and marketing of document and knowledge management solutions for vertical markets such as manufacturing, financial services, and utilities

ment of new product introductions, and changes in executive positions) during the three-day window around the announcement resulted in the elimination of 36 announcements that could potentially confound the results. The accuracy and confounding event check procedures yielded a final sample of 167 dyads. Our sample size compares well with those in studies that have used the event study methodology (Srinivasan and Bharadwaj 2003), offering sufficient statistical power to test our hypotheses. We collected the measures of firm size and market capitalization from the Compustat database.

A sample description of the NPD alliances in our data appears in Table 2. The larger firms ranged from Microsoft to Lucent Technologies. The smaller firms included Shiva Corp.; Documentum, Inc.; and Xylan Corp. Some of the NPD alliances explicitly included marketing agreements as well.

Measures and Methodology

Table 3 provides a summary of the variables and the operationalization of their measures. We discuss them below.

Focal variables

Net Present Value. The dependent measures of this study are the financial gains or losses or the net present value of the NPD announcement accruing to the partner firms. We computed financial gains as the product of short-term cumulative abnormal returns in the event window of (−1, +1) and the market capitalization of the firm 20 days before the alliance announcement, consistent with Chan et al. (1997). Our choice of financial gains or losses over short-term abnormal stock returns as the measure of the dependent variable was influenced by the following consideration: Short-term cumulative abnormal returns vary with firm size (Anand

Table 3
Variable Operationalization and Data Sources

Variable	Operational Measure	Data Source(s)
Net present value	Cumulative short-term abnormal returns x Market capitalization 20 days prior to the announcement	Center for Research in Security Prices (CRSP)
Alliance experience	Number of alliances entered by the firm from 1993 including the current alliance	Securities Data Company (SDC), LexisNexis
Alliance scope	Number of functional areas in which the partners agree to cooperate	SDC, LexisNexis
Alliance type		
■ Scale	If the alliance agreement states that the activities are undertaken jointly by the partners *Example*: "Sun Microsystems Computer Corp, a unit of Sun Microsystems, Inc. and Ancor Communications, Inc. have agreed to jointly develop and market the industry's first switched fiber channel attachment to a disk storage array."	SDC, LexisNexis
■ Link	If the alliance agreement states that the activities are exchanged between the partners *Example*: Lucent Technologies and Novatel Wireless have entered into a strategic alliance to develop the next-generation high-tech wireless products that will allow mobile users to access the Internet and corporate networks over the 3G universal mobile telecommunications system network. According to the terms of the agreement, Novatel was to develop multi-mode multi-band UMTS/GPRS wireless PC card modems while Lucent was to contribute marketing support.	
Partner reputation	8-item scale	*Fortune* Database
Partner innovativeness	No. of patents granted to the firm in the five years prior to the current alliance	United States Patent and Trademark Office (USPTO)
Firm size	Logarithm of firm assets	COMPUSTAT
Firm age	Number of years from the founding date to the date of the current alliance	Mergent Online/Lexis Nexis
Macroeconomic condition (used in computation of selection correction, λ)	30-day U.S. Treasury bill return	CRSP

and Khanna 2000). That is, larger firms tend to have smaller cumulative abnormal returns, and smaller firms tend to have greater cumulative abnormal returns. Therefore, the use of total financial gains or losses as the measure alleviates the scale problem associated with cumulative abnormal returns.

We use the event study methodology to assess the abnormal returns accruing to firms entering into NPD alliances. We estimated the daily stock returns for every firm in the sample over a 240-day period prior to the event day using the market model (Brown and Warner 1985). The short-term return event study methodology rests

on the assumption of efficient markets. That is, the market has sufficient information to gauge the effectiveness of a firm's NPD alliance. Although concerns have been voiced regarding the validity of the assumption, prior research in strategic alliances has explicitly tested the efficient market hypothesis and shown that the short-term abnormal returns to alliance announcements are strongly correlated with firm performance reported by managers (see Kale, Dyer, and Singh 2002; Koh and Venkatraman 1991 for reviews). The NPV of the firm following the NPD alliance announcement is computed using the market model for the event study (see Appendix 1 for details).

Alliance Experience. We construct this measure by counting the number of alliances in which the firm was involved from the beginning of 1993 until (and including) the focal alliance.[6] We recognize that this count measure does not distinguish between different types of alliances, such as narrow-scope and broad-scope alliances. However, this is not likely to be a concern because firms usually learn how to coordinate across organizational boundaries, select appropriate contract structures, and evaluate performance, even in the case of narrow-scope alliances (Sampson 2005). This count measure also does not distinguish between prior alliances that were either successful or unsuccessful, but because firms tend to learn from both successes and failures, this issue is also not a problem.

Alliance Scope. We operationalize alliance scope in terms of the number of functional activities covered in the alliance. For example, we coded an alliance involving cooperation in a single functional area as one and an alliance involving cooperation in R&D, manufacturing, and marketing as three.

Alliance Type. We operationalize scale alliances in terms of the nature of the contribution made by alliance partners. We coded alliances in which firms jointly contributed resources to the NPD stage of the value chain as scale alliances, whereas we coded alliances in which firms contributed resources to different stages of the value chain as link alliances. For instance, we coded alliances in which firms jointly developed products as scale alliances and alliances in which one firm contributed all the R&D resources and the other firm contributed all the marketing resources as link alliances.

Pa**rtner Reputation**. We obtained measures of the partners' reputation from 1993 to 2004 from the list of America's most admired companies published by *Fortune*. *Fortune's* annual survey rates firms' reputations on an 11-point scale (0 denoting poor and 10 denoting excellent) of eight characteristics: long-term investment value; financial soundness; wise use of corporate assets; quality of management; quality of products/services; innovativeness; ability to attract, develop, and keep talented people; and community and environmental responsibility. We use this measure because it is a valuable source for such a rich and abstract concept (see Fombrun and Shanley 1990; Houston and Johnson 2000).

Partner Innovativeness. We capture the innovativeness of the partner firm by counting the patent citations received by the partner firm in the five years before the focal alliance date. We collected the data on patents filed by firms from the United States Patent and Trademark Office (USPTO) database. The USPTO provides detailed information on patents filed by information technology and telecommunication firms from the beginning of 1975. The innovation literature argues that a patent citation count measure is a better indicator of the technological position of the firm than R&D intensity (Griliches 1990) and has been widely used in prior research to measure innovation output (Acs and Audretsch 1988; Bound et al. 1984).

Control variables

Firm Size. Consistent with prior studies (Stuart 2000), we control for the size of the firm by using the logarithm of the asset value of the firm at the time of the NPD alliance. We obtained the

asset value of the firm from the COMPUSTAT database.

Firm Age. We operationalize firm age as the time elapsed from the date of the firm's founding to the date the NPD alliance was announced. We retrieved the founding date of the firm from the Mergent/LexisNexis databases. Controlling for firm age is necessary to ensure that the changes in firm values when a NPD alliance is announced are not a consequence of aging and maturation of the partner firms.

Year of Alliance Formation. To control for differences in financial gains among the firms due to relevant economic and business conditions in the year in which the alliance was formed, we use dummy variables to capture these effects.

Industry Fixed Effect. To control for variance in financial gains due to industry-specificity (Kumar, Ramaswami, and Srivatsava 2000), we use dummy variables for the industry in which the focal firm operates.

Firm Fixed Effect. To control for variance in firm financial gains due to firm-specific characteristics, we use dummy variables for firms involved in multiple alliances in the dataset.

Selection Correction. A potential econometric issue in estimating changes in shareholder value created by firm strategies or events is the bias that could arise on account of sample selection. In general, sample selection bias can occur when the criterion for selecting the observations is not independent of the outcome variables. In this study, we observe that more larger firms enter into asymmetric alliances than do smaller firms during a given time period. Therefore, models that do not account for the sample selection and attrition processes could potentially result in biased predictor estimates (Greene 2002; Shane, Shankar, and Aravindakshan 2006). To obtain unbiased estimates, we use Lee's (1983) generalization of a Heckman selection correction model that uses predicted probabilities for firm failure to generate a selection correction variable, λ given by:

$$\lambda_{kt} = \phi[\Phi^{-1}(F_k(t))]/(1 - F_k(t)) \quad (1)$$

where $F_k(t)$is the cumulative hazard function for firm k at time t, ϕ is the standard normal density function and Φ^{-1}, the inverse of the standard normal distribution function (Lee 1983).

The rate of alliance formation has been observed to be a function of the macroeconomic conditions for the business involved. That is, firms tend to form more alliances during periods of economic growth than during periods of economic decline (Park, Chen, and Gallagher 2002). Following Audretsch and Mahmood (1995), who explicitly examined the link between macroeconomic conditions and business cycles, we use the 30-day U.S. Treasury bill interest rate to compute the predicted probability of observing the event (i.e., asymmetric NPD alliance). We include the selection correction term, λ_{kt}, as a regressor in the model that captures firm value created through asymmetric NPD alliances.

Model development

Tests of hypotheses 1 to 6 entail analysis of 167 alliances involving 75 larger firms and 150 smaller firms in our data. We develop two equations, one for the larger firm and the other for the smaller firm. The dependent variable in both equations is the change in the shareholder wealth or net present value created by the NPD alliance. The explanatory variables are the focal and control variables. The system of equations is given by:

$$\begin{aligned} NPV_i = {} & \beta_0 + \beta_1 FALEXP_i + \beta_2 ASCOPE_i + \\ & \beta_3 ATYPE_i + \beta_4 PALEXP_i + \beta_5 PINNOV_i + \\ & \beta_6 FSIZE_i + \beta_7 FAGE_i + \beta_8 \lambda_i + \\ & \sum_{p=1}^{P-1} \beta_{9p} IND_{pj} + \sum_{r=1}^{9} \theta_r YEAR_{ri} + \sum_{m=1}^{M-1} \gamma_m F_m + \zeta_i \end{aligned} \quad (2)$$

$$NPV_j = \gamma_0 + \gamma_1 FALEXP_j + \gamma_2 ASCOPE_j + \gamma_3 ATYPE_j + \gamma_4 PALEXP_j + \gamma_5 PREP_j + \gamma_6 FSIZE_j + \gamma_7 FAGE_j + \gamma_8 \lambda_j + \sum_{q=1}^{Q-1} \gamma_{9q} IND_{qj} + \sum_{r=1}^{9} \phi_r YEAR_{rj} + \sum_{n=1}^{N-1} \delta_n F_n + \omega_j \quad (3)$$

where, i is the larger firm, j is the smaller firm,

NPV_i = Change in the shareholder wealth

FALEXP = Cumulative number of alliances entered into by the focal firm, including the current alliance

ASCOPE = Number of functional areas covered in the alliance

ATYPE = 1 for scale alliance, 0 for link alliance

PALEXP = Cumulative number of alliances entered into by the partner firm, including the current alliance

PINNOV = Cumulative number of patent citations received by the alliance partner firm in the five years prior to the current alliance

PREP = Mean value of eight items on a survey of the reputation of the alliance partner firm

FSIZE = Logarithm of firm assets

FAGE = Number of years from the firm's inception date until the date of the current alliance

λ = Selection control variable for the firm

IND = Dummy variable for the industry to which the focal firm belongs

$YEAR_r$ = Dummy variable for the year r, $r \in \{1,2,..9$, each representing years 1994 through 2004, 1993 is the base year, no alliance in 1996$\}$, = 1 if r is the year in which the NPD alliance is announced, 0 otherwise

F = Dummy variable for each firm involved in multiple alliances in the data period

P = Number of industries represented by larger firms = 7

Q = Number of industries represented by smaller firms = 10

M = Number of larger firms with multiple alliances in the data period

N = Number of smaller firms with multiple alliances in the data period

ζ, ω = Error terms

Model estimation

Because the financial gains of the larger and smaller firms are generated from the same alliance, the system of equations can be correlated through their residuals. Using a standard Breusch-Pagan Lagrange Multiplier (LM) test, we are able to reject the null hypothesis of independent residuals across equations ($\chi^2 = 25.45$, $p < .001$). Because seemingly unrelated regression (SUR) estimates of the system of two equations are more efficient than are ordinary least squares (OLS) estimates, we estimate the system using SUR (Zellner 1962). Because the same firm may be involved in more than one NPD alliance, to control for unobserved firm heterogeneity, we use the fixed-effects approach (operationalized by dummy variables), consistent with Shane, Shankar, and Aravindakshan (2006). Based on the number of multiple alliances found in the data, we include 11 firm fixed effects for the larger firm equation and three firm fixed effects for the smaller firm equation.

Results

Tables 4 and 5 provide the descriptive statistics and the correlation matrices for the variables used in the study. From these tables, it is evident that there is considerable variance in firm value changes, the dependent measures for the study. The tables also suggest that the correlations between the independent variables in the equations are relatively small, the condition indexes are reasonable, and the variance inflation factors (VIF) are less than 10, alleviating concerns about potential multicollinearity.[7]

Hypotheses tests and controls

To test our hypotheses, we compared three models for both larger and smaller firms. The results appear in tables 6, 7, and 8. Model 1 captures the effects of firm characteristics on

Table 4

Summary Statistics and Correlation Matrix for Larger Firms

Variable	Mean	Std. Deviation	*NPV*	*FALEXP*	*ASCOPE*	*ATYPE*	*PALEXP*
NPV	50,722	145,875	1				
FALEXP	4.40	4.92	.45	1			
ASCOPE	.57	.04	.13	.00	1		
ATYPE	.41	.04	.06	.00	.24	1	
PALEXP	1.22	.52	.16	.05	.14	–.01	1
PINNOV	16.14	49.93	.11	.18	–.01	.01	.00
FSIZE	3.96	.80	.11	.59	.00	.08	.16
FAGE	44.58	33.89	–.07	.35	–.10	–.02	.08
λ	1.38	.02	–.11	–.13	.02	.22	–.07
Y1994	.02	.01	–.07	–.09	.05	.01	–.05
Y1995	.04	.01	–.13	.23	–.08	.06	–.03
Y1997	.06	.02	.26	–.00	.05	.12	.00
Y1998	.04	.01	.19	.09	–.05	.09	–.02
Y1999	.10	.02	.09	.17	–.04	–.15	.14
Y2000	.14	.03	.04	.09	.04	–.21	–.07
Y2001	.10	.02	.00	.02	–.06	–.07	–.07
Y2002	.23	.03	–.02	–.06	.00	–.07	.06
Y2003	.12	.03	–.13	–.11	.06	.10	.11

Table 5

Summary Statistics and Correlation Matrix for Smaller Firms

Variable	Mean	Std. Deviation	*NPV*	*FALEXP*	*ASCOPE*	*ATYPE*	*PALEXP*
NPV	13,017	86,858	1				
FALEXP	1.22	.52	.47	1			
ASCOPE	.57	.04	.04	.05	1		
ATYPE	.41	.04	.14	–.08	.28	1	
PALEXP	4.40	4.92	.20	.30	–.03	–.06	1
PREP	6.93	1.04	.08	.06	–.07	–.03	.18
FSIZE	2.04	.76	.26	.39	.14	.11	.26
FAGE	13.49	11.64	–.03	.02	.02	–.07	.17
λ	1.78	.01	–.15	–.10	–.08	.19	.06
Y1994	.02	.01	–.02	–.03	–.01	.02	–.09
Y1995	.04	.01	–.04	–.05	–.10	.03	.36
Y1997	.06	.02	.63	.18	.10	.16	.09
Y1998	.04	.01	–.03	–.03	.02	.16	.05
Y1999	.10	.02	–.02	.14	–.04	–.22	.07
Y2000	.14	.03	–.04	–.06	–.04	–.07	.24
Y2001	.10	.02	–.03	.13	–.02	–.18	.00
Y2002	.23	.03	–.09	–.10	–.01	–.07	–.20
Y2003	.12	.03	–.05	–.04	.07	.08	.13

PINNOV	*FSIZE*	*FAGE*	λ	Y1994	Y1995	Y1997	Y1998	Y1999	Y2000	Y2001	Y2002	Y2003
1												
.04	1											
−.08	.63	1										
−.06	.00	.08	1									
−.04	−.16	.04	.07	1								
.19	.06	.06	.14	−.02	1							
−.07	−.05	−.17	−.17	−.04	−.03	1						
−.10	−.05	.00	−.05	−.03	−.03	−.05	1					
.04	.03	−.02	−.01	−.05	−.05	−.07	−.07	1				
−.04	−.11	.04	−.23	−.07	−.06	−.10	−.09	−.14	1			
−.10	.02	.01	−.08	−.05	−.04	−.07	−.06	−.11	−.13	1		
.17	.14	−.04	−.20	−.10	−.09	−.14	−.13	−.20	−.25	−.19	1	
−.07	.02	.07	.19	−.06	−.04	−.07	−.07	−.11	−.14	−.10	−.20	1

PREP	*FSIZE*	*FAGE*	λ	Y1994	Y1995	Y1997	Y1998	Y1999	Y2000	Y2001	Y2002	Y2003
1												
.08	1											
−.03	.20	1										
−.28	.07	−.04	1									
−.20	.01	−.04	.40	1								
−.13	.05	−.06	.59	−.03	1							
−.01	.21	−.11	−.21	−.03	−.05	1						
−.06	−.08	.06	.00	−.03	−.05	−.05	1					
.05	.04	.08	−.07	−.05	−.09	−.08	−.08	1				
.00	.06	−.02	−.15	−.05	−.09	−.08	−.08	−.14	1			
−.10	−.05	.03	−.17	−.05	−.09	−.08	−.08	−.14	−.12	1		
.24	−.16	.00	−.49	−.08	−.15	−.14	−.14	−.24	−.21	−.21	1	
.16	.00	.02	.16	−.04	−.07	−.06	−.06	−.11	−.11	−.11	−.19	1

Table 6

Financial Value from Asymmetric Alliances: Seemingly Unrelated Regression Results for Larger Firms

	Model 1 (*N* = 156)	**Model 2 (*N* = 145)**	**Model 3 (*N* = 102)**
Firm alliance experience	.24 (.06)***	.27 (.05)***	.15 (.06)**
Alliance scope		53.71 (22.09) **	40.80 (19.00) **
Alliance type		15.75 (12.54)	24.71 (22.00)
Partner alliance experience			6.21 (2.43)***
Partner innovativeness			.01 (.00)**
Control variables			
Firm size	13.64 (18.83)	19.11 (13.17)	–.00 (.00)**
Firm age	.27 (.35)	–.53 (0.41)	–.16 (.27)
Selection correction (λ)	–137.03 (51.44)**	–134.26 (46.14)***	–166.07 (38.53)***
Firm fixed effects	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*
Chi-square (χ^2)	63.82***	62.40***	116.80***
R^2 (Overall)	.27	.29	.47

Notes: * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent measure is the change in the firm's market value measured in millions of dollars. Estimates of year and industry dummies are insignificant, so they are not shown in the table.

the financial gains to larger and smaller firms. Model 2 captures the effects of firm characteristics and alliance characteristics on the financial gains to larger and smaller firms. Model 3 captures the effects of firm characteristics, alliance characteristics, and partner characteristics on the financial gains to the larger and smaller firms.[8] Table 6 suggests that the explained variance for larger firms in Model 3 (adjusted R^2 = .47) is significantly higher than the explained variance in Model 1 (adjusted R^2 = .27) and that in Model 2 (adjusted R^2 = .29). Similarly, Table 7 suggests that the explained variance for smaller firms in Model 3 (adjusted R^2 = .28) is significantly higher than the ex-plained variance in Model 1 (adjusted R^2 = .20) and that in Model 2 (adjusted R^2 = .24). There-fore, we focus only on the parameter estimates in Model 3 in discussing our results. Table 8 shows the results of the tests of differences between the corresponding coefficients for the larger and smaller firms.

H1 states that alliance experience will exhibit a positive relationship, with financial gains to each partner firm. The results from Table 6 suggest that the parameter estimate of firm alliance experience is positive and significant ($p < .05$) for the larger firm. Specifically, every additional alliance by a larger firm adds approximately $.15 million to the shareholder value of the larger firm. From Table 7, the parameter estimate for the effect of prior alliance experience is also positive and statistically significant ($p < .001$) for the smaller firm. However, every additional alliance by a smaller firm contributes approximately $3.15 million to the value of the smaller firm—much higher than that for the larger firm ($p < .001$ from Table 7). Thus, H1 is supported, but importantly, the size of the effect is asymmetric across the larger and smaller firms.

H2 states that the financial gains to the larger firm will be greater for broad-scope NPD alliances than they are for narrow-scope NPD alliances. The parameter estimate of alliance scope is positive and statistically significant ($p < .05$), supporting H2. Specifically, a broad-scope alliance increases the market value of the

Table 7

Financial Value from Asymmetric Alliances: Seemingly Unrelated Regression Results for Smaller Firms

	Model 1 (*N* = 156)	**Model 2 (*N* = 145)**	**Model 3 (*N* = 102)**
Firm alliance experience	2.60 (.43)***	2.64 (.73)***	3.15 (.64)***
Alliance scope		7.85 (5.84)	7.18 (6.13)
Alliance type		25.98 (11.35)**	40.61 (19.24)**
Partner alliance experience			.07 (.19)
Partner reputation			– 7.60 (8.72)
Control variables			
Firm size	– .00 (.00)**	– .00 (.56)	– .00 (.45)
Firm age	– .01 (.48)	– .00 (.83)	– .37 (.79)
Selection correction (λ)	– 3.24 (2.66)	– 10.04 (5.98)*	– 42.03 (24.22)*
Firm fixed effects	0 out of 3 fixed effects significant*	0 out of 3 fixed effects significant*	0 out of 3 fixed effects significant*
Chi-square (χ^2)	34.38***	37.80***	39.57***
R^2 (Overall)	.20	.24	.28

Notes: * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent measure is the change in the firm's market value measured in millions of dollars. Estimates of year and industry dummies are insignificant, so they are not shown in the table.

Table 8

Test of Equality of Coefficients Between Larger and Smaller Firms

Variable	**Test Statistic (χ^2, d. f.= 1)**
Firm alliance experience	21.53***
Alliance scope	5.22**
Alliance type	.55
Partner alliance experience	9.70***

Notes: * $p < .10$, ** $p < .05$, *** $p < .01$. The dependent measure is the change in the firm's market value measured in millions of dollars. A significant chi-square statistic implies that the coefficient for the larger firm is significantly different from that for the smaller firm.

larger firm by $40.80 million, relative to a narrow-scope alliance. This effect is substantially significant when compared to the mean financial gains to the larger firm ($50.72 million). Although we did not have a formal hypothesis for the effect of alliance scope on the financial gains for a smaller firm, the results suggest that the coefficient of alliance scope for smaller firms is statistically insignificant ($p > .10$). That is, the difference between the smaller firm's market value changes between broad- and narrow-scope NPD alliances is indistinguishable from zero. In addition, the results from Table 7 suggest that alliance scope has a positive and significantly higher impact ($p < .01$) on the larger firm's gains than it has on the smaller firm's gains.

H3a argues that the financial gains to larger firms will be greater for link alliances than they are for scale alliances. Contrary to H3a, we find that the effect of alliance type on change in shareholder value of the larger firm is statistically insignificant ($p > .10$). For a link alliance to have a greater impact on change in the shareholder value of a larger firm than a scale alliance, it would have to bring a sufficiently high level of complementary competency to NPD. The smaller firms in our data perhaps did not bring such high complementary value to the larger firms.

H3b argues that the financial gains to smaller firms will be greater for scale alliances than they are for link alliances. The results suggest that the parameter estimate of alliance type is positive and statistically significant ($p < .05$), supporting H3b. Specifically, a scale alliance contributes $40.61 million more to the value of the smaller firm than does a link alliance. This contribution is considerably large when compared to the mean increase in shareholder value of $13.01 million for the smaller firm. However, the results from Table 8 suggest that the parameter estimate of alliance type for the smaller firm is not significantly different from that for the larger firm ($p > .10$). In addition, we tested for possible interaction effects of alliance type and alliance scope on the financial gains. The interaction effect turned out to be statistically insignificant ($p > .10$), so we did not include it in the final model. To sum up the effects of alliance characteristics, we find considerable asymmetries between larger and smaller firms with regard to the impact of alliance scope, but not so with regard to alliance type.

With regard to H4a about the relationship between partner alliance experience and financial gains to the larger firm, the parameter estimate of partner alliance experience is positive and significant at the .01 level. In terms of magnitude, every additional past alliance of the smaller partner firm increases the financial gains to the larger firm by approximately $6.21 million. Thus, H4a is strongly supported. However, the effect of partner alliance experience on the financial gains for smaller firms is statistically insignificant ($p > .10$). Thus, H4b is not supported. Consistent with H4a and H4b results, the parameter estimates from Table 7 suggest that partner alliance experience has a positive and significantly higher ($p < .01$) impact on the larger firm's gains than it has on the smaller firm's gains.

H5 argues that the financial gains to smaller firms are greater when partnering with larger firms of high reputation than they are when teaming up with larger firms of low reputation. However, the results suggest that the effect of partner reputation on the financial gains of smaller firms is not statistically significant ($p > .10$). Hence, H5 is not supported.[9] According to H6, the financial gains to larger firms will be greater when partnering with innovative smaller firms than when partnering with noninnovative smaller firms. The effect of partner innovativeness is significant ($p < .05$), supporting H6.

The effects of the control variables either are in the expected directions or are insignificant. Firm size is negatively associated with the gains of the larger firm ($p < .05$), but is not significantly related to the gains of the smaller firm ($p > .10$). Firm age is not statistically significant for both larger and smaller firms ($p > .10$). Selection correction is negative and significant for both larger and smaller firms ($p < .10$), underscoring the need to control for selection bias. None of the year or industry dummies, however, is significant ($p > .10$). Finally, four of the 11 firm fixed effects are significant in the larger firm equation ($p < .10$), but none are significant in the smaller firm equation ($p > .10$). Thus, controlling for unobserved firm heterogeneity is important for larger firms, but not for smaller firms.

We performed several analyses to ensure the robustness of the findings. A summary of these analyses and their results is reported in Appendix 2. Details on an analysis of long-term returns to NPD alliance that we performed as a robustness check appear in Appendix 3. Overall, these additional analyses checks reveal that our analysis and results are robust.

A summary of the results appears in Table 9. Firm alliance experience has a positive and significant effect on the financial gains of both larger and smaller firms. However, the similarity between larger and smaller firms ends there. The effects of alliance scope, alliance type, and other partner characteristics on financial gains are asymmetric across larger and smaller firms. Larger firms gain more from broad-scope alliances, but smaller firms' gains are not related to alliance scope. In contrast,

Table 9
Summary of Results

Factors (Hypotheses)	Predicted Effects		Results			Brief Rationale
	Larger Firm	Smaller Firm	Larger Firm	Smaller Firm	Relative Coefficients	
Firm alliance experience (H1)	+	+	+	+	$\beta_1 < \gamma_1$	Although prior alliance experience adds value to both larger and smaller firms, every additional NPD alliance is more beneficial to the smaller firm as it provides more critical information to investors regarding the smaller firm's future revenues.
Alliance scope (H2)	+	NP	+	NS	$\beta_2 > \gamma_2$	Larger firms tend to gain disproportionately from broad-scope NPD alliances because of the greater opportunity for private gains.
Alliance type (Scale versus link) (H3a and H3b)	–	+	NS	+	$\beta_3 = \gamma_3$	Greater contribution of resources by the smaller firm to downstream activities of NPD shifts the balance to the middle resulting in both the larger and smaller firms gaining equally from scale alliances.
Partner alliance experience (H4a and H4b)	+	+	+	NS	$\beta_4 > \gamma_4$	Partner alliance experience matters more for the larger firm because, unlike for the smaller firm, it helps screen partner firms with unproven track records (typically smaller firms).
Partner innovativeness (H5)	+	NP	+	NA	NA	Partner innovativeness matters from the standpoint of the larger firm as it provides new information to investors about the quality of NPD effort pursued by the larger, well-established firm.
Partner reputation (H6)	NP	+	NA	+	NA	It may be unrealistic to expect a transfer of reputation from the larger firm to the smaller firm without accounting for the tangible resources contributed by the larger firm to the NPD alliance.

NS: not significant, NA: not applicable, NP: no prediction

smaller firms gain from scale alliances, but larger firms' gains are not related to alliance type. Partner alliance experience has a positive influence on the gains of the larger firm, whereas it is not related to the gains of the smaller firm. Furthermore, partner innovativeness has a positive influence on the gains of the larger firm, but partner reputation has no effect on the gains of the smaller firm. Finally, although firm alliance experience has a positive effect on the financial gains of both larger and smaller firms, the absolute value of gains is much higher for the smaller firms than it is for the larger firms.

Theoretical and Managerial Implications

The first main finding from this study is that an asymmetric NPD alliance is not a win-lose partnership, but a win-win or shareholder value-adding alliance for both the larger and smaller partner firms. Although previous studies have not examined shareholder value changes to NPD alliances, they have suggested that the value of one partner firm may improve at the expense of the other partner. Our findings also show that the magnitudes and drivers of the financial gains are different across the larger and smaller firms.

Prior research provides only partial insights into the effects of firm characteristics, alliance characteristics, and partner characteristics on firm value, albeit not in the NPD context. This study extends prior research by studying all the effects in a single framework and by empirically showing that the relative influences of these characteristics on the firm values of smaller and larger firms vary substantially. While prior research

seems to suggest that alliance characteristics matter equally to the partner firms in an alliance, the motivation for firms to enter into asymmetric alliances is different for larger and smaller firms. Broad-scope alliances are intrinsically complex and uncertain, pose greater threats of opportunism, and result in frequent ex-post alliance changes (Oxley and Sampson 2004; Reuer, Zollo, and Singh 2002). Our results suggest that broad-scope NPD alliances create greater financial value for larger firms than do narrow-scope NPD alliances. However, the effect for smaller firms is not significantly different between broad-scope alliances and narrow-scope alliances. Likewise, we find that smaller firms tend to gain more from scale alliances than they do from link alliances. The finding regarding the smaller firm is new, and the result relating to the larger firm is consistent with prior research. This shows that as long as the alliance profits are high, there is an incentive for the larger firm to enter into the alliance, whereas the incentive for the smaller firm to enter into the alliance depends on how the benefits from technology development would be shared (Lerner and Merges 1998; Veugelers and Kesteloot 1996).

These findings have several useful implications for managerial practice. For the larger firm to gain from its partnership with the smaller firm, the alliance agreement needs to be broad-based, involving cooperation in more than one functional area. In contrast, for the smaller firm to gain from its partnership with the larger firm, greater pooling of resources through a scale alliance is desirable, as it increases the opportunity for symmetric revenue sharing and lowers the possibility of exploitation by the larger partner.

Prior research also suggests that the alliance experience of the firm creates value because of learning effects (Anand and Khanna 2000; Sampson 2005). Consistent with these research findings, we also find that alliance experience contributes to the financial value of both larger and smaller firms. However, we find that the magnitude of the gains differs considerably across larger and smaller firms. We find that every additional alliance creates more financial value for smaller firms than it does for larger firms. A smaller change in the value of the larger firm due to firm alliance experience is consistent with the fact that the stock market is well informed about the strategies of larger firms and an additional past alliance by the larger firm may be insufficient to result in a large change in the firm's value. In contrast, the stock market has considerably less information about the strategies of smaller firms, and hence, every additional alliance with a larger firm aids the investor in resolving the uncertainty related to its future cash flows. The implication for a manager of a smaller firm is that every additional past alliance with other firms not only improves its chances of survival, but also signals the firm's financial potential to investors. Alliances with larger, well-established firms are indeed the path to growth for smaller, entrepreneurial firms. Managers in larger firms need to note that every additional past alliance is valued lower than that for a smaller firm, as it does not provide a significantly new piece of information to investors. Perhaps larger firms tend to gain more from their ability to manage a portfolio of alliances (Wuyts, Dutta, and Stremersch 2004) than they do from incremental alliances with smaller firms. Indeed, large firms such as Hewlett-Packard and Eli Lilly have mastered alliances by establishing exhaustive knowledge stores that aid in partner selection as well as alliance design (Johnson, Sohi, and Grewal 2004; Kale, Dyer, and Singh 2002).

A rich body of literature suggests that endorsement by a larger, powerful firm enables smaller firms to overcome the liability of their smallness that stems from their lack of reputation (Baum, Calabrese, and Silverman 2000; Gulati and Higgins 2003; Stuart 2000). Interestingly, we find that neither partner alliance experience nor partner reputation has a significant impact on the financial gains to the smaller firm in our sample. However, the lack of empirical support for H4b and H5 suggests that larger firms part-

nering with inexperienced or less innovative smaller firms tend to be viewed as less valuable. An implication is that asymmetric NPD alliances are characterized by asymmetric information. Specifically, the characteristics of the smaller partner play a crucial role in reducing the adverse selection problem faced by the larger firm when selecting a smaller alliance partner. However, we find that the larger partner's attributes do not matter from the standpoint of the smaller firm's market value. These findings imply that in selecting smaller firms with whom to partner, larger firms need to pay closer attention to their partner's attributes (e.g., partner alliance experience and partner innovativeness) because of their ability to reduce investor uncertainty about the quality of smaller firms.

Limitations, Future Research, and Conclusion

Like most empirical research, this study suffers from certain limitations that can be addressed by future research. The first limitation is the absence of granular information pertaining to alliance agreements (e.g., terms and conditions, deal value, and resource contributions by the larger and smaller partners). Future research could collect and use such information. Second, the sample for this study is limited to publicly traded U.S. firms in the information technology and telecommunication industries. Future research needs to examine whether the findings can be generalized in other industries characterized by asymmetric NPD alliances (e.g., biotechnology and pharmaceutical industries). Third, although stock prices provide good estimates of future performance, they can be limiting in some respects. For example, the underlying assumption that stockholders are the only stakeholders is somewhat restrictive. Future research could incorporate comprehensive performance measures by including the views of multiple stakeholders as well as by taking into account the actual cash flows realized by firms.

The ubiquity of NPD alliances between "unequals" in high-technology industries can be attributed to the fact that neither larger firms nor smaller firms are able to muster all the resources needed to develop, manufacture, and market products on their own. Although such alliances frequently conjure up images of "David versus Goliath" at first glance, our results show that value is created for both the partners. More importantly, there are interesting asymmetries in the magnitude and drivers of the changes in the values for the larger and smaller partner firms, offering valuable insights. ■

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Appendix 1. Computation of NPV or Short-term Abnormal Returns

The market model for the event study is given by:

$$R_{kt} = \alpha_k + \beta_k R_{mt} + \varepsilon_{kt} \quad \text{(A1.1)}$$

where R_{kt} denotes the daily returns of k^{th} firm in the NPD alliance at time t, measured over a 240-day window, α_k, β_k are firm-specific parameters, R_{mt} is the daily return on the CRSP equally-weighted market index, and ε_{kt} is an error term assumed to be distributed i.i.d. normal. Furthermore,

$$\hat{R}_{kt} = \hat{\alpha}_k + \hat{\beta}_{kt} R_{mt}. \quad \text{(A1.2)}$$

The abnormal return (AR) and cumulative abnormal return (CAR), are thus given by:

$$AR_{kt} = R_{kt} - \hat{R}_{kt} \quad \text{(A1.3)}$$

$$CAR_{kt(-1,1)} = \sum_{t=-1}^{1} AR_{kt}. \quad \text{(A1.4)}$$

Because stock prices are strongly correlated with firm size, to control for this size effect, we compute the net present value accruing to the partner firm as the product of cumulative abnormal returns over the event window and the market capitalization of the firm. In line with previous research, we computed the market capitalization of the firm as the product of the firm's share price and number of outstanding shares 20 days prior to the alliance announcement (Chan et al. 1997, p. 210).[10]

The *NPV* of firm *k* following the NPD alliance announcement at time *t* is operationalized as

$$NPV_{kt} = NSHARES_{k(t-20)} P_{k(t-20)} CAR_{kt(-1,1)} \quad \text{(A1.5)}$$

where $NSHARES_{k(t-20)}$ = Number of outstanding shares of firm *k* 20 days prior to the event,
$P_{k(t-20)}$ = Firm *k*'s stock price 20 days prior to the event, and the other terms are as defined earlier.

Appendix 2. Robustness Checks

We performed several robustness checks. First, a common criticism of the event study methodology is that the results are sensitive to the chosen event windows. To alleviate this concern, we calculated the financial gains by using the cumulative abnormal returns over different event windows (e.g., −3 to +3, −5 to + 5). The substantive results of the analysis remain unchanged across the event windows.

Second, an emerging body of research in finance and in marketing (e.g., Fama and French 1993; Lyon, Barber, and Tsai 1999; Sorescu, Shankar, and Kushwaha 2006) contends that because stock markets are at best semi-efficient, there is a need to examine the long-term stock performance (typically 12 months after the event), especially if short-term gains are insignificant. Our results show that short-term financial gains are significant for both larger and smaller firms. Nevertheless, consistent with studies of long-term returns, we performed calendar-time portfolio regressions to assess the long-term stock performance (see Appendix 3 for details). The results of this analysis show that the long-term abnormal returns accruing to both the larger and smaller firms, although significant, are marginal, confirming that the gains are mainly short term. Thus, these results rule out the possibility of long-term performance reversals.

Third, we checked whether our results are robust to alternative operationalizations of firm size. We operationalized firm size in terms of the number of employees and sales revenues. These alternative operationalizations did not alter the patterns of asymmetry in the NPD alliance. Furthermore, the results for the hypothesized effects did not change substantively, regardless of the firm size measures employed.

Fourth, additional robustness checks for asset size ratios (of larger to smaller firm) greater than 6, 8, and 10 did not alter the substantive results, although the standard errors were inflated because of reduced sample size.

Fifth, to check if there are spillover or feedback effects of changes in shareholder values of the larger and the smaller firms on each other, we estimated a simultaneous equation model using two-stage least squares (2SLS), three-stage least squares (3SLS), and generalized method of moments (GMM) methods. The effect of the change in shareholder value of each type of firm on the change in the shareholder value of its partner firm did not turn out be significant, so we retain our proposed model.

Sixth, it can be potentially argued that the smaller firm gains more than the larger firm because of anticipation on the part of the investors that the smaller firm might be acquired by the bigger firm. To rule out this possibility, we examined our data for acquisitions. Only three alliances in our data resulted in an acquisition of the smaller firm by the larger firm. We reestimated our model by excluding these three alliances, but the substantive results remained unchanged.

Finally, we performed additional analyses to check if alliance characteristics result in value changes for the combined portfolio of larger and smaller firms. The results suggest that alliance type and alliance scope did not have statistically significant effects on the combined wealth change of the partner firms ($p > .10$). However, the interaction of alliance type and alliance scope had a statistically significant effect on the combined financial gains ($p < .05$). Thus, these results suggest that scale alliances that are of broad scope enhance the combined wealth of the partner firms.

Appendix 3. Long-term Returns for Partner Firms in an Alliance

The commonly used approach in the event study literature for examining long-run abnormal returns is the buy-and-hold abnormal returns method. However, this method is unable to control for cross-sectional dependence and often yields inflated test statistics (Lyon, Barber, and Tsai 1999). A second approach that controls for cross-sectional dependence is based on calendar-time portfolios (e.g., Fama and

Long-term Abnormal Returns for Larger Firms: Calendar-Time Portfolio Regressions

Coefficient	Average month in (−12, 12)	OLS *t*-statistic	Heteroscedasticity consistent *t*
α_p	.01	2.23*	2.27*
(Abnormal return)			
β_p	1.21	13.64***	11.07***
δ_p	.21	2.52*	1.94+
γ_p	−.70	−6.76***	−6.01***
R^2	.79		

Long-term Abnormal Returns for Smaller Firms: Calendar-Time Portfolio Regressions

Coefficient	Average month in (−12, 12)	OLS *t*-statistic	Heteroscedasticity consistent *t*
α_p	.00	2.21*	2.08*
(Abnormal return)			
β_p	1.58	8.70***	8.48***
δ_p	1.14	6.15***	4.80***
γ_p	−1.16	−5.08***	−4.01***
R^2	.71		

Notes: + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

French 1993; Sorescu, Shankar, and Kushwaha 2006). In this approach, the sample firms are grouped into portfolios based on the event date and the inference is based on a time series of the mean abnormal return of the portfolio.

We used the Fama-French three-factor model to compute the one-year long run abnormal returns. We used the calendar-time return on a portfolio of firms created on the basis of the event date to estimate the following regression:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + \gamma_p SMB_t + \delta_p HML_t + \varepsilon_{it} \quad \text{(A2.1)}$$

where R_{pt} is the simple returns of the calendar-time portfolio p at time t, R_{ft} is the return on three-month Treasury bills, R_{mt} is the return on the value-weighted market index, *SMB* is the difference in the returns of the portfolio of small stocks and big stocks, *HML* is the difference in the returns of the portfolio of high book-to-market stocks and low book-to-market stocks, and ε is the error term. The intercept is the mean monthly abnormal returns on the calendar-time portfolio. The results for larger and smaller firms are shown below.

Notes

1. The abnormal return of a stock due to an event or announcement can be defined as the difference between the expected return on that stock and the actual return that accrues from the event or announcement over a predefined time period (typically, within five days around the event or announcement for short-term return).

2. The net present value of a firm's stock is the present value of the stock's future cash flows.

3. It is worth noting that resource scarcity and information asymmetry problems in publicly held small firms may not be as severe as they are in privately held small firms. However, even small publicly held firms are faced with problems of survival. In addition, given that it is almost impossible to objectively assess the performance of privately held firms, focusing on small public firms is the only practical approach to empirically test our hypotheses.

4. Subsequent alternate operationalizations of firm size in terms of sales and number of employees yielded substantively identical results with regard to size asymmetries in alliances.

5. Although the SDC database on alliances is by far the most comprehensive source of information on alliance agreements, the dates are occasionally misreported (Anand and Khanna 2000). In some cases, the database reports the date on which negotiations for the alliance began, whereas in other cases, it reports the date on which the alliance was signed. In addition, observations on a single agreement mistakenly appear more than once.

6. The measure of firm alliance experience is left censored (i.e., alliances entered into by firms prior to 1993 are ignored), and this could potentially introduce measurement error into this variable. From a practical standpoint, however, this measure is reasonable, given that asymmetric alliances by firms in information technology and telecommunication industries began gathering momentum only in the early 1990s (Dalziel 2001). Nevertheless, we subsequently reestimated our model using an alternate measure, namely, total past alliances (including those before 1993 all the way back until 1985 for which data were available). The substantive results remained unchanged.

7. The correlations relating to the industry dummies are not shown for lack of space. They are, however, quite small, alleviating any concerns of potential multicollinearity.

8. We compared models for larger and smaller firms by altering the sequence of entry of firm, alliance, and partner characteristics into the regression equations. In all these comparison checks, the model with firm, alliance, and partner characteristics outperformed all the rival models.

9. The reputation ratings for larger firms were available in the *Fortune* database for only 130 firms. Therefore, we do not rule out the possibility that the inability to detect the positive effects of reputation on smaller firm value may be due to lack of statistical power. In addition, we recognize that the use of a global measure of reputation could have led to statistical insignificance (Fryxell and Wang 1994).

10. In the event that the market was closed for trading 20 days prior to the announcement date, the previous trading day was selected to retrieve the share price and the number of outstanding shares of the firm.

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