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Asymmetric New Product Development Alliances: Win-Win or Win-Lose Partnerships?

Kartik Kalaignanam, Venkatesh Shankar, Rajan Varadarajan
Department of Marketing, Mays Business School, Texas A&M University, 4112 TAMU, College Station, Texas 77843-4112
{kkalaignanam@mays.tamu.edu, vshankar@mays.tamu.edu, varadarajan@tamu.edu}

Interorganizational alliances are widely recognized as critical to product innovation, particularly in high-technology markets. Many new product development (NPD) alliances tend to be asymmetric, that is, they are formed between a larger firm and a smaller firm. As is the case with alliances in general, asymmetric alliances also typically result in changes in the shareholder values of the partner firms. Are the changes in shareholder values of the partner firms significant? Are asymmetric NPD alliances win-win or win-lose partnerships? Are the gains or losses symmetric for the larger and smaller partner firms? What factors drive the changes in shareholder values of the partner firms? These important questions remain largely unexplored as evidenced by the dearth of empirical research on the effect of asymmetric NPD alliances on shareholder value and on the apportionment of this value between the partner firms. We develop and empirically test a model of short-term changes in shareholder values of larger and smaller firms involved in NPD alliances, using the event study methodology on data covering 167 asymmetric alliances in the information technology and communication industries. In this model, we examine alliance, firm, and partner characteristics as potential determinants of the changes in shareholder values of the partner firms due to an NPD alliance announcement. Our model accounts for selection correction, potential cross-correlation across the residuals from the models of firm value changes for the larger and smaller firms, and unobserved heterogeneity. The results suggest that both the 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 the gains of the partner firms. The results relating to alliance characteristics suggest that while a broad scope alliance enhances the financial gains for the larger firm, a scale R&D alliance (relative to a link alliance) contributes positively to the financial gains for the smaller firm. With regard to partner characteristics, while partner alliance 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. Regarding firm characteristics, the magnitude of the financial gains accruing from a firm's own alliance experience is considerably higher for the smaller firm than it is for the larger firm. We outline the implications of the research findings for future research and management practice.

Key words: innovation; new product development; strategic alliance; shareholder value; strategic management
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1. 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 as *asymmetric alliances*. In particular, in high-technology markets, during 1970–1990, approximately 2,300 asymmetric alliances were formed (Barley et al. 1991, Kogut and Kim 1991). Furthermore, asymmetric alliances in high-technology industries increased by over 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 have been traditionally 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 et al. 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 NPD efforts. Second, partnerships with prominent partners such as larger, established firms buffer smaller firms from their liability of smallness, enhance their chances of survival, and boost sales growth

(Baum et al. 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 two larger firms, Compaq and Sprint (*Business Week* 1999).

The outcomes of asymmetric alliances, particularly changes in the 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., Houston and Johnson 2000, Kumar et al. 2000).[1] 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 NPD. For instance, evidence from the mergers and acquisitions (M&A) literature suggests that the acquired (the smaller) firm and the acquiring (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 et al. 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 the larger and smaller partners. In many cases, much of the economic value created by smaller/entrepreneurial 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. Likewise, Chan et al. (1997) conclude that while smaller partners experience larger abnormal returns than do larger partners, the magnitudes of the gains are roughly equal. In contrast, based on an analysis of 60 nonequity alliances in the information technology sector, Koh and Venkatraman (1991) note that on average, the smaller partner gains substantially ($19.2 million) more 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 firm (Das et al. 1998). The divergent results in prior studies can be attributed to heterogeneity in the focus of the alliance (e.g., NPD, marketing, and licensing). Not much is known about how an NPD alliance affects the changes in the shareholder values of the partners and whether these changes are asymmetric.

More importantly, despite the recognition that an understanding of 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, very 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.

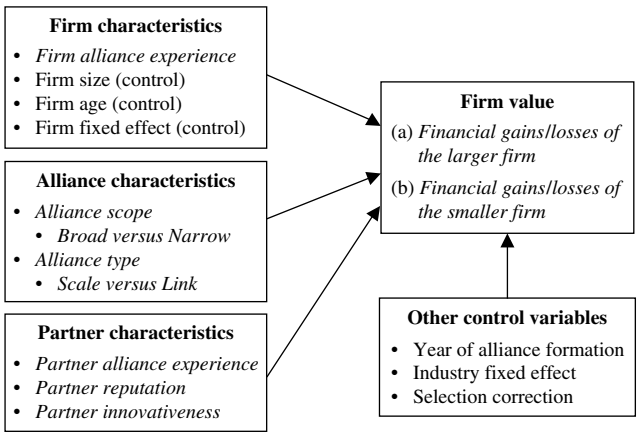
Are the changes in shareholder values of the partner firms in an NPD alliance announcement significantly positive or negative? Is the NPD alliance a win-win or win-lose partnership? Are the gains or losses symmetric between the larger and the smaller partner firms? What are the determinants of the changes in shareholder values of the partner firms in an NPD alliance? The answers to these questions are important for both larger and smaller firms from the standpoint of alliance-related decisions such as partner selection, scope, and type of alliance, and the resources to be allocated for NPD. The objective of this paper is to develop and empirically test a model of factors influencing changes in 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 model delineating 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 communication 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 et al. 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. 1997,

[1] Abnormal returns can be measured using either a *short-term* horizon surrounding the date of the announcement (e.g., Brown and Warner 1985), or a *longer-term* horizon that extends beyond the announcement date (e.g., Kothari and Warner 2005). The short-term horizon typically consists of a narrow three-day window centered on the announcement day. Both methods entail a comparison of realized stock returns with those that would have occurred if the event had not taken place (i.e., the "expected" returns).

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



Wuyts et al. 2004), or firm characteristics (Anand and Khanna 2000, Chan et al. 1997, Johnson et al. 2004), or partner characteristics (Baum et al. 2000, Stuart 2000). We extend the literature by developing and empirically testing a model that incorporates the effects of all three types of factors (i.e., firm, alliance, and partner characteristics) on changes in the shareholder values of the NPD alliance partners in a single framework. Our model accounts for selection correction, potential cross-correlation across the residuals from the models of firm value changes for the larger and smaller firms, and unobserved heterogeneity.

2. Conceptual Framework and Research Hypotheses

Figure 1 presents a conceptual model delineating the factors influencing the changes in partner firms' values in asymmetric NPD alliances. An event such as the formation of an alliance is likely to change a firm's asset price through a change in the anticipated cash flows as well as a change in the discount rate associated with the firm's future cash flows (Schwert 1981). Based on past research in related areas (e.g., Acs et al. 1994, Anand and Khanna 2000, Johnson et al. 2004, Oxley and Sampson 2004) and conceptual reasoning, 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. 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 results of the tests of the hypotheses.

2.1. Firm Characteristics

Among firm characteristics, we focus on alliance experience as the primary potential driver of changes in shareholder values of the partner firms in an NPD alliance in light of prior research which suggests that alliance experience is an important determinant of abnormal returns to strategic alliances in general (Anand and Khanna 2000, Sampson 2005). We treat firm size, firm age, firm selection, and other firm-specific factors as control variables.

2.1.1. 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. 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 development of a general alliance management capability and the establishment of interorganizational routines that aid in partner selection and conflict management (Ireland et al. 2002, Kale et al. 2002). Second, firms accumulate valuable technological and product-market knowledge from past alliances that enable them to be more successful in subsequent new NPD alliances.

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 about larger firms than 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 as well lowers its risk profile (see Baum et al. 2000 and 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. Through its experience and private information about new or emerging technologies, the smaller firm can bring valuable expertise to an alliance. We summarize our arguments through the following hypothesis.

Hypothesis 1 (H1). *The greater the alliance-related experience of a firm in an NPD alliance, the greater the financial gains to that firm.*

2.2. Alliance Characteristics

Among alliance characteristics, we focus on alliance scope and alliance type as the predominant drivers of value creation from an NPD alliance because previous research on R&D alliances suggests that these two factors often produce asymmetric NPD outcomes for partnering firms (Dussauge et al. 2000, Oxley and Sampson 2004). We treat other alliance characteristics such as year of alliance formation and industry as control variables.

2.2.1. Alliance Scope (Broad vs. Narrow). The scope of the NPD alliance can influence changes in the value of the firms in the alliance. Alliance scope refers to the breadth of functional activities (e.g., R&D, manufacturing, and marketing) 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 pre-commercial 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 toward the alliance than does a narrow scope alliance.

Despite this perspective regarding the benefits of broad scope NPD alliances, narrow scope NPD alliances are quite common, particularly 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 are higher in broad and complex alliances than they are in narrow scope alliances, the larger firm (i.e., pharmaceutical partner) is likely to appropriate a greater proportion of the revenues than the smaller firm (i.e., biotechnology partner) (Alvarez and Barney 2001, Lerner and Merges 1998). 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. 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 leakage of knowledge (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.

Hypothesis 2 (H2). *The broader the scope of an NPD alliance, the greater the financial gains to the larger firm.*

2.2.2. Alliance Type (Scale vs. Link). NPD alliances 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 partnerships in which resources are pooled for performing 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 partnerships in which resources are exchanged for performing activities relating to 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.

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. Dussauge et al. (2000) note that alliances in which resources are exchanged (link) tend to produce more asymmetric outcomes than alliances in which resources are pooled (scale). In general, in NPD-focused link alliances, 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, and 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 for 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 the partners agree to pool resources for R&D and possibly, manufacturing and marketing, thereby providing the smaller firm with 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 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, leading to the following hypotheses.

Hypothesis 3 (H3). *Larger firms gain more financially from link alliances, while smaller firms gain more from scale alliances.*

2.3. Partner Characteristics

Among partner characteristics, we focus on partner alliance experience as a key determinant of abnormal returns to the NPD alliance paralleling the alliance experience of the focal firm as a driver under firm characteristics. In addition, following prior research (Stuart 2000, Hitt et al. 2000), we model partner reputation and partner innovativeness as drivers of NPD-led changes in the shareholder values of the smaller and the larger firm, respectively. Both these serve as credible signals for investor assessment of potential returns to an NPD alliance.

2.3.1. Partner Alliance Experience. In addition to own alliance experience, the alliance experience of the 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 et al. 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 firms 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 investors are 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.

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 et al. 2003). Thus, the smaller firms could benefit from the experience of larger partners as it provides them the opportunity to mimic their alliance management techniques (e.g., process routines to initiate, manage, and terminate alliances; see Johnson et al. 2004). Therefore, we expect the effect to be positive because investors are likely to be better informed about the strategies of larger firms with higher R&D alliance experience than about other larger firms. As a result, we advance the following hypothesis:

Hypothesis 4 (H4). *The greater the partner's alliance experience, the greater the financial gains to the focal firm in an NPD alliance.*

2.3.2. 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 entering into alliances assess potential partners on reputation (Baum et al. 2000, Shane et al. 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. Therefore, we expect the performance of smaller firms to be enhanced in their alliances with reputable larger firms, leading to the following hypothesis.

Hypothesis 5 (H5). *In an NPD alliance, the financial gains to the smaller firm are greater when its larger partner firm has a higher reputation.*

2.3.3. Partner Innovativeness. While smaller firms can benefit from the reputation of larger partner firms, larger firms risk diluting 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 NPD alliance partners to larger firms because of their expertise in niche areas of technology, especially in industries where the locus of innovation lies more outside 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 their innovative capabilities in niche areas enable larger firms to overcome their structural inertia and technological rigidity. In high-technology settings (e.g., information and communication equipment, semiconductors, and pharmaceuticals), the value added by smaller firms stems from the informational advantages with which they are bestowed. Such informational advantages of smaller firms are captured by partner innovativeness (of the smaller firm). 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.

Hypothesis 6 (H6). *In an NPD alliance, the financial gains to the larger firm are greater when the smaller partner firm is more innovative.*

In addition to the focal variables delineated in H1 to H6, we also expect control variables such as firm size, firm age, year of alliance announcement, and industry-specific and firm-specific characteristics to impact the changes in the value of the partner firms in an NPD alliance. We discuss the operationalization of these variables and the results relating to their effects in §§4 and 5, respectively.

3. 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.

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 selection of this time period was influenced by the fact 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 start 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.[2] Our third sampling requirement was inclusion of nonequity alliances. This was necessary because equity alliances could potentially be an intermediate step for the larger firm to acquire the smaller firm, and therefore the stock market could potentially be responding to the smaller firm's potential as an acquisition target.

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 cut-off point for size differences. Prior research has operationalized firm size as assets or sales or number of employees. In this study, we operationalize firm size in terms of the assets of the firm in millions of dollars.[3] To better examine asymmetry in NPD alliances, we consider only those alliances in which the ratio of the larger firm's assets to that of the smaller firm is greater than five. Table 1 provides the frequency distribution of asymmetric R&D

[2] 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. We recognize that for a privately held smaller firm, the formation of an NPD with a larger firm could enable them to secure financing through private investors, venture capitalists, or initial public offering. This in turn, could boost their shareholder value.

[3] 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.

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 the 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 multimode, multiband 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

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 larger and smaller firms. We checked the accuracy of the NPD alliance announcement date, the most critical aspect of the event study methodology, using Lexis-Nexis.[4] We eliminated 19 observations due to uncertainty about the announcement date. In the remaining cases, the SDC announcement date did not differ from the announcement dates provided by Lexis-Nexis. Additional checks for concurrent events (e.g., announcement of quarterly results, announcement of new product introductions, and changes in executive positions) around the three-day window surrounding 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 using the event study methodology (Srinivasan and Bharadwaj 2003), offering sufficient statistical power. We collected the measures of firm size and market capitalization from the Compustat database.

A sample of descriptions 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.

[4] Although the SDC database on alliances is the most comprehensive source of information on alliance agreements, the dates are occasionally misreported in the database (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.

4. Measures and Methodology

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

4.1. Focal Variables

4.1.1. Net Present Value. The dependent measures of this study are the financial gains/losses or the net present value of the NPD announcement accruing to the partner firms. Consistent with Chan et al. (1997), 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. Our choice of NPV 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 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/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, in prior research on strategic alliances, the efficient market hypothesis has been explicitly tested and shown that the short-term abnormal returns to alliance announcements are strongly correlated with firm performance as reported by managers (see Kale et al. 2002 and Koh and Venkatraman 1991 for reviews). The NPV of the firm following the

Table 3 Variable Operationalization and Data Sources

Variable	Operational measure	Data source(s)
Net present value	Cumulative short-term abnormal returns × 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), Lexis Nexis
Alliance scope	Number of functional areas in which the partners agree to cooperate	SDC, Lexis Nexis
Alliance type		SDC, Lexis Nexis
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."	
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 users to access 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 multimode multiband UMTS/GPRS wireless PC card modems while Lucent was to contribute marketing support."	
Partner reputation	Eight-item scale	Fortune Magazine Database
Partner innovativeness	No. of patent citations received by 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

NPD alliance announcement is computed using the market model for the event study.

4.1.2. 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.[5] 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 are likely to 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 successful and those that were unsuccessful, but because firms tend to learn from both successes and failures, this issue is not a problem as well.

4.1.3. 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.

4.1.4. 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.

4.1.5. Partner Reputation. We obtained measures of firm reputation for the partners during 1993–2004 from the list of America's most admired companies published by *Fortune*. *Fortune's* annual survey rates

[5] 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 of past alliances (including those before 1993 all the way until 1985 for which data were available). The substantive results remained unchanged.

firm reputation on an 11-point scale (0 denoting poor and 10 denoting excellent) on 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 and Houston and Johnson 2000).

4.1.6. Partner Innovativeness. We capture the innovativeness of the partner firm through a count of the patents citations received by the partner firm in the five years prior to the focal alliance date. We collected patent data 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).

4.2. Control Variables

4.2.1. 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.

4.2.2. Firm Age. We operationalize firm age as the time elapsed from the date of founding of the firm to the date of announcement of the NPD alliance. We retrieved the founding date of the firm from the Mergent/Lexis Nexis databases. Controlling for firm age is necessary to ensure that the changes in firm values following a NPD alliance announcement are not a consequence of aging and maturation of the partner firms.

4.2.3. 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 for the years to capture these effects.

4.2.4. Industry Fixed Effect. To control for variance in financial gains due to industry-specificity (Kumar et al. 2000), we use dummy variables for the industry to which the focal firm belongs.

4.2.5. 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 data set.

4.2.6. 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 large firms enter into asymmetric alliances than smaller firms do 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 et al. 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

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

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} is 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 et al. 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., the 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.

4.3. Model Development

Tests of H1 to H6 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

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

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

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, $r \in \{1, 2, \ldots, 9$, 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, and

ς, ω = Error terms.

4.4. Model Estimation

Because the financial gains of the larger and smaller firms are generated from the same alliance, the system of equations could 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 ($\chi^2 = 25.45$, $p < 0.001$). Therefore, seemingly unrelated regression (SUR) estimates of the system of two equations are more efficient than ordinary least squares (OLS) estimates are, so 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 et al. (2006). Based on the number of multiple alliances found in the data, we include 11 firm fixed effects in the equation for the larger firm and three firm fixed effects in the equation for the smaller firm. Furthermore, to account for heteroscedasticity, we estimated the model using heteroscedasticity-consistent estimates.

5. Results

Tables 4 and 5 provide the descriptive statistics and the correlation matrices for the variables used in the study for the larger and smaller firms, respectively. 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.[6]

5.1. Hypotheses Tests and Controls

To test our hypotheses, we compared three models for both larger and smaller firms. The results are presented in Tables 6, 7, and 8. Model 1 captures the effects of firm characteristics on 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.[7] Models 4 and 5 are alternative nonlinear models with double log and semi-log functional forms, respectively. Table 6 suggests that the fit of Model 3 is significantly better than those of Models 1, 2, 4, and 5 based on pseudo log-likelihood values. Similarly, Table 7 suggests that the fit of Model 3 is significantly better than those of Models 1, 2, 4, and 5. Therefore, 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.

[6] 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.

[7] We compared the 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.

Table 4 **Summary Statistics and Correlation Matrix for Larger Firms**

	Mean	Std. deviation	*NPV*	*FALEXP*	*ASCOPE*	*ATYPE*	*PALEXP*	*PINNOV*	*FSIZE*	*FAGE*	λ	*Y*1994	*Y*1995	*Y*1997	*Y*1998	*Y*1999	*Y*2000	*Y*2001	*Y*2002	*Y*2003
NPV	50,722	145,875	1																	
FALEXP	4.40	4.92	0.45	1																
ASCOPE	0.57	0.04	0.13	0.00	1															
ATYPE	0.41	0.04	0.06	0.00	0.24	1														
PALEXP	1.22	0.52	0.16	0.05	0.14	−0.01	1													
PINNOV	16.14	49.93	0.11	0.18	−0.01	0.01	0.00	1												
FSIZE	3.96	0.80	0.11	0.59	0.00	0.08	0.16	0.04	1											
FAGE	44.58	33.89	−0.07	0.35	−0.10	−0.02	0.08	−0.08	0.63	1										
λ	1.38	0.02	−0.11	−0.13	0.02	0.22	−0.07	−0.06	0.00	0.08	1									
*Y*1994	0.02	0.01	−0.07	−0.09	0.05	0.01	−0.05	−0.04	−0.16	0.04	0.07	1								
*Y*1995	0.04	0.01	−0.13	0.23	−0.08	0.06	−0.03	0.19	0.06	0.06	0.14	−0.02	1							
*Y*1997	0.06	0.02	0.26	−0.00	0.05	0.12	0.00	−0.07	−0.05	−0.17	−0.17	−0.04	−0.03	1						
*Y*1998	0.04	0.01	0.19	0.09	−0.05	0.09	−0.02	−0.10	−0.05	0.00	−0.05	−0.03	−0.03	−0.05	1					
*Y*1999	0.10	0.02	0.09	0.17	−0.04	−0.15	0.14	0.04	0.03	−0.02	−0.01	−0.05	−0.05	−0.07	−0.07	1				
*Y*2000	0.14	0.03	0.04	0.09	0.04	−0.21	−0.07	−0.04	−0.11	0.04	−0.23	−0.07	−0.06	−0.10	−0.09	−0.14	1			
*Y*2001	0.10	0.02	0.00	0.02	−0.06	−0.07	−0.07	−0.10	0.02	0.01	−0.08	−0.05	−0.04	−0.07	−0.06	−0.11	−0.13	1		
*Y*2002	0.23	0.03	−0.02	−0.06	0.00	−0.07	0.06	0.17	0.14	−0.04	−0.20	−0.10	−0.09	−0.14	−0.13	−0.20	−0.25	−0.19	1	
*Y*2003	0.12	0.03	−0.13	−0.11	0.06	0.10	0.11	−0.07	0.02	0.07	0.19	−0.06	−0.04	−0.07	−0.07	−0.11	−0.14	−0.10	−0.20	1

Table 5 **Summary Statistics and Correlation Matrix for Smaller Firms**

	Mean	Std. deviation	*NPV*	*FALEXP*	*ASCOPE*	*ATYPE*	*PALEXP*	*PREP*	*FSIZE*	*FAGE*	λ	*Y*1994	*Y*1995	*Y*1997	*Y*1998	*Y*1999	*Y*2000	*Y*2001	*Y*2002	*Y*2003
NPV	13,017	86,858	1																	
FALEXP	1.22	0.52	0.47	1																
ASCOPE	0.57	0.04	0.04	0.05	1															
ATYPE	0.41	0.04	0.14	−0.08	0.28	1														
PALEXP	4.40	4.92	0.20	0.30	−0.03	−0.06	1													
PREP	6.93	1.04	0.08	0.06	−0.07	−0.03	0.18	1												
FSIZE	2.04	0.76	0.26	0.39	0.14	0.11	0.26	0.08	1											
FAGE	13.49	11.64	−0.03	0.02	0.02	−0.07	0.17	−0.03	0.20	1										
λ	1.78	0.01	−0.15	−0.10	−0.08	0.19	0.06	−0.28	0.07	−0.04	1									
*Y*1994	0.02	0.01	−0.02	−0.03	−0.01	0.02	−0.09	−0.20	0.01	−0.04	0.40	1								
*Y*1995	0.04	0.01	−0.04	−0.05	−0.10	0.03	0.36	−0.13	0.05	−0.06	0.59	−0.03	1							
*Y*1997	0.06	0.02	0.63	0.18	0.10	0.16	0.09	−0.01	0.21	−0.11	−0.21	−0.03	−0.05	1						
*Y*1998	0.04	0.01	−0.03	−0.03	0.02	0.16	0.05	−0.06	−0.08	0.06	0.00	−0.03	−0.05	−0.05	1					
*Y*1999	0.10	0.02	−0.02	0.14	−0.04	−0.22	0.07	0.05	0.04	0.08	−0.07	−0.05	−0.09	−0.08	−0.08	1				
*Y*2000	0.14	0.03	−0.04	−0.06	−0.04	−0.07	0.24	0.00	0.06	−0.02	−0.15	−0.05	−0.09	−0.08	−0.08	−0.14	1			
*Y*2001	0.10	0.02	−0.03	0.13	−0.02	−0.18	0.00	−0.10	−0.05	0.03	−0.17	−0.05	−0.09	−0.08	−0.08	−0.14	−0.12	1		
*Y*2002	0.23	0.03	−0.09	−0.10	−0.01	−0.07	−0.20	0.24	−0.16	0.00	−0.49	−0.08	−0.15	−0.14	−0.14	−0.24	−0.21	−0.21	1	
*Y*2003	0.12	0.03	−0.05	−0.04	0.07	0.08	0.13	0.16	0.00	0.02	0.16	−0.04	−0.07	−0.06	−0.06	−0.11	−0.11	−0.11	−0.19	1

Table 6 Financial Value from Asymmetric NPD Alliances: Seemingly Unrelated Regression Results for Larger Firms

	Model 1 ($N = 156$) Linear	Model 2 ($N = 145$) Linear	Model 3 ($N = 102$) Linear	Model 4 ($N = 102$) Double-log	Model 5 ($N = 102$) Semi-log
Firm alliance experience	0.28 (0.05)***	0.26 (0.08)***	0.18 (0.07)***	0.20 (0.12)*	0.00 (0.00)*
Alliance scope		38.83 (19.92)*	40.67 (18.17)**	1.39 (0.55)**	0.51 (0.28)*
Alliance type		22.33 (24.56)	27.22 (23.13)	0.92 (0.91)	0.31 (0.85)
Partner alliance experience			4.13 (2.11)***	1.11 (0.29)***	0.05 (0.01)***
Partner innovativeness			0.01 (0.00)**	0.03 (0.00)***	0.00 (0.00)**
Control variables					
Firm size	11.46 (13.64)	17.77 (15.74)	−0.00 (0.00)**	0.63 (1.10)	1.09 (1.09)
Firm age	0.36 (0.43)	−0.50 (0.46)	−0.06 (0.73)	−0.13 (0.82)	−0.01 (0.02)
Selection correction (λ)	−92.48 (32.14)***	−81.42 (36.75)**	−161.07 (37.17)***	−11.64 (3.15)***	−7.59 (2.21)***
Firm fixed effects	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*	4 out of 11 fixed effects significant*
Log pseudolikelihood	−4,015.28	−3,762.66	−1,645.10	−1,955.20	−2,011.48

Notes. 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 figures in parentheses are heteroscedasticity-consistent robust standard errors.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

H1 states that alliance experience exhibits 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 ($p < 0.01$) for the larger firm. Specifically, every additional alliance by a larger firm adds approximately \$0.18 million to the shareholder value of the larger firm. From Table 7, the estimate for the effect of prior alliance experience is also positive and statistically significant ($p < 0.001$) for the smaller firm. However, every additional alliance by a smaller firm contributes approximately \$2.73 million to the value of the smaller firm—much higher than that for the larger firm ($p < 0.001$). Thus, H1 is supported, but importantly, the effect size 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 significant ($p < 0.05$), supporting H2. Specifically, a broad scope alliance increases the market value of the larger firm by \$40.67 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 insignificant ($p > 0.10$). In addition, the results from Table 7 suggests that alliance scope has a positive and significantly higher impact ($p < 0.01$) on the

Table 7 Financial Value from Asymmetric NPD Alliances: Seemingly Unrelated Regression Results for Smaller Firms

	Model 1 ($N = 156$) Linear	Model 2 ($N = 145$) Linear	Model 3 ($N = 102$) Linear	Model 4 ($N = 102$) Double-log	Model 5 ($N = 102$) Semi-log
Firm alliance experience	1.95 (0.61)***	2.01 (0.66)***	2.73 (0.89)***	0.86 (0.25)***	0.04 (0.01)***
Alliance scope		12.55 (12.85)	9.68 (8.11)	0.24 (0.31)	0.13 (0.39)
Alliance type		23.02 (10.35)**	35.32 (16.53)**	1.00 (0.45)**	1.42 (0.61)**
Partner alliance experience			0.06 (0.08)	0.13 (0.29)	0.00 (0.00)
Partner reputation			−13.03 (10.22)	−2.28 (1.89)	−0.58 (0.48)
Control variables					
Firm size	9.38 (5.72)*	7.24 (6.19)	14.57 (10.46)	1.74 (0.44)***	1.68 (0.43)***
Firm age	−0.30 (0.26)	−0.25 (0.26)	−0.53 (0.28)*	−0.64 (0.36)**	−0.01 (0.02)
Selection correction (λ)	−5.91 (2.65)	−14.84 (6.11)*	−48.72 (28.11)*	−16.84 (2.89)***	−9.12 (1.65)***
Firm fixed effects	0 out of 3 fixed effects significant*	0 out of 3 fixed effects significant*	0 out of 3 fixed effects significant*	1 out of 3 fixed effects significant*	1 out of 3 fixed effects significant*
Log pseudolikelihood	−4,015.28	−3,762.66	−1,645.10	−1,955.20	−2,011.48

Notes. 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 figures in parentheses are heteroscedasticity-consistent robust standard errors.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table 8 Test of Equality of Coefficients Between Larger and Smaller Firms

Variable	Test statistic (χ^2, d.f. = 1)
Firm alliance experience	17.68***
Alliance scope	4.59**
Alliance type	0.44
Partner alliance experience	7.47***

Notes. 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.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

larger firm's gains than it has on the smaller firm's gains.

H3 argues that the financial gains to larger firms will be greater for link alliances than they are for scale alliances. Contrary to H3, we find that the effect of alliance type on change in shareholder value of the larger firm is insignificant ($p > 0.10$). For a link alliance to have a greater impact on change in shareholder value of a larger firm than that of 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.

H3 also 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 ($p < 0.05$), supporting H3. Specifically, a scale alliance contributes \$35.32 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 ($p > 0.10$). 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 ($p > 0.10$), 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 H4 about the relationship between partner alliance experience and financial gains, the parameter estimate of partner alliance experience is positive and significant for the larger firm ($p < 0.01$). In terms of magnitude, every additional past alliance of the smaller partner firm increases the larger firm's financial gains by approximately \$4.13 million. Thus, H4 is strongly supported for the larger firm. However, the effect of partner alliance experience on the financial gains for smaller firms is statistically insignificant ($p > 0.10$), so H4 is not supported for the smaller firm. Consistent with H4 results, the parameter estimates from Table 8 suggest that partner alliance experience has a significantly higher ($p < 0.01$) 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 ($p > 0.10$). Hence, H5 is not supported.[8] 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 ($p < 0.05$), supporting H6.

The effects of the control variables are either in the expected directions or are insignificant. Firm size is negatively associated with the gains of the larger firm ($p < 0.05$), but is not significantly related to the gains of the smaller firm ($p > 0.10$). Firm age is not statistically significant for both larger and smaller firms ($p > 0.10$). Selection correction is negative and significant for both larger and smaller firms ($p < 0.10$), underscoring the need to control for selection bias. None of the year or industry dummies, however, is significant ($p > 0.10$). Finally, four of the 11 firm fixed effects are significant in the equation for the larger firm ($p < 0.10$), but none are significant in the equation for the smaller firm ($p > 0.10$). Thus, controlling for unobserved firm heterogeneity is important for larger firms, but not for smaller firms.

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 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, smaller firms gain from scale alliances, but larger firms' gains are not related to

[8] The reputation ratings for larger firms were available in the *Fortune* database only for 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 lead to statistical insignificance (Fryxell and Wang 1994).

Table 9 Summary of Results

Factors (Hypotheses)	Predicted effects: Larger firm	Predicted effects: Smaller firm	Results: Larger firm	Results: Smaller firm	Results: Relative coefficients	Brief rationale
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)	+	N.P.	+	N.S.	$\beta_2 > \gamma_2$	Larger firms tend to gain disproportionately from broad-scope NPD alliances because of the greater opportunity for private gains.
Alliance type (scale versus link) (H3)	−	+	N.S.	+	$\beta_3 = \gamma_3$	Greater contribution of resources by the smaller firm to the 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 (H4)	+	+	+	N.S.	$\beta_4 > \gamma_4$	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)	+	N.P.	+	N.A.	N.A.	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)	N.P.	+	N.A.	N.S.	N.A.	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.

Note. N.S., not significant; N.A., not applicable; N.P., no prediction.

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.

6. Theoretical and Managerial Implications

6.1. Theoretical 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 prior studies have not examined shareholder value changes to NPD alliances, they have suggested that the value of one partner may improve at the expense of the other partner. Our findings also show that the magnitudes and drivers of the financial gains are different for 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 the effects of all of the above in a single integrative model 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 are 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 et al. 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).

Prior research also suggests that 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.

A rich body of literature suggests that endorsement by a larger, powerful firm enables smaller firms to overcome their liability of smallness that stems from their lack of reputation (Baum et al. 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 H4 for smaller firms and H5 suggests that larger firms partnering 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.

6.2. Managerial Implications

These findings have several useful implications for larger and smaller firms. From the larger firm's standpoint, 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 et al. 2004) than they do from incremental alliances with smaller firms. In addition, an alliance agreement with the smaller firm needs to be broad-based involving cooperation in more than one functional area for the larger firm to gain from its partnership. In addition, these findings also have clear implications for the large firm's partner selection. The larger firm is also better off forming an NPD alliance with a smaller firm with rich alliance experience. Finally, the larger firm might want to scout for innovative smaller firms—those that have a large number of patents and strong R&D capabilities. The implication of these findings for larger firms is to build well-established partner selection routines to bolster its overall NPD alliance management capability. 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 et al. 2004, Kale et al. 2002).

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. 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. The broader implication for smaller firms is to enter into NPD alliances with larger firms in times when it can contribute adequate resources to the NPD effort. In such situations, the smaller firm can hope to stake a greater claim to the residual rights from the innovation. Finally, the issue of partner selection is less important to smaller firms. Specifically, the smaller firm need not seek to partner with reputable larger firms or larger firms with greater alliance experience, as neither reputation of the larger firm nor the larger firm's alliance experience appear to have a significant effect on the change in shareholder value of the smaller firm.

7. Limitations, Future Research, and Conclusion

Like most empirical research, this study suffers from certain limitations that can be addressed in future research. First, granular information is absent on alliance agreements (e.g., terms and conditions, and 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 generalize to other industries (e.g., biotechnology and pharmaceutical industries). Third, although stock prices provide good estimates of future performance, they can be limiting in some

respects. 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. Fourth, the logic behind asymmetry on firm size relies on the theory of power in interfirm relationships (Gaski 1984). However, firm size is just one source of power and other bases of power such as know-how also exist (e.g., French and Raven 1959). Thus, differences in firm valuation can come from other sources of power difference than just size, so this issue could be explored by future research.

The ubiquity of NPD alliances between "unequals" conjures up images of the biblical story of "David and Goliath." However, the results from our study suggest that such alliances are win-win alliances, where both the partners gain in shareholder value, in contrast to the conclusions from that biblical story.

More importantly, our results show that there are interesting asymmetries in the magnitude and drivers of the changes in the shareholder values for the larger and the smaller firms. The drivers in our study included firm, alliance, and partner characteristics. We find that every prior NPD alliance by a firm contributes its financial gains from an NPD alliance to a greater extent in the case of the smaller firm than in the case of the larger firm. Furthermore, we find that while a broad scope alliance benefits the larger firm more than it helps the smaller firm, a scale NPD alliance benefits both the larger and smaller firms. Finally, the results show that partner characteristics contribute more to the financial gains of the larger firm than to the financial gains of the smaller firm.

To sum up, asymmetric NPD alliances are win-win partnerships, but the sources of the win are quite different for the larger and the smaller firms, suggesting that managers of such alliances should think differently about managing their alliances. We expect these findings to stimulate further research on asymmetric NPD partnerships.

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Appendix. Robustness Checks

We performed several analyses to ensure the robustness of the findings. 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 et al. 1999, and Sorescu et al. 2007) contends that because stock markets are at best semi-efficient, there is a need to examine the long-term (typically 12 months after the event) stock performance 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 the appendix 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 firm 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.

Seventh, 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 ($p > 0.10$). However, the interaction of alliance type and alliance scope had a statistically significant effect on the combined financial gains ($p < 0.05$). Thus, these results suggest that scale alliances that are of

broad scope enhance the combined wealth of the partner firms.

Finally, we tested for alternate model specifications (log-log and semi-log models). The substantive results remain unchanged. Because our proposed linear model has a better fit than those of the alternative models, we retain our proposed model.

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