Value Co-Creation and Wealth Spillover in Open Innovation Alliances

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Abstract

In this study, we investigate the economic and strategic value of open innovation alliances (OIAs), in which collaborators and competitors integrate in the pursuit of the co-development of technological innovations. Given that OIAs differ substantially from traditional, closed alliances in many aspects, including their strategic scope and scale, governing mechanisms, and member composition, it is important to understand and assess the potential value inherent in these new modes of collaboration. Furthermore, OIAs evolve over time and the participating members can enter and leave the alliance at any time; therefore, we also examine the on-going value creation and wealth spillover that result from changes in membership. Moreover, we examine whether a firm's participation in an IT-based open alliance increases or decreases the market value of its rivals operating in the same marketplace. To gain additional insight into the factors that moderate the market valuation of OIA participation, several contextual factors, including the degree of partner heterogeneity, innovation type, and the degree of openness of the OIAs are used to account for variability in abnormal returns. On the basis of 194 observations, we found that allying firms realize significant positive abnormal returns when their entry into an OIA is made public. The results also suggest that substantial excessive returns accrue to the allying firms with the belated entry of a market leader firm. Furthermore, we discovered that a firm's entry into an OIA increase, rather than decrease, the market valuation of its rival. Interestingly, an incumbent rival that did not participate in the alliance appears to gain greater "free-riding" benefits from the OIA, as compared to peer rivals. Innovation type and openness were significantly associated with the amount of abnormal returns accruing to allying firms, while no significance was found for partner heterogeneity. Finally, we conclude with a discussion of the implications of our findings for research and practice with respect to value co-creation in multi-firm environments.

Keywords: open innovation, open innovation alliances, value co-creation, wealth spillover, event study

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INTRODUCTION

Innovation is an essential strategic thrust that plays an important role in both the survival and prosperity of firms of all sizes and in every industry (Utterback, 1994). The importance of innovation will continue to grow in the future, as the business environment becomes increasingly uncertain and competitive. Traditionally, innovation has been created and marketed under "closed" settings, in which companies follow a virtuous circle and internally manage all of the processes involved in the innovation lifecycle (Chesbrough, 2003). For example, a company making internal R&D investments aims to uncover scientific discoveries that can then be commercialized in the form of new products and services. The increased sales and profits that result from innovation are typically reinvested in order to reinforce the firm's innovation capabilities, which lead to further breakthroughs. During this process, the company typically seeks legal protection for its intellectual property and know-how in order to prevent its competitors from infringing on proprietary knowledge and exploiting it for their own benefits.

Recently, this type of closed innovation has been the main target for innovation (Chesbrough, 2003). Given that consumers' needs and requirements are evolving rapidly in today's markets, the traditional, closed innovation paradigm, generating new ideas only internally and marketing them slowly through a single path, is inefficient and inflexible in a fast-changing environment (West and Lakhani, 2008). In light of this recognition, a new paradigm has recently emerged under the rubric of "open innovation," which is defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough et al., 2006, p.2). In contrast to a closed model of

innovation, an open innovation mechanism goes beyond conventional boundaries to tap into unique ideas from various constituencies within the innovation ecosystem.

Despite their nascent stage of development, many contemporary business enterprises have jumped on the bandwagon of this emerging industrial trend, participating in open innovation alliances (OIAs) in pursuit of leveraging purposive knowledge inflows and outflows. For example, in 2007 a group of leading IT companies, including Google, T-Mobile, Intel, Qualcomm, and Samsung, formed *Open Handset Alliance* and launched an initiative called *Android* to develop an array of innovative infrastructure platforms and software applications for mobile technologies[1]. Such innovation-driven open collaborations are frequently used by firms operating in the mobile phone industry, including handset manufacturers, software developers, and mobile operators. These collaborations facilitate the value co-creation through the joint design and development of technologically innovative devices, services, and standards. The collaborative maneuvers currently being harnessed in high-tech industries could potentially reshape the competitive dynamics and alter the strategic positioning of the companies that operate within this vibrant and fast-paced environment. Moreover, the technological innovations cultivated through OIAs could enable the participating firms to develop and introduce an entirely new market, which would create substantial economic value and opportunities for all parties involved in such a collaboration.

In spite of the burgeoning interest in open innovation and OIAs, our understanding of multi-firm-based, open arrangements remains limited. Unlike dyadic, contract-based, and closed alliances, OIAs typically consist of a collection of companies, operating on a "module" basis with diverse roles and responsibilities. Moreover, OIAs are formed and maintained based on

[1] See http://www.openhandsetalliance.com/press_110507.html for a full list of founding members.

several unique governing principles, such as open membership, transparency, self-regulation, and self-monitoring, all of which rarely occur in traditional alliances. Furthermore, such open alliances evolve dynamically over time in terms of member composition and pursued objectives and goals. Consequently, the arguments and findings of previous studies on strategic alliances might not apply to OIAs. Therefore, in the present study, we focus on the wealth implications for firms participating in OIAs and their rivals, and seek to address the following questions: How does the market evaluate a firm's strategic decision to participate in OIAs? What is the impact on the market valuations of firms that already participate in the OIA when a market leader joins the existing alliance? What do OIAs mean to non-participating rivals and their market valuation? Due to both the prematurity of the development stage and the complexity involved in the value creation process, the executives of partner firms and their competitors are faced with distressing challenges when assessing an OIA's value creating capacity. Based on a popular valuation method that utilizes event studies, this study seeks to fill this void and enhance our understanding of value co-creation in the context of OIAs[2].

Our study contributes to a growing body of research on open innovation in several important ways. First, OIAs have emerged as a new collaborative paradigm in multi-firm settings, and it is clear that they differ substantially from traditional, inter-firm alliances. Given that various aspects of these alliances, including their strategic scope and scale, governing mechanisms, member composition, and evolutionary dynamics, separate OIAs from traditional alliances, it is important to understand and assess the potential value inherent in these new modes of collaboration. Our theorizing based upon the unique characteristics of OIAs, and the empirical

[2] Our study focuses on the market valuation of a firm's entry into OIAs to participate in value co-creation. Hence, we used individual firms' abnormal returns to examine the value accruing to individual firms when they participate in OIAs. However, although it was beyond the objective of our study, we performed a portfolio abnormal returns analysis (Swaminathan et al., 2008) and obtained the results that are generally consistent with those of individual returns analyses. See the Results section for details.

validation through an established methodology contribute to the growing body of literature on strategic alliances, in general, and on open alliances, in particular.

Second, unlike traditional alliances, OIAs transform dynamically over time as new members join. This evolutionary aspect of OIAs might have important implications for the value creation process presented to existing members and, therefore, it merits particular investigation. Yet, event studies on strategic alliances have focused exclusively on the market value of alliances at the time of formation, while shedding relatively little light on the on-going value creation after their initial formation. To the best of our knowledge, no studies in either the alliance literature or the IS literature have examined this issue.

Third, this is among the first studies in IS that provide insights into the wealth effect of IT-related initiatives on the market valuation of rival companies. Previous studies thus far have focused on whether specific IT investments result in either positive or negative abnormal returns for a particular investing firm, but they are all silent about what these investments mean to rival firms and their market valuations.[3] In markets where competitive dynamics govern the firms' behaviors (e.g., Porter, 1980; Tirole, 1988), investors typically not only observe the actions of their company of interest, but they also monitor and analyze rival companies as well (Eckbo, 1983). However, the main goals and value-drivers of OIAs generally seek to increase overall market demand rather than market share. In other words, OIAs seek to enlarge the "economic pie," through value co-creation, rather than fighting with competitors over a "fixed pie." Consequently, the rivals who do not participate in the alliance may also benefit from the OIAs.

[3] As we will mention later, there are studies in strategy and finance fields that have examined the impact on rival firms' market valuation (e.g., Oxley et al., 2009). However, we are not aware of any IS event studies that have analyzed wealth effects on rivals.

As such, we seek to uncover whether a firm's participation in an IT-enabled open alliance increases or decreases the market value of rivals operating in the same marketplace.

Fourth, we have developed and validated a specific empirical model to gain insight into the variations in firms' market valuation that results from OIA participation announcements. On the basis that there is a paucity of knowledge about the future profitability of OIAs, which manifests as abnormal stock returns, it is worthwhile to seek to identify the factors that could have value-creation implications for OIA constituents. In fact, to the best of our knowledge, no research is available that investigates the contextual factors that are specific to OIAs. Our results suggest that the type of innovation and the degree of openness are significantly associated with the future profitability of OIAs. Therefore, we believe that our approach is not only unique, but also offers new insights.

Finally, in addition to these scholarly contributions, our study is likely to benefit practitioners whose businesses are critically affected by new technological innovations. The results of this study provide managers in high tech and knowledge intensive industries with valuable insights into the potential value creation associated with participating in OIAs. Moreover, since participation is voluntary, managers can choose the "best" alliance to join and can base their decisions on many criteria, including the characteristics of the innovations to be developed and the degree of openness of the alliance.

Next, we review the related literature, and present the research model and hypotheses. Then, the data and research methods employed in the present study are discussed. The next section describes the results of our study. Finally, the paper concludes with a discussion of the results and implications as well as avenues for future research.

THEORETICAL BACKGROUNDS AND HYPOTHESES

Numerous theoretical and empirical inquiries notwithstanding, confusion still remains in academic circles regarding the performance implications of strategic alliances formed in pursuit of the exchange, sharing, or co-development of products, technologies, or services (Gulati, 1998). Some studies have shown positive empirical regularities between such inter-organizational partnering and the firms' financial performance (e.g., McConnell and Nantel, 1985), other studies have found no statistically significant patterns (e.g., Finnerty et al., 1986), and some have identified even the negative impacts of strategic alliances on performance (e.g., McGahan and Villalonga, 2005). One source of these inconsistent and fragmented findings stems from the lack of rigorous assessment procedures by which the complex patterns and structures embedded in inter-organizational alliances can be discerned (Kogut, 1989). In fact, investigating the performance of strategic alliances poses onerous challenges on researchers and practitioners since alliances have an eclectic variety of forms (e.g., joint ventures, technology-licensing, cooperative marketing). The many endogenous (e.g., other major strategic initiatives) and exogenous factors (e.g., environmental shift) at play could also lead to the misinterpretation of the outcomes of such inter-organizational combinations (Anderson, 1990).

For several decades, event studies have been widely used as a valid and potent mechanism for understanding, at the holistic level, the potential value of strategic alliances (Oxley et al., 2009). Values attached to a particular strategic alliance can be assessed based on the magnitude of abnormal stock returns, which indicate the collective beliefs of investors about the competence and capacity of such strategic actions to generate future cash flows for the participating firms. The majority of previous studies utilizing event studies as a performance mechanism, with a few exceptions (e.g., Finnerty et al., 1986; McGahan and Villalonga, 2005),

found that the announcement of strategic alliances resulted in a positive stock market reaction. This reflects the investors' confidence with respect to the value creation capability of the collective arrangement (Oxley et al., 2009). For example, based on 136 joint venture announcements, which occurred in the 1970s, McConnell and Nantell (1985) showed that the wealth of stockholders in firms involved in the alliances increased substantially (0.73%) following the announcement. Likewise, using 175 joint venture initiatives involving 239 firms in the IT sector, Koh and Venkatraman (1991) revealed that strategic alliance announcements resulted in excessive returns of 0.87% for the firms involved. More recently, based on 297 strategic alliance announcements from1985 to 1995, Reuer and Koza (2000) showed that the alliance announcements led to positive abnormal returns (0.44%) for the allying firms. Drawing upon several theories of the firm, such as transaction cost economics (TCE) (Williamson, 1979) and resource-based views (Barney, 1991), these studies offer conceptual insights into the positive reaction to such inter-firm arrangements, which can be subsumed under two main categories (Wolff and Reed, 2000; Oxley et al., 2009): (1) reduced transaction costs (Hennart, 1991), and (2) organizational learning and synergistic resource pooling (Hamel, 1991; Koh and Venkatraman, 1991).

Market Reaction to Open Innovation Alliances

From a TCE perspective, several aspects unique to OIAs will encourage investors to react positively to OIA announcements. Openness, transparency and self-regulation, and self-monitoring are the defining characteristics and the operational norm upon which OIAs are formed and sustained. Since the functioning and governance-related activities within OIAs, including knowledge exchange and strategic decision-making, are known to participants and the public, self-interest and opportunism are structurally discouraged in OIAs, unlike in contract-

based "closed" alliances. The presence of self-monitoring and a common ownership structure ensure that OIAs have the capacity and capability to economize on transaction costs and preclude opportunistic bargaining and self-centered manipulations. Since members can freely enter and exit the OIA, "hostages" or "hold-ups" (Williamson, 1979) are neither possible nor important for safeguarding the exchanges during the *ex ante* (selection) and the *ex post* (bonding) periods.

Moreover, OIAs provide their members with corporate roundtables that facilitate learning and the assessment of resources and skills complementary to their current knowledge and capabilities. Such learning, resource-accessibility, and the internalization of external skills are critical strategic drivers for organizational growth, especially for those competing in high-tech industries. Innovations, whether product-related or process-driven, can be more successfully designed and implemented in open environments in which both the exploration of new ideas and the exploitation of old certainties (Schumpeter 1942; March, 1991) can be readily facilitated. Specifically, when established by firms with diverse backgrounds, an OIA can be thought of as a dynamic "adaptive system" in the sense noted by March (1991), which not only promotes knowledge exploration (e.g., search, variation, and experimentation) as well as exploitation (e.g., refinement, choice and efficiency), but also responds quickly to environmental changes. The OIAs' unique structural mix arising from both lateral and vertical integrations offers a competent organizational form conducive to effective learning and resource-pooling necessary for innovation. Based on these arguments, we posit that:

H1: Positive abnormal stock returns will accrue to firms that participate in an OIA.

Wealth Spillover[4]

Unlike most closed strategic alliances, which typically maintain continuity and stability with regard to their membership for a pre-specified period, OIAs evolve dynamically over time as members freely enter and exit the alliance. Although studies abound regarding the market reaction to strategic alliances at the time of formation, little is known about the on-going value creation and wealth spillover that result from changes in member composition over time. For example, to what extent does the entry of a market leader affect the value of the existing members of an OIA? Is there any wealth spillover in the form of increased market value for the existing partners when a market leader joins the group? This is an important question for both OIA participants and their shareholders because the resulting wealth may be significantly affected by membership dynamics. In this study, we focus on the specific circumstances that are involved when a market leader enters an existing OIA, and we investigate the extent to which the addition of such a company boosts the market value of existing OIA members[5]. Our goal is to understand the membership dynamics that may govern the value creation trajectories that occur in this unique setting.

We postulate that when a market leader, such as Microsoft, Intel, NTT, or Cisco, joins an existing OIA, the firm will substantially enhance the market value of the current OIA members because investor confidence regarding the profitability and marketability of the ongoing project will be boosted. In accordance with resource-based theory (Barney, 1991), a market leader entering into an existing alliance can help the alliance to dramatically expand and diversify its resource repository by acquiring key resources from both the new participant and its network.

[4] Throughout the paper, "spillover" loosely refers to a phenomenon in which one party benefits from the actions of other party without incurring significant costs.

[5] For a comprehensive assessment, the wealth effect associated with the exit of existing members from the alliance should also be examined. However, because an OIA is a new phenomenon, we were unable to collect the sufficient "exit samples" to investigate this issue.

The expanded resource pool that arises from the addition of the market leader would increase the likelihood of the OIA's success and future profitability.

More importantly, the signalling effect contributes most to wealth creation for the existing OIA members. According to signalling theory (Spence, 1974), the entry of a market leader into an existing coalition can send a credible signal to the stock market regarding the future prospects of the products or services that are under development, and it can mitigate investors' perceived uncertainties regarding the alliance. Because the open platform transparently disseminates to the public all of the information related to the project, the late entrant benefits from a late-mover advantage in that it can monitor the project's progression. Shareholders may view the new membership of a large company as an expert endorsement that attests to both the value and potential of the ongoing initiative (Diamond, 1984). Moreover, the participation of a market leader typically signals to the market that more companies are likely to join this "certified" alliance in the future, which could lead to a snowball effect. Consequently, the existing members' wealth will increase upon the entry announcement of a market leader company. Therefore, we posit that:

> H2: The announcement of the entry of a market leader company into an existing OIA will result in positive abnormal returns for current OIA member firms.

OIAs and Their Impacts on Rivals' Market Valuation

Despite the increased adoption of event studies in management research, there has been a glaring lack of empirical inquires, with the exception of Eckbo (1983) and Oxley et al. (2009), that investigate how alliance announcements affect the wealth of the allying firms' rivals. Two contrasting views have emerged regarding the impact of partners' strategic alliances on the

market valuation ascribed to their rivals (Oxley et al., 2009). The *competitiveness-enhancing* perspective suggests that if an alliance is expected to increase the resource portfolio and complementarities of the participating firms and to enhance their competitiveness accordingly, announcements of such strategic actions will produce negative abnormal stock returns for the rivals of the allying firms. In contrast, the *competition-attenuation* view claims that an alliance of partnering firms is likely to dampen competition intensity in that industry. As a result, rivals that do not participate in the alliance can take advantage of the "residual" free-riding effects (Salant et al., 1983). Consequently, when a new alliance is announced, positive abnormal returns could accrue to both the allying firms and their rivals (Eckbo, 1983; Stillman, 1983). Recently, Oxley et al. (2009) found no significant impact, at the aggregate level, of an alliance announcement on the market valuation of rival companies. These authors attributed the insignificant association to the possible co-presence of two effects (competitiveness-enhancement and competition attenuation), which might cancel each other out. Reporting their results, they stated; "Taken together, our results thus suggest that R&D alliances may have both competitiveness-enhancing and competition-softening effects; which of these two effects dominates depends on both the type of alliance that is established and the context in which the alliance takes place." (Oxley et al., 2009, p. 1335).

On the basis that OIAs differ substantially from traditional alliances, the perspectives Oxley and her colleagues offered might not apply to OIAs. For example, the competitiveness-enhancement perspective, in which partners "privately" acquire or access new skills through the closed alliance and thus improve their competitiveness (while rivals become less competitive than they were before the OIA alliance), does not accurately reflect the founding goal of "sharing and co-creating" and the potential value of OIAs. Based on two theoretical insights, namely,

increased market demand and knowledge spillover, we hypothesize that rivals also benefit from OIAs they are not members of. First, rivals that do not participate in an OIA can take advantage of "free-riding" benefits as allying OIA partners enlarge the "economic pie" through innovations. The main goals and value-drivers of an OIA are to increase overall market demand, rather than market share. In other words, the goal of OIAs is to enlarge the pie, through value co-creation, rather than fighting with competitors over a pie that is fixed in size. It is important to note that OIAs fundamentally differ from open source communities, such as Sourceforge.net, in which individual programmers and users develop a wide variety of software applications and distribute them to the public free of charge. Although software development is one operational function OIA partners perform, the goal of the alliance extends far beyond software development and focuses on the creation of new, revolutionary products (e.g., smart phone devices) or services (e.g., interactive digital TV services). These new products and services are enabled by technological innovations that are co-developed by OIA partners and can enhance the industry's total profitability, amplifying the business prospects of both participants and their rivals.

Another way OIAs can benefit the rivals of participating firms is through knowledge spillover. Knowledge spillover typically occurs when firms can utilize, for their own benefit, the output of R&D investments from other firms without incurring any additional direct costs (Griliches, 1992). In the case of organizational integrations, knowledge spillover, whether intended or unintended, often takes place among alliance partners (Inkpen, 1998). In contrast to closed innovation where the knowledge associated with the innovation is not readily accessible by rivals prior to commercialization, all the technical specifications of the products and services developed by OIAs are publicly available, including to the participating firms' rivals. Spilled-over knowledge contributes to the wealth and innovation capabilities of rivals because they can

replicate the innovation without having to “reinvent the wheel” and at lower cost. By capitalizing on knowledge spillover, rivals can effortlessly render their product compatible and interoperable with "dominant designs" (Farrell and Saloner, 1985). We, therefore, posit the following:

> H3: The announcement of OIAs will result in positive abnormal stock returns for the rival firms that compete with the firms participating in OIAs.

Degree of Partner Heterogeneity

The degree to which partners participating in an alliance are homogeneous has been suggested to influence alliance outcomes. For example, Borys and Jemison (1989) and Harrigan (1988) demonstrated that partners with a high degree of homogeneity in terms of their activities and processes can easily establish a common ground upon which they can facilitate the sharing of skills and resources. Moreover, partners that compete in the same industry, when forming an alliance, can develop strategic and organizational compatibility with much less effort and cost than partners that operate in different industries (Koh and Venkatraman, 1991). The former is often referred to as a horizontal alliance, whereas the latter is described as a vertical alliance.

Interestingly, OIAs provide a unique context in which a horizontal alliance "meets" a vertical alliance as they are typically comprised of many rivals that compete in the same industry (e.g., IBM and HP, Intel and AMD) as well as many non-rivals that operate in unrelated business domains. Two opposing views can be found with respect to the impact of partners' homogeneity on the market reaction to OIA announcements. One view posits that an alliance formed by homogeneous partners (e.g., competitors) makes the inter-organizational integration and maintenance smoother and less costly (Koh and Venkatraman, 1991). This ultimately enhances, to a larger extent, the participants' market power and economies of scale (Pfeffer and Nowak,

1976). In contrast to this "economic efficiency" perspective, the "resource multiplicity" view postulates that a horizontal alliance between partners with similar origins has a limited complementary capacity as a value-maximizing mechanism because it tends to lack essential structural diversities in terms of resources, skills and capabilities (Balakrishnan and Koza, 1993). On the contrary, a vertical cooperative arrangement with both upstream and downstream integrations enable participating partners to capitalize on resource diversities from which new, innovative products and services can be developed and commercialized (Barki and Pinsonneault, 2005). Moreover, an alliance with heterogeneous partners can widen a window of opportunities in the form of new product and market expansions, which are not easily facilitated in the case of the horizontal integration with homogeneous participants. For example, Nike and iPod, which compete in different industries, innovatively combine their products and services together to revolutionize the way people entertain and exercise. The synthesis of the two otherwise separate products not only enhances the products' features, but also helps each company in considerably expanding its business territories.

We argue that benefits accruing from "resource multiplicity" outweigh those generated from "economic efficiency" in the case of OIAs. Consequently, firms that participate in an OIA with more heterogeneous partners will exhibit higher abnormal returns than firms that join an OIA with more homogeneous partners. Our rationale is that the scale and scope of innovation can be larger and the new market opportunity widened, when more heterogeneous companies participate in a coalition to jointly develop and commercialize innovations. Companies with similar backgrounds who band together to deepen their specialties will find their financial and technical gains to be much narrower. Although the vertical integration may require higher coordination and development costs, and take a relatively longer time to succeed than the

horizontal linkage, its potential returns, when successful, are likely to surpass those that can be produced from a horizontal arrangement. In this light, the market will reciprocate more favorably to the firms that participate in a heterogeneous OIA than those that join a homogeneous OIA. Therefore, we posit the following;

> H4: All else being equal, firms that participate in an OIA with more heterogeneous partners will experience higher abnormal returns than firms that join an OIA with more homogeneous partners.

Innovation Type

Although projects initiated by OIAs are, in general, technologically innovative, they differ in terms of the degree of innovativeness. For example, some projects are based on *incremental innovation*, which "introduces relatively minor changes to the existing product and exploits the potential of the established design" (Henderson and Clark, 1990, p. 9); others make use of *radical innovation*, which is based on "a different set of engineering and scientific principles and often opens up whole new markets and potential applications" (Henderson and Clark, 1990, p. 9). More specifically, some OIA projects (e.g., Android, Eclipse)[6] aim to develop new processing paradigms, frameworks, tools, and applications from the ground-up, and this entails unconventional scientific concepts and engineering principles. By contrast, although considerable skills and ingenuity are still required, other projects (e.g., Khronos, Liberty Alliance)[7] focus on the architectural enhancement of existing technologies or the expansion of technological specifications to augment interoperability and compatibility.

Different types of innovation have different economic and competitive consequences (Tirole, 1988). Therefore, investors' reactions are expected to vary substantially depending on the

[6] See http://www.android.com/, http://www.eclipse.org/
[7] See http://www.khronos.org/, http://www.projectliberty.org/

innovativeness of the project under development. We propose that OIA announcements that involve radical innovation will generate higher abnormal stock returns than OIA announcements that relate to incremental innovation because revolutionary and radical innovation, when successful, can generate a future cash flow that is substantially larger than that of incremental innovation (Henderson and Clark, 1990). Products or services that embody radical innovation present firms with an opportunity to expand into new markets, whereas such drastic market expansion is largely limited in the case of incremental innovation. Moreover, the value of complementary resources and capabilities integrated through OIAs can be maximized when these resources are used to create innovations that are paradigm-breaking, disruptive and transformational. Finally, OIAs involving radical innovation may be perceived as more risky than those focusing on incremental innovation, and hence can enjoy a risk premium from the market (Dewan et al., 2007). Therefore, we posit the following:

> H5: All else being equal, firms that participate in an OIA driven by radical innovation will experience higher abnormal returns than firms that join an OIA focusing on incremental innovation.

Degree of Openness

The term, *open*, is a central concept of the motives and the roles of OIAs. However, the degree of openness may vary from OIA to OIA, depending on the level and locus of access and decision authority permitted to participating members (Boudreau, 2008). On the basis of Boudreau's framework (2008), we define *access* as the extent to which external partners are allowed to enter into the OIA to make use of the existing resources and capabilities that other members contribute. We define *decision authority* as the extent to which a member of an OIA is authorized to participate in both day-to-day operational activities and strategic decision-making.

Some OIAs provide their members with full access and decision authority, whereas others do so only in a limited capacity. As mentioned previously, corporate alliances that are established in an open form bring about many benefits, including the evasion of small numbers bargaining, reduced transaction costs, and the accumulation of complementary resources and skills (Powell et al., 1996). In this regard, the higher the degree of openness, the greater the benefits that OIAs can produce. Therefore, we hypothesize the following:

> H6: All else being equal, firms that participate in an OIA with full access and decision authority will experience higher abnormal returns than firms that join an OIA with limited access and decision authority.

RESEARCH METHODS

Data

We collected the samples based on a full-text search of public announcements of OIAs appearing in two leading news sources (*PR Newswire* and *Business Wire*) between January 1, 2000 and August 30, 2009. We designed and implemented a two-stage identification procedure to improve the rigor of our search. In the first stage, general search terms such as *open innovation*, *open standards*, and *open alliance* were used to identify OIAs. This search yielded 1,382 articles. Each article was read by at least one of the authors of this study, and 24 active OIAs were identified. Of these recognized OIAs, six open-marketing alliances were removed because they did not involve the development of any new technologies; their main goal is to co-promote the adoption of existing technologies. We also excluded three OIAs established in 2009 because at the time of this study abnormal returns and financial data were not yet available from

the WRDS database (wrds.wharton.upenn.edu/). Consequently, fifteen OIAs were retained and used in the second-stage search.

The second stage involved the identification of the firms that participated in the OIAs identified in the first search. In this stage, the specific OIA names or their project names (e.g., Open Handset Alliances or Android) were used as search strings and all of the articles that contained such keywords were extracted. The second search process yielded 2,466 articles. As in the first stage, two authors engaged in a filtering process by which the articles were manually analyzed. Any duplicate announcements (those made by both an OIA organization and an individual firm) on the same event date were counted as one event. Upon the completion of this procedure, 257 events were identified that were related to a firm's OIA participation. Of these 257 events, 31 were excluded because the firms involved were either private or foreign companies whose stocks were not traded publicly in U.S. stock exchanges. In addition, 32 were removed because of confounding announcements (such as earnings and dividend announcements, other major M&As and strategic alliances, and stock split or repurchase) that occurred within a three-day period around the event date. Consequently, 194 events were included in the test of Hypothesis 1. Table 1A provides the step-by-step procedure for data collection and screening. [8]

Table 1A. OIA Member Data Screening Process for H1

Description	Number of Articles
First stage keyword search (OIA search)	1,382
Second stage keyword search (firm search)	2,466
Total articles	3,848
	Number of Events

[8] We checked whether our results change when we control for confounding announcements related to the existing members of OIAs. As presented in Appendix B, we obtained similar results after removing 22 events that have confounding events related to existing members.

Relevant and unique announcements	257
Less 31 events (private or foreign companies)	226
Less 32 events (confounding events)	194
Total events for H1	194

Table 1B. Market Leader Entry Data Generating Process for H2

Description	Number of Events
Founding firms from H1 sample	106
Less 27 events (no late entry of a market leader firm)	79
Less 10 events (confounding events)	69
Total events for H2	69

Table 1C. Incumbent Rival Data Generating Process for H3

Description	Incumbent Rivals
Total events in H1 sample	194
Less 85 firms (rival matching processes)	109
Less 19 firms (prior collaboration with the members of the OIA)	90
Less 18 firms (confounding events)	72
Total incumbent rivals for H3	72

Table 1D. Peer Rival Data Generating Process for H3

Description	Peer Rivals
Initial set of peer rivals matching the H1 sample firms	851
Less 58 firms (prior collaboration with the members of the OIA)	793
Less 1 firm (duplication with incumbent rival sample)	792
Less 89 firms (duplication within peer rival sample)	703
Less 52 firms (confounding events)	651
Total peer rivals for H3	651

To test Hypothesis 2, the 194 events were sub-divided into two groups based on the time of the firm's entry into a particular OIA: one group contained the events related to the OIA-founding members (*N*=106) and the other included the events related to non-founding members (*N*=88). To test Hypothesis 2, which examines the wealth effect of a market leader firm's late entry into an existing OIA, the largest firm among the non-founding members was chosen. To ensure that no other major events related to the existing members occurred around the date when the market leader company announced its entry, we used the procedure described earlier for removing possible confounding effects. Through this process, we eliminated 10 firms in the H2 sample for which there were confounding events on the belated entry dates. See Table 1B for the detailed procedures.

Procedures similar to those used by Eckbo (1983) and Oxley et al. (2009) were adopted to test H3. These procedures utilized the four-digit SIC codes available in Compustat to identify the rivals of the OIA participants. While the previous literature used all possible firms classified under the same SIC codes as legitimate rivals irrespective of firm size, in order to investigate the size effects of rivals, two types of rivals were identified for each participant in this study. The first type, *incumbent rivals*, included firms that were recognized as leaders in the corresponding industry at the time when the OIA was announced. The second type, *peer rivals*, comprised firms whose total asset size was close to that of the OIA partners. The rationale for such a division is that peer rivals are in direct, short-term competition with the OIA partner while incumbent rivals are established firms with whom the OIA partners wish to outcompete in the long term. See Tables 1C and 1D for a detailed description of the sampling procedure.

To minimize possible noise in the data for the identification of the incumbent rivals, the sample data was refined in several ways. First, when primary SIC codes were not available,

complementary sources including secondary SIC codes as well as other public sources (e.g., Hoovers and Lexis Nexis company profiles) were used. These external sources list a specific firm's direct competitors within the same industry. Moreover, those firms participating in OIAs, whose rivals could not accurately be identified through the use of these multiple sources, were removed from the sample. Second, when a rival company was found to be a "common enemy" to multiple partners within an OIA, we counted the rival only once. Third, when the OIA participant was the largest firm in terms of total assets within a specific SIC category, the second-largest firm was chosen to be the incumbent rival of this firm. However, if the second-largest firm was determined to be substantially smaller than the largest firm (i.e., a difference of 30% or more in total asset size), this rival was removed from the incumbent rival list. In other words, a large company participating in an OIA was considered to have no incumbent rival in such instances. Fourth, several companies operating in the IT and telecommunications service industries (e.g., AT&T Wireless) were in competition with foreign companies (e.g., NTT DoCoMo) that perform in different markets. These foreign rivals were excluded from the sample to avoid potential contamination of the results as firms with different countries of origin might face varying economic conditions. This data-cleaning process yielded a list of 109 incumbent rivals. Further, to ensure that the identified rivals were engaged in direct competition with the focal firm and its OIA, we investigated the possible existence of a prior collaborative relationship between the identified rival and any participant in the OIA to which the focal firm belonged. To this end, we checked all of the previous OIAs to determine whether they had ever formed partnerships in the same OIA(s). We also searched the SDC Platinum database to uncover whether any direct strategic alliances were made between the focal firm and the identified rival outside of the OIAs. We found a total of 19 such relationships and, thus, excluded

those rivals from the sample. Finally, due to confounding effects 18 additional rivals were removed. Consequently, a total of 72 rivals were included in the incumbent rival analysis in H3 (See Table 1C).

With respect to the identification of peer rivals, multiple similar-sized firms can exist as the rivals of one focal firm; thus, unlike the case of incumbent rivals, selecting only one rival firm might be too arbitrary. Therefore, for each focal firm in the H1 dataset, we identified a group of peer rivals using the following definition: *the firms sharing the same primary 4-digit SIC code with the focal firm, constrained within +/- 20% of total asset compared with that of focal firm on the basis of the previous year of the event.* Subsequently, a total of 851 rivals were identified on the basis of this definition. Then, these samples were refined as follows.[9] First, as in the incumbent rival case, the prior collaboration check was conducted and when such rivals were identified, they were removed from the sample. Second, to avoid any double-counting, the incumbent sample was assessed for peer rivals, and, when found, they were removed from the sample. In addition, when the same rival was counted more than once for the same event date, we counted it only once. This resulted in 703 rivals. Finally, the rivals that had confounding events on the same dates were removed, resulting in a total of 651 rivals associated with 116 events[10] (See Table 1D). The number of rivals for each event ranged from 1 to 41 with a mean of 5.61 and standard deviation of 6.95.

Measures of OIA Characteristics

[9] For a robustness check, we also applied 10% and 30% as the criteria for selecting peer rivals, and obtained similar results.

[10] Note that the number of events was reduced to 116 from the initial sample size of 194 in the H1 dataset. Similar to the incumbent rival case, the large focal firms often found no similar-sized rival firms (even some of the medium or small size firms had no such rivals), and a number of events with only a single rival were removed due to confounding events or collaborative relationships with a focal firm or its partner.

To test Hypotheses 4, 5 and 6, we collected additional data that could account for firm-to-firm and OIA-to-OIA variability with respect to the observed CARs. To operationalize partner heterogeneity, we used Shannon's entropy index (Shannon and Weaver, 1949)[11]. The degree of partner heterogeneity of each OIA *k* was measured as follows:

$$H_k = -\sum_{i=1}^{N_k} p_i log p_i ,$$

where N_k is the number of SICs in the alliance and p_i is the proportion of a specific SIC *i* in the alliance. For each alliance, we identified all of the SICs on a four-digit basis and then computed p_i for each SIC by dividing the number of firms belonging to that code by the total number of firms in the alliance.

Regarding innovation type (Hypothesis 5), based on Henderson and Clark (1990), two of the authors independently categorized the OIAs into two types: incremental or radical. All available resources (e.g., OIA participation announcements, the firms' web sites, and other relevant information) were used to determine the innovation type.

Based on Boudreau (2008), we operationalized degree of openness (Hypothesis 6) as consisting of two dimensions: access and decision authority. Access was coded as high if an OIA imposed no restrictions on firms in terms of their entry into the alliance and was coded low if otherwise. For instance, the Symbian Foundation (http://www.symbian.org/), an OIA for developing an open mobile software platform, was classified as high in access because it allows

[11] This measure has been widely used in the organization and management science literature to indicate the structural heterogeneity and diversity (Ancona and Caldwell, 1992; Cummings, 2004; Kuk, 2006). Why the Shannon's entropy fits the heterogeneity is specifically discussed in Martin and Rey (2000). The measure is suitable for our research because it takes into account both the size of an alliance and variability in the SIC classification. Intuitively, in the case of the same number of SICs, the more uniformly distributed the firms are over the SICs the higher the heterogeneity value. If all of the firms belong to a single SIC category then heterogeneity will be equal to 0. In contrast, if the firms all have different SICs, the heterogeneity value will increase in the size of the alliance.

the participation of developers without much restriction. Similarly, decision authority was coded to be high if a firm's technological development activities are transparent to all of the participating members and if the decision-making process is not dominated by the membership hierarchies. Decision authority is coded to be low if otherwise. Openness was measured as the sum of the two dimensions: openness = 2 if both dimensions were high; 1 if only one dimension was high; and 0 if otherwise.

Two authors independently coded innovation type and the two dimensions of openness on dichotomous scales. The levels of agreement in categorizing OIAs were measured using Cohen's Kappa (Cohen 1960), which takes into account agreement that can be attributed to chance. The Kappa coefficient for innovation type was .737 (p-value = .003, standard deviation = .167). For the two dimensions of openness, namely access and decision authority, the Kappa coefficient was .762 (p-value = .002, standard deviation = .223) and .857 (p-value = .001, standard deviation = .137), respectively. [12] The discrepancies in the initial coding were reconciled in a face-to-face meeting between the two judges.

We included several control variables in order to attenuate their potential effects on the results. Firms possess different levels of innovative capabilities and these differences might play an important role in eliciting a favorable market reaction from investors. In this light, the number of patents was used as a proxy to represent a firm's innovative capability. The patent data were collected from an online database maintained by the U.S. Patent and Trademark Office (http://patft.uspto.gov/). We queried for the number of patents issued by the announcing firm during the five years prior to the event date. The holder of the patents was confirmed by

[12] While no general authority exists with respect to a minimum level of inter-judge agreement, scores greater than 0.65 are considered to be good (Moore and Benbasat 1991; Soh et al., 2006; Vessey et al., 2002) and scores greater than .80 are regarded as "almost perfect" (Landis and Koch, 1977).

comparing the names and locations of the patent assignees with information provided on the firms' web sites. Finally, we extracted and used information on total assets obtained from Compustat database to control for the effect of firm size.

Estimation Method

We use an event study methodology to estimate the stock market's assessment of the change in the value accruing to participant firms and their rival firms on the announcement of an OIA.[13] In the event study, abnormal returns are used as the estimates of changes in the market value of the firm during event periods. The abnormal returns for the stock of firm *i* on day *t* are calculated as:

$$AR_{it} = R_{it} - R_{it}^{*},$$

where AR_{it} denotes the abnormal return for firm *i* on day *t*; R_{it} represents the actual return for firm *i* on day *t* and R_{it}* are the predicted return of firm *i* on day *t*. To predict daily returns (i.e., R_{it}*) for each firm *i* over the specific event window, we estimate the market model of each firm's stock returns:

$$R_{it}^{*} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it},$$

where R_{mt} represents the equally-weighted market return on day *t*, α_i and β_i are the ordinary least squares estimates of firm-specific parameters, and ε_{it} is an independent and identically distributed

[13] Building on the efficient market hypothesis (Fama et al., 1969), event studies evaluate the future profitability of business "events" based on the market's reactions as reflected in stock price changes. Since the work of Dos Santos et al. (1993) which was the first to examine the impact of IT investments on stock market returns, the application of this method has grown in depth and sophistication in the quest for exploring the economic value of many IT-related initiatives, including general IT investments (Im et al., 2001), e-commerce (Subramani and Walden, 2001; Dewan and Ren, 2007), IT-based knowledge management initiatives (Sabherwal and Sabherwal, 2005), IT infrastructure development (Chatterjee et al., 2002), transformational IT (Dehning et al., 2003), ERP (Ranganathan and Brown, 2006), Y2K spending (Anderson et al., 2006), and IT outsourcing (Loh and Venkatraman, 1992; Oh et al., 2006).

disturbance term.

Following prior research (e.g., Chatterjee et al., 2001, Dehning et al., 2004), a 255-day estimation period is used to estimate the market model, which begins 300 trading days before the event date (t = -300), and ends 45 trading days before the event date (t = -45). In this study, we use two event windows: a two-day window [-1, 0] and a three-day window [-1, +1].[14] We compute the cumulative abnormal returns (CARs) for each firm *i* by adding the ARs over the event window. This yields CAR2 and CAR3, which represent the cumulative abnormal returns experienced by a participant firm around an OIA announcement, over a two-day [-1, 0] and three-day [-1, +1] window, respectively. For hypothesis testing (H1-H3), we use the z-statistic (Patell, 1976) to test whether the standardized mean CARs are significantly different from zero. The same tests have been used in prior studies (Chatterjee et al., 2001; Dehning et al., 2004) and the details on the test statistics are provided in Appendix A.

RESULTS

A combination of CAR and regression analyses was used as our main analytical strategy to test our hypotheses. The first three hypotheses (H1-H3) are tested by means of CAR analyses, while the remaining three (H4-H6) are validated based on OLS regression approaches. Before reporting the results, we present descriptive statistics and correlations between the variables included in the model (Tables 2A & 2B). As expected, our dependent variables, CAR2 and CAR3 are highly correlated with each other. Innovation type is positively correlated with the

[14] While these two event windows are most commonly used in event studies, some studies (e.g., Oxley et al., 2009) use longer windows (e.g., seven-day, ten-day) as well. However, it is not advised to use long windows unless it can be justified, because it is much more difficult to control for confounding effects when long windows are used (McWilliams and Siegel, 1997).

dependent variables whereas the degree of openness and partner heterogeneity are negatively correlated with the CARs.

Table 2A. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CAR2	194	.002	.058	-.265	.302
CAR3	194	.005	.063	-.198	.299
Heterogeneity	194	1.742	.445	1.080	2.465
Innovation Type	194	.464	.499	0	1
Openness	194	1.325	.729	0	2
Total asset	194	33,319	100,821	3.9	1,119,548
Patents	194	1,636	2,757	0	16,253

Table 2B. A Correlation Table

	CAR2	CAR3	Heteroge-neity	Innovation Type	Openness	Total Asset	Patents
CAR2	1.00						
CAR3	0.82**	1.00					
Heterogeneity	-0.22**	-0.1	1.00				
Innovation Type	0.20**	0.15**	-0.24**	1.00			
Openness	-0.16**	-0.08	0.66**	0.30**	1.00		
Total asset	0.01	0.02	0.12	0.04	0.11	1.00	
Patents	-0.04	-0.06	-0.08	0.06	-0.05	0.11	1.00

$^{**}p < 0.05$

Market Value of OIA Participation

Based on 194 observations, we found that allying firms realize significant positive abnormal returns when their entry into OIAs is made public (Table 3). The same pattern was observed consistently across both event windows (CAR2 and CAR3), lending support for Hypothesis 1 ($p<0.05$). This suggests that investors are optimistic about the participating firm's future cash flow when it forms alliances with other firms, including with their competitors, to co-develop technological innovations. Interestingly, when firms participate in an OIA with the goal of co-developing "public IT goods," the firms realize abnormal returns that are higher (in terms of the magnitude of CARs) than would be seen if they had made investments in proprietary IT.

For example, when a two-day window is used (CAR2), the returns accrued to the participating firms (0.23%) are substantially higher than those reported by Dos Santos et al. (1993) (0.09%) and Im et al. (2001) (0.02%), both of which examined the market reaction to a firm's proprietary IT investments.[15] Although this by no means indicates a superior market value of non-proprietary IT initiatives in comparison with their proprietary counterparts, one interpretation could be that the market highly values the IT initiatives that are co-developed and co-managed in a multi-firm environment. This might be because such arrangements mitigate the risk of failures and maximize the utilization of resources and capabilities.

Table 3. Abnormal Stock Returns to Allying Firms (*N*=194)

	Mean	Number of Positive: Negative CARs	Z-Stat
***CAR2* [-1, 0]**	0.23%	103:91	1.761**
***CAR3* [-1, +1]**	0.47%	106:88	2.072**

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Wealth Spillover

In Hypothesis 2 we argue that because of the signalling effect the "belated" entry of a market leader firm into an existing alliance enhances the investors' confidence and interest in the participating firms. This subsequently increases their market value. The results summarized in Table 4 provide support for this hypothesis. Although CAR2 indicates no significant abnormal returns, in the case of CAR3 substantially excessive returns accrued to the allying firms when a large company announced its entry into the coalition ($p<0.05$). Although it is difficult to interpret directly the magnitude of these CARs in relation to those reported in Table 3 due to the

[15] This needs to be interpreted with care because these studies use data from different time periods than ours and investors' reaction may be different in different time periods.

small sample size (*N*=69), it appears that the allying firms' wealth increases more significantly when a large company enters into an existing alliance than when the alliance was initially formed.

Table 4. Abnormal Stock Returns to Allying Firms When a Large Firm Joins (*N*=69)

	Mean	Number of Positive: Negative CARs	Z-Stat
***CAR2* [-1, 0]**	0.37%	38:31	1.114
***CAR3* [-1, +1]**	0.66%	44:25	1.739**

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Wealth Impacts on Allying Firms' Non-Participating Rivals

When both incumbent rivals and peer rivals are included in the sample (*N*=723), the analysis suggests that a firm's entry into an OIA increases the market valuation of its rival ($p<0.05$ for CAR2; $p<0.1$ for CAR3). Therefore, Hypothesis 3 is confirmed (See Table 5A). To gain additional insights, we performed the analysis using two sub-samples (incumbent rivals and peer rivals) separately (See Table 5B). Although overall the findings are similar to the full sample results, based on CAR2 event window incumbent rivals experience substantially greater wealth increase (0.6%) compared to peer rivals (0.23%).

Table 5A. Abnormal Stock Returns to Allying Firms' Rivals (when combining both types of rivals) (*N*=723)

	Mean	Number of Positive: Negative CARs	Z-Stat
***CAR2* [-1, 0]**	0.26%	364:359	2.309**
***CAR3* [-1, +1]**	0.01%	373:350	1.383*

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

We speculate that the difference in the impact on rivals' wealth could be driven by the fact that each rival has a different level of absorptive capacity (Cohen and Levinthal, 1990) with which it can capitalize on the common goods co-produced by the allying partners. Firms that substantially differ in size are likely to have a different capability and capacity to "recognize the value of new, external information, assimilate it and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128). Moreover, March and Simon (1958: 188) suggested that innovations result from borrowing and not from invention, and, therefore, compared with a peer rival, an incumbent rival has greater capacity and accumulated stock of knowledge to "borrow" ideas originating from allying partners and to turn them into innovative products and services.

Table 5B. Abnormal Stock Returns to Allying Firms' Rivals by Rival Type

	Mean	Number of Positive: Negative CARs	Z-Stat
Incumbent (N=72)			
CAR2	0.60%	37:35	1.689**
CAR3	0.26%	38:34	0.693
Peer (N=651)			
CAR2	0.23%	327:324	1.871**
CAR3	-0.02%	335:316	1.227

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Impacts of OIA Characteristics on Allying Firms' Abnormal Returns

We use regression analysis to test the hypotheses concerning the impact of OIA characteristics (i.e., partner heterogeneity (H4), innovation type (H5), and degree of openness (H6)) on firm's cumulative abnormal returns. To control for firm size and innovation capability, we include the firms' total assets one year before the announcement was made and the number of patents from past 5 years to the time of announcement. For example, if a firm's participation was announced on March 30th, 2008, this firm's total asset in 2007 and the number of patents registered under the name of this firm from March 2003 to March 2008 are used in the regression. In addition,

to control for the heterogeneity across industries to which firm belong, we include industry dummies (two-digit SIC codes). This yields the following model specification:[16]

$$CAR_i = \beta_0 + \beta_1 HET_i + \beta_2 TYPE_i + \beta_3 OPEN_i + \beta_4 \log(PAT_i) + \beta_5 \log(ASSET_i) + \sum_k D_k + \varepsilon_i$$

where HET_i, $TYPE_i$, and $OPEN_i$ and denote partner heterogeneity, innovation type (radical vs. incremental), and degree of openness (0, 1, or 2) of the alliance that firm *i* joins, respectively. PAT_i denotes the number of patents firm *i* has registered for the past 5 years up to the announcement date and $ASSET_i$ denotes firm *i*'s total assets one year before the announcement date. D_k denotes dummy variable for industry *k*.

Given that the announcement dates for the founding members are the same for each OIA and multiple firms may join an OIA on the same date, the firms' abnormal returns may be cross-sectionally correlated. Furthermore, due to the different size and characteristics of firms joining OIAs, the abnormal returns may be heteroskedastic. Ordinary least squares (OLS) estimates may not adjust for cross-sectional correlations and heteroskedasticity. To address these issues we use both OLS and WLS and report both estimates.[17] For WLS, we use the groupwise heteroskedasticity procedure described in Greene (2000). The same WLS procedure was used in prior event studies (e.g., Mitra and Singhal, 2008).

[16] We could not include OIA dummies in our regression due to near perfect collinearity between the dummies and the OIA-level variables such as member heterogeneity, innovation type, and openness – the values of these variables are the same for all firms within the same OIA. To check the significance of OIA-specific effects, we estimated our regression model with only the firm-level variables and OIA dummies. Out of 23 OIA dummies, only one turned out to be significant. Thus, we believe that unobservable OIA-specific effects do not significantly influence our results.

[17] Sefcik and Thompson (1986) recommend an alternative procedure that involves the construction of portfolio returns of firms that share contemporaneous event periods. Karafiath (1994; 2009) uses the Monte Carlo technique to compare different estimation procedures including OLS, weighted least squares (WLS), and Sefcik and Thompson's portfolio approach. The general conclusion drawn from the simulation is that Sefcik and Thompson's portfolio approaches offer no clear advantages over OLS or WLS. Karafiath (2009) also shows that WLS estimates are modestly biased toward rejecting the null hypothesis, but WLS always offers a significant increase in power relative to OLS.

To test the three hypotheses (H4-H6) related to the impact of alliance characteristics on allying firms' abnormal returns, we used CAR2 and CAR3 as our dependent variables for regression analysis. As shown in Table 6, all the models based on OLS and WLS are significant, and the results are similar across the two windows. The mean variance inflation factor (*VIF*) for the independent variables is 2.01, much lower than 10, a commonly used threshold value for multicollinearity diagnostics (Kennedy, 1994).

Table 6. Regression Results[18]

	OLS Estimates		WLS Estimates	
Dependent Variable	***CAR2***	***CAR3***	***CAR2***	***CAR3***
	(1)	(2)	(3)	(4)
Partner Heterogeneity	.003 (.018)	.004 (.019)	.003 (.012)	.006 (.016)
Innovation Type	.038*** (.011)	.038** (.012)	.031*** (.010)	.033*** (.011)
Degree of Openness	-.023** (.010)	-.022* (.011)	-.020** (.008)	-.020** (.010)
log(Patents)	.003 (.004)	-.002 (.004)	.001 (.003)	-.001 (.003)
log(Total asset)	-.004 (.004)	.001 (.004)	-.001 (.003)	.002 (.004)
N	176[19]	176	176	176
F-Statistic	2.59***	2.77***	1.70*	1.77**
R-squared	0.12	0.14	0.06	0.07

Industry dummies (SIC 2-digit) are included but not shown. Standard errors are in parenthesis.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Impact of Partner Heterogeneity

Partner heterogeneity was found to be insignificant (p>0.1) and, therefore, Hypothesis 4 is not supported. This insignificant result might be due to investors' mixed perception regarding the two contrasting views (economic efficiency vs. resource multiplicity) illustrated earlier. That

[18] We also estimated the models including year dummies, and obtained similar results.
[19] The final sample size used in the regression is 176 instead of 194 because of the missing observations for the control variables.

is, for some investors the benefits arising from partner homogeneity, such as enhanced market power and economies of scale outweigh the benefits accrued from partner heterogeneity, such as diverse resources and capabilities. Yet, for other investors the exact opposite holds true when they evaluate the benefits of member composition. Consequently, neither of the two viewpoints (economic efficiency and resource multiplicity) clearly dominates the other and therefore results in statistical insignificance.

Impact of Innovation Type

We found that firms participating in an OIA that engages in radical innovation achieve higher abnormal returns than those joining an OIA associated with incremental innovation ($p<0.05$), supporting Hypothesis 5. Based on the WLS results (columns (3) and (4)), the values of the regression coefficient on innovation type are 0.031 and 0.033 when CAR2 and CAR3 are used, respectively. This suggests that all else being equal, firms announcing their participation in an OIA that is associated with radical innovation experience abnormal returns that are as much as 3.1 (CAR2) and 3.3 (CAR3) percentage points higher than those joining an OIA engaged in incremental innovation. This suggests that investors perceive OIAs involving radical innovation as being able to create new markets and generate substantially greater cash flow compared to OIAs associated with incremental innovation. This is also consistent with the notion that radical innovation is generally more risky than incremental innovation, and hence OIAs focusing on radical innovation can earn a risk premium from the market.

Impact of Degree of Openness

In Hypothesis 6, we argued that OIAs that are more open will result in higher abnormal returns than their more restrictive counterparts. Interestingly, contrary to our expectation, we found that firms joining an OIA that is more open in terms of access and decision authority

experience significantly *lower*, instead of higher, abnormal returns than those participating in an OIA that is more restrictive. Based on the WLS results (columns (3) and (4)), the value of regression coefficient on openness is -0.02 for both windows. This indicates that all else being equal, firms joining an OIA that have a high (medium) level of openness achieve abnormal returns about 2 percentage points lower than those joining an OIA with a medium (low) level of openness. This suggests that the market reacts less favourably to those OIAs with more open access and decision authority structures. One reason for this somewhat unexpected result may be that the investors perceive that OIAs with the high degree of openness are susceptible to high coordination costs and slow decision-making processes.[20] We will elaborate more on this interesting result in the Implications and Future Research section.

Additional Analysis: Portfolio Abnormal Returns[21]

As mentioned earlier, our study focuses on examining the value accruing to individual firms when they participate in OIAs for value co-creation. Although our study focuses on examining the value accruing to individual firms when they participate in OIAs for value co-creation, we analyze portfolio abnormal returns to gain additional insights. Portfolio abnormal returns refer to the abnormal returns aggregated across firms that are involved in a common event. Portfolio abnormal returns have been used in prior event studies to aggregate the abnormal returns of firms involved in M&A (Swaminathan et al., 2008), joint ventures (McConnell and Nantell, 1985), and other types of closed strategic alliances (Chan et al., 1997). As the abnormal returns of firms involved in the same event are likely to be correlated, portfolio abnormal returns

[20] An alternative explanation is that greater openness is associated with lower abnormal returns *because* there is greater knowledge spillover and free-riding benefits to rivals. To verify this zero-sum game explanation, we examined whether OIAs with greater openness are associated with greater benefits to rivals using a regression model, but the result was not significant. Thus, we conclude that it is rather the high coordination costs and slow decision making processes that drive the result.

[21] We thank the AE and an anonymous reviewer for suggesting this analysis.

have been used as a means to control for these cross-sectional correlations in returns (Chan et al., 1997; McConnell and Nantell, 1985). Two types of weights can be used in aggregating firms' abnormal returns to calculate portfolio returns: equal-weight and value-weight. In equally-weighted portfolio returns (*EPCAR*), firms' abnormal returns are aggregated within each portfolio without applying any weights as follows:

$$EPCAR_i = \sum_{j=1}^{N_i} CAR_{ij} ,$$

where CAR_{ij} denotes the CAR of firm *j* in portfolio *i* and N_i is the number of firms in portfolio *i*.

In value-weighted portfolio returns (*VPCAR*), firms' relative market value is used as the weight, and, as a result, those firms with a greater market value are given greater weights within each portfolio:

$$VPCAR_i = \sum_{j=1}^{N_i} CAR_{ij} \cdot \frac{MVE_{ij}}{\sum_{j=1}^{N_i} MVE_{ij}},$$

where CAR_{ij} is the CAR of firm *j* in portfolio *i*, N_i is the number of firms in portfolio *i*, and MVE_{ij} is the market value of equity of firm *j* in portfolio *i*.

The sample used in H1 contains 72 event dates associated with 194 firms. Among these, 45 event dates are associated with only one firm announcing its entry into an OIA and the remaining 27 event dates correspond to multiple firms announcing their entry into the same OIA at the same time. For the 27 event dates with multiple partners, we combined the CARs of the partners to construct portfolio abnormal returns. Note that each portfolio contains firms that announced participation in the same OIA on the same date. The founding members of an OIA constitute a single portfolio because they announced the founding of the OIA on the same date. Furthermore, portfolio size ranges from 2 to 17, with the average size at 5.52.

When the 27 portfolio returns and 45 individual returns (72 "securities" in total) were pooled together in the analysis, we did not obtain significant results using either equally- or value-weighted portfolio returns (see Table 7A). Given that founding members typically comprise the biggest portfolio in each OIA and each security is given equal weight in calculating portfolio abnormal returns for the whole sample, analyzing all 72 securities together can be problematic; the returns of 45 individual securities would have a disproportionately greater impact on the calculated portfolio returns as compared with those of the firms that belong to portfolios (especially bigger ones). To resolve this issue, we analyzed the 27 portfolio returns and 45 individual returns separately. Our analysis of the 27 portfolio returns yielded results that are consistent with the main results for H1 based on the 194 individual firms' returns (see Table 7B). However, the mean CARs of the 45 individual firms were not significant (see Table 7C).

Table 7A. Portfolio Abnormal Stock Returns to Allying Firms: Full sample (*N* = 72)

	Mean	Number of Positive: Negative CARs	Z-Stat
Equally-weighted			
CAR2	-0.40%	35:37	-0.087
CAR3	-0.29%	15:12	0.237
Value-weighted			
CAR2	-0.32%	35:37	0.059
CAR3	-0.36%	38:34	0.027

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 7B. Abnormal Stock Returns to 27 Portfolios

	Mean	Number of Positive: Negative CARs	Z-Stat
Equally-weighted			
CAR2	0.51%	16:11	1.503*
CAR3	0.66%	15:12	1.594*
Value-weighted			
CAR2	0.72%	16:11	1.744**

CAR3	0.48%	16:11	1.414*

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 7C. Abnormal Stock Returns to 45 Individual Firms

	Mean	Number of Positive: Negative CARs	Z-Stat
CAR2	-0.94%	19:26	-1.274
CAR3	-0.86%	22:23	-1.061

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

To test H3, we constructed the rivals' portfolio abnormal returns by aggregating the peer rivals' CARs for each partner firm, similar to Eckbo (1983) and Stillman (1983). [22] As shown in Table 7D, we obtained significant CARs for both equally-weighted and value-weighted portfolios, which is similar to the results based on individual rivals' abnormal returns. Note that we did not analyze portfolio returns for H2 because we had only 10 portfolios, and this small sample size prevented us from conducting a meaningful statistical test.[23]

Table 7D. Portfolio Abnormal Stock Returns to Peer Rivals (*N* = 116)

	Mean	Number of Positive: Negative CARs	Z-Stat
Equally-weighted			
CAR2	0.49%	59:57	1.989**
CAR3	0.40%	64:52	1.704**
Value-weighted			
CAR2	0.50%	59:57	1.732**
CAR3	0.30%	61:55	2.040**

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

[22] We could not analyze portfolio returns for incumbent rivals because each firm has at most one incumbent rival. Aggregating the returns of both leader and peer rivals yielded similar results.

[23] We estimated our regression equation using the portfolio abnormal returns as the dependent variable. However, the estimated model was not significant ($p>0.1$), probably due to the small sample size and loss of variation from aggregation.

IMPLICATIONS AND FUTURE RESEARCH

Although the importance of understanding and measuring the business value of IT in a multi-organizational environment has been emphasized frequently, little progress has been made in this area (Kohli and Grover, 2008). This can most likely be attributed to the difficulties involved in assessing the value of IT investments made by multiple organizations. Moreover, prior IT valuation research has focused primarily on the competitive setting and delved into how closed and proprietary technologies benefit the investing firm in the form of increased market share or profits. According to resource-based theory (Barney, 1991), these proprietary technologies can be a source of competitive advantage only when they are unique and difficult to imitate. Therefore, it has been implicitly assumed that IT-based innovations solely benefit the investing firm and serve as detrimental to its competitors. However, such a “zero-sum” or "differential IT value" point of view (Bhatt and Grover, 2005) might be inappropriate to explain value creation in the cases of OIAs involving otherwise fierce competitors.

In this study, we examined the stock market’s valuation of nascent IT-enabled OIAs, in which value is co-created and wealth spills over to both partners and rivals. The resulting innovations can be shared not only by the allied partners, but also by their rivals. Our empirical findings and their implications for practice are summarized in Table 8.

Table 8. Co-creating Value in IT-enabled Open Innovation Alliances: Results and Implications

Hypotheses	Theoretical Insights	Key Empirical Findings	Implications	Sources of Value Co-creation
H1: Positive abnormal stock returns will accrue to firms that participate in an OIA.	OIAs economize on transaction costs through self-monitoring and common ownership structure, and facilitate organizational learning and internalization of external skills.	A firm's market valuation increases when joining an OIA in which "public" IT goods are co-developed by a large number of participants.	The market values the IT initiatives that are co-developed and co-managed in a multi-firm environment. Therefore, firms should actively collaborate with their partners by participating in OIAs.	Multi-firm, open alliance for IT development.
H2: The announcement of the entry of a market leader company into an existing OIA will result in positive abnormal stock returns for current OIA member firms.	A market leader's entry into an OIA provides key complementary resources to current OIA members, and signals the importance and future prospect of the OIA.	Current members of an OIA benefit from a market leader's delayed entry into the OIA in terms of market valuation.	Firms should put forth significant effort to attract market leaders into their OIAs in order to take advantage of the wealth spillover.	Wealth spillover
H3: The announcement of OIAs will result in positive abnormal stock returns for the rival firms that compete with the firms participating in OIAs.	Rival firms benefit from competition attenuation in the industry. They can also enjoy "free-riding" benefits due to knowledge spillover.	When a firm joins an OIA, the market valuation of rival firms also increases. Incumbent rivals in particular, who possess greater absorptive capacity, experience a substantially larger increase in wealth compared to peer rivals.	While OIAs co-create value for participating firms, they may also benefit non-participating rivals due to knowledge spillover and value appropriation. Firms should recognize this tradeoff and decide whether to enhance their own competitiveness through closed innovation or to increase the size of the entire "pie" through OIAs.	Knowledge-sharing and value appropriation
H4*: All else being equal, firms that participate in an OIA with more heterogeneous partners	The resource multiplicity view suggests that an alliance with heterogeneous partners has a significant	The degree to which partners participating in OIAs are heterogeneous is not significantly associated with	Value co-creation tends to be determined by both resource heterogeneity and economies of scale. Consequently, firms	Resource heterogeneity and economies of scale in IT development

will experience higher abnormal returns than firms that join an OIA with more homogeneous partners.	complementary capacity to co-create value, as it tends to have essential structural diversities in terms of resources, skills and capabilities.	value co-creation.	should employ a contingency approach in such a way that optimizes the magnitude of value co-creation.	
H5: All else being equal, firms that participate in an OIA driven by radical innovation will experience higher abnormal returns than firms that join an OIA focusing on incremental innovation.	OIAs pursuing radical innovation are perceived to have greater market expansion potential, and can earn a higher risk premium due to the considerable risks involved, compared to those OIAs, which focus on incremental innovation.	A firm's market valuation increases more substantially when it joins an OIA based on a radical innovation than when it participates in an OIA which focuses on an incremental innovation.	To maximize value co-creation, the founders of OIAs should focus on developing radical, "paradigm-breaking" innovations rather than incremental, "paradigm-preserving" innovations. Non-founding firms should join OIAs that aim to develop radical innovations.	Radical IT innovation
H6**: All else being equal, firms that participate in an OIA with full access and decision authority will experience higher abnormal returns than firms that join an OIA with limited access and decision authority.	OIAs with limited openness incur lower coordination costs and benefit from faster decision-making, compared to fully open OIAs.	A firm's market valuation has a higher level of increases when it joins an OIA with limited access and decision authority than when it participates in an OIA offering full access and decision authority.	Members of an OIA need to find the "right" level of openness that can facilitate the pooling of complementary skills and resources without incurring excessive coordination costs.	Controlled openness of IT development platforms

*: unsupported; **: contrary to expectation

Our findings have several important implications for managers, particularly in light of value co-creation. First, the market reacts positively to IT initiatives that are co-developed and co-managed in a multi-firm, open collaborative environment (H1). Moreover, attracting market leaders into an OIA generates additional positive abnormal returns to the members of the existing OIA (H2). These findings suggest that IT firms for which technological innovations are critical aspects of their survival should proactively take part in OIAs and co-create value with their collaborators as well as competitors. However, participating firms should bear in mind that OIAs can operate in their full capacity only when necessary skills, resources and experiences are continuously available within such value co-creation ecosystems. Therefore, OIA founders should continue making efforts to encourage market leaders to join their collaborations.

Second, our results also suggest that substantial knowledge spillover can occur when non-participating firms utilize and exploit the technological innovations created from the OIA without incurring significant additional costs (H3). If knowledge spillover to external parties (e.g., rivals) can be detrimental to the firm's own survival, it should remain independent and enhance its competitiveness through closed innovation paradigms. However, since knowledge spillover and value appropriation by external parties can also occur in closed settings (Griliches, 1992), firms en route to the proprietary IT innovation should strengthen the protection mechanisms in order to minimize unintended knowledge spillover.

Although firms are motivated to participate in OIAs in order to capitalize on new market opportunities, the fact that their innovations may generalize to unintentionally benefit others (including their rivals) may prevent them from fully engaging in the technological development (Uzzi and Gillespie, 2002). Prior research suggests that firms tend to under-invest when they are unable to internalize those benefits which other firms are simultaneously capturing (Cheng and

Nault, 2007). Since the majority of OIAs are still in their embryonic development stage, self-regulated mechanisms have not yet been established to discourage such self-interested behaviors. Given that OIAs are formed and operated in the spirit of openness, enacting an inordinate number of rules and regulations may eliminate not only the desire to join an OIA, but the benefits of value co-creation. Yet, being excessively open as a result of the absence of governance in OIAs could also penalize the participating firms' financial prosperity due to the potential, inadvertent transfer of knowledge to non-participating firms.

Third, our results indicate that the type of innovation of an OIA significantly influences the investors' perception of future cash flow. As predicted in H5, investors consider radical innovation to be a key driver of a firm's future growth and profitability. It appears that innovation becomes innovation only when frame-breaking and transformational ideas are realized as commercial products or services. The founders and constituents of OIAs should focus on radical innovations rather than incremental innovations, particularly when the OIA is being formed.

Fourth, interestingly, our data indicate that the market reaction is negatively related to the degree of an OIA's openness in terms of access and decision authority (H6). This may be due to the fact that, as pointed out earlier, a high degree of openness is associated with substantial costs such as knowledge spillover and value appropriation by rivals. These frictional costs could outweigh the benefits arising from the cultivation and sharing of creative ideas. The governing parties of OIAs, therefore, should understand the strategic trade-offs between costs and benefits, and determine the optimal level of openness. In fact, to minimize the knowledge spillover OIAs could adjust their degree of openness depending on the lifecycle of the technological innovations (Chesbrough, 2003). For instance, openness could be fully guaranteed during the initial inception

and growth stages, but once the ideas develop into products or services the degree of openness could be adjusted in such a way as to simultaneously minimize knowledge spillover and maximize value co-creation. When the market for these products or services matures, the OIA could fully re-open its doors to elicit new ideas from outside the OIA. Clearly, managing the openness of OIAs through this dynamic model poses a number of challenges to the constituencies, because OIA members, competitive landscapes, and consumer needs are all evolving dynamically over time. Nevertheless, the lifecycle approach could serve as an ideal mechanism for effectively managing OIAs, and thus, maximizing the value co-created by the participating members.

Finally, managers should be mindful that “co-opetition” (Brandenburger and Nalebuff, 1996) reflects the complicated and dynamic relationships between the OIA participants. By combining their complementary resources and competencies, these companies collaborate with mutual interests to co-create value and increase the size of the "economic pie." However, when it comes to either dividing or distributing the value of the produced innovation, the firms cease collaborating and resume competing. Companies that participate in OIAs are motivated by both private and common interests. On the one hand, a firm joins an alliance with the goal of internalizing its partners' skills and deepening its specialization. On the other hand, a firm participates in order to co-develop innovative technological products or open standards that enhance its industry's overall profitability. Such co-opetition and positive-sum perspectives of value creation have been largely ignored in the IS literature to date. These new forms of value creation send a clear message to executives; firms, particularly those that depend heavily on technological innovations, should actively collaborate with partners in multi-firm-based, open

environments in order to create and sustain "co-opetitive advantages" that may extend the scale and scope of individual competitive advantages.

Taken together, in light of the IT value co-creation initiated by Kohli and Grover (2008), OIAs serve as unique inter-organizational collaborative platforms in which "(a) IT value is increasingly being created and realized through actions of multiple parties, (b) value emanates from robust collaborative relationships among firms, and (c) structures and incentives for parties to partake in and equitably share emergent value are necessary to sustain co-creation" (Kohli and Grover, 2008. p. 28). Specifically, the concerted joint actions of multiple companies and their strong cooperative and complementary relationships have made it possible for an OIA to emerge as a potent organizational form that co-creates economic value. Furthermore, the "open" structure and incentives to expand market demand, rather than competing with one another, through technological innovations enable OIAs to sustain their value creation trajectories.

This study suggests several important directions for future research. First, given that a company may join multiple OIAs, an inter-organizational network view of the alliance (Gulati, 1998) might offer an interesting lens with which to understand the complex web of relationships and value-creation trajectories among the participating firms as well as with their rivals. Figure 2 shows how participants are linked together through various OIAs in our data. The relational power (e.g., the number of firms to which a focal firm is linked through multiple OIAs) or the positional control (e.g., how often a focal firm is situated between two nonadjacent firms within OIA networks) might impact the market's valuation because network density or position have important implications for resource accessibility and for strategic expansion (Sharaf et al., 2007). Because of open entries, the growth aspect of OIA networks makes such a network perspective both dynamic and enriching. For example, how do changes in network structure caused by the

addition of new nodes and links re-distribute the wealth across the participating firms? What effect does this have on their rivals? This network growth view might provide valuable insights into the value co-creation and re-distribution mechanisms within OIA networks.

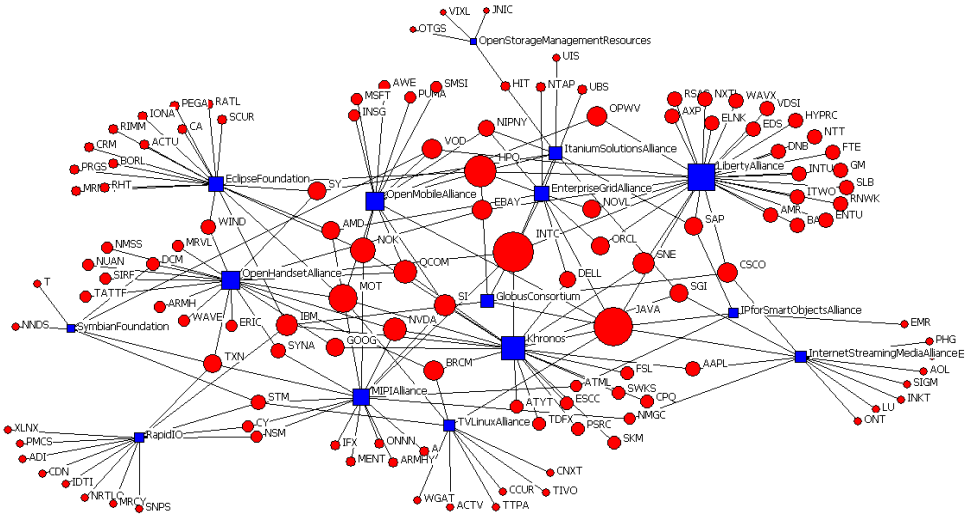

Figure 2. A Network View of Open Innovation Alliances (the circles indicate allying firms and the squares represent the OIAs)

Second, our approach of using stock market valuation should be triangulated by assessing a firm's real performance, such as revenues and profits. This type of systematic inquiry is necessary in order to validate whether participation in an OIA indeed increases the future financial performance and strategic positioning of the focal company. This will be an exciting avenue for future research. However, one challenge facing this approach might lie in isolating the impact of OIAs on individual partners from confounding effects that might affect the participating firms. Finally, while this study focused on open innovation alliances, it would be interesting to explore the market's valuation of closed innovation alliances and their impacts on rivals. On the one hand, closed innovation alliances might benefit rivals by creating a new market or by expanding an existing market, as do OIAs. On the other hand, rivals might be

adversely affected by closed innovation alliances because the resulting innovation is not readily available to them; the rivals will be put at a competitive disadvantage.

CONCLUSION

This paper sought to investigate the business and strategic value of an open and collaborative organizational form, namely an OIA, by which participating firms co-create economic value through the joint development and co-marketing of IT innovations. In competitive organizational settings, there is a general belief that one company's good news is usually bad news to its competitor because a zero-sum principle defines the nature of competition. However, such conventional wisdom does not always hold true when competitors and collaborators are considered to be parts of a business ecosystem, wherein mutual interest can benefit all parties involved. Open innovation alliances offer an interesting context within which such an ecosystem can be studied. Value creation is a difficult task; however, it can be facilitated by the prosperity of collaborators as well as rivals in a multi-organizational environment. The "many hands make light work" principle seems to suggest a useful perspective for value co-creation. One question remains: To what extent do the enhanced industrial profits resulting from OIAs translate into consumer welfare? The "real" value of co-creation can be materialized only when the derived or invented value is shared and recognized by consumers.

REFERENCES

Ancona, D. G. and Caldwell, D. F. “Demography and design: Predictors of new product team performance,” *Organization Science* (3:3), 1992, pp. 321-341.

Anderson, E. “Two firms, one frontier: on assessing joint venture performance,” *Sloan Management Review* (31: 2), 1990, pp. 19–30.

Anderson, M., Banker, R., and Ravindran, S. “Value implications of investments in information technology,” *Management Science* (52:9), 2006, pp. 1359-1376.

Balakrishnan, S., Koza, M. "Information asymmetry, market failure, and joint ventures: theory and evidence," *Journal of Economic Behavior and Organization* (20), 1993, pp.99-117.

Barki, H., and Pinsonneault, A. “A Model of organizational integration, implementation effort, and performance,” *Organization Science* (16:2), 2005, pp. 165-179.

Barney, J. “Firm resources and sustained competitive advantage,” *Journal of Management* (17: 1), 1991, pp. 99-120.

Bhatt, G.D., and Grover, V. "Types of information technology capabilities and their role in competitive advantage: An empirical study," *Journal of Management Information Systems* (22:2), Fall 2005, pp 253-277.

Borys, B., and Jemison, D.B. “Hybrid arrangements as strategic alliances: Theoretical issues in organizational combinations,” *Academy of Management Review* (14:2), 1989, pp. 234-249.

Boudreau, K. 2008. “Opening the platform vs. opening the complementary good? The effect on product innovation in handheld computing,” working paper, London Business School, London, UK.

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

Chan, S. H., Kensinger, J. W., Keown, A. J., and Martin, J. D. “Do strategic alliances create value?,” *Journal of Financial Economics* (46:2), 1997, pp. 199-221.

Chatterjee, D., Pacini, C., and Sambamurthy, V. “The shareholder-wealth and trading-volume effects of information-technology infrastructure investments,” *Journal of Management Information Systems* (19:2), 2002, pp. 7-42.

Chatterjee, D., Richardson, V. J., and Zmud, R. W. “Examining the shareholder wealth effects of announcements of newly created CIO positions,” *MIS Quarterly* (25:1), 2001, pp. 43-70.

Cheng, Z., and Nault, B. R. “Industry level supplier-driven IT spillovers,” *Management Science* (53: 8), 2007, pp. 1199-1216.

Chesbrough, H. 2003. *Open innovation: The new imperative for creating and profiting from technology*, Boston, MA: Harvard Business School Press.

Chesbrough, H., Vanhaverbeke, W., and West, J. 2006. *Open innovation: Researching a new paradigm*, Oxford: Oxford University Press.

Cohen, J. "A coefficient of agreement for nominal scales," *Educational and Psychological Measurement* (20:1), 1960, pp. 37-46.

Cohen, W. M., and Levinthal, D. A. "Absorptive capacity: A new perspective on learning and innovation," *Administrative Science Quarterly* (35: 1), 1990, pp. 128-152.

Cummings, J. "Work groups, structural diversity, and knowledge sharing in a global organization," *Management Science* (50:3), 2004, pp. 352-364.

Dehning, B., Richardson, V. J., Urbaczewski, A., and Wells, J. D. "Reexamining the value relevance of e-commerce initiatives," *Journal of Management Information Systems* (21:1), 2004, pp. 55-82.

Dehning, B., Richardson, V. J., and Zmud, R. W. "The value relevance of announcements of transformational information technology investments," *MIS Quarterly* (27:4), 2003, pp. 637-656.

Dewan, S., and Ren, F. "Risk and return of information technology initiatives: Evidence from electronic commerce announcements," *Information Systems Research* (18:4), 2007, pp. 370-394.

Dewan, S., Shi, C., and Gurbaxani, V. "Investigating the risk-return relationship of information technology investment: Firm-level empirical analysis," *Management Science* (53:12), 2007, pp. 1829-1842.

Diamond, D. W. "Financial intermediation and delegated monitoring," *Review of Economic Studies* (51), 1984, pp. 393-414.

Dos Santos, B. L., Peffers, K. and Mauer, D. "The impact of information technology investment announcements on the market value of the firm," *Information System Research* (4:1), 1993. pp. 1-23.

Eckbo, B. E. "Horizontal mergers, collusion and stockholder wealth," *Journal of Financial Economics* (11), 1983, pp. 241–273.

Fama, E. F., Fisher, L., Jensen, M. C., and Roll, R. "The adjustments of stock prices to new information," *International Economic Review* (10:1), 1969, pp. 1-21.

Farrell, J., and Saloner, Garth. "Standardization, compatibility, and innovation," *Rand Journal of Economics* (16), 1985, pp. 70-83.

Finnerty, J. E., Owers, J. E., and Rogers, R.C. “The valuation impact of joint ventures,” *Management International Review* (2), 1986, pp. 14–26.

Greene, W. H. 2000. *Econometric analysis* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Griliches, Z. “The search for R&D spillovers,” *Scandinavian Journal of Economics* (94), 1992, pp. 29-47.

Gulati, R. “Alliances and networks,” *Strategic Management Journal* (19), 1998, pp. 293-317.

Hamel, G. “Competition for competence and inter-partner learning within international strategic alliances,” *Strategic Management Journal* (12:S1), 1991, pp. 83–103.

Harrigan, K. R. “Joint ventures and competitive strategy,” *Strategic Management Journal* (9:2), 1988, pp. 141-158.

Henderson, R. M., and Clark, K. B. “Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms,” *Administrative Science Quarterly* (35), 1990, pp. 9-30.

Hennart, J. "Transaction costs theory of joint ventures: An empirical study of Japanese subsidiaries in the United States," *Management Science* (37:4), 1991, pp.483 - 497.

Im, K. S., Dow, K. E., and Grover, V. “A reexamination of IT investment and the market value of the firm: An event study methodology,” *Information Systems Research* (12:1), 2001, pp. 103-117.

Inkpen, A. C. “Learning and knowledge acquisition through international strategic alliances,” *Academy of Management Executive* (12:4), 1998, pp. 69-80.

Karafiath, I. “On the efficiency of least squares regression with security abnormal returns as the dependent variable,” *The Journal of Financial and Quantitative Analysis* (29:2), 1994, pp. 279-300.

Karafiath, I. “Is there a viable alternative to ordinary least squares regression when security abnormal returns are the dependent variable?,” *Review of Quantitative Finance and Accounting* (32:1), 2009, pp. 17-31.

Kennedy, P. 1994. *A Guide to Econometrics*, Cambridge, MA: The MIT Press.

Kogut, B. “The stability of joint ventures: Reciprocity and competitive rivalry,” *Journal of Industrial Economics* (38), 1989, pp. 183-198.

Koh, J., and Venkatraman, N. “Joint venture formations and stock market reactions: An assessment in the information technology sector,” *Academy of Management Journal* (34:4), 1991, pp. 869–892.

Kohli, R. and Grover, V. "Business value of IT: An essay on expanding research directions to keep up with the times," *Journal of the AIS* (9:1), 2008, pp.23-39.

Kuk, G. “Strategic interaction and knowledge sharing in the KDE developer mailing list,” *Management Science* (52:7), 2006, pp. 1031-1042.

Landis, J.R. and Koch, G.G., “The Measurement of observer agreement for categorical data,” *Biometrics*, (33:1), 1977, pp. 159-174.

Loh, L. and Venkatraman, N. 2002. “Stock market reaction to information technology outsourcing: An event study,” Sloan School of Management Working Paper, Massachussetts Institute of Technology.

March, J. G., “Exploration and exploitation in organizational learning,” *Organization Science* (2:1), 1991, pp. 71-87.

March, J. G., and Simon, H. A. 1958. *Organizations*, New York, NY: Wiley.

Martín, M. A. and Rey, J.-M. “On the role of Shannon's entropy as a measure of heterogeneity,” *Geoderma* (98:1-2), 2000, pp. 1-3.

McConnel, J. J., and Nantell, T. J. “Corporate combinations and common stock returns: The case of joint ventures,” *Journal of Finance* (40:2), 1985, pp. 519-536.

McGahan, A. M., and Villalonga, B. 2005. “Does the value created by acquisitions, alliances and divestitures differ?” working paper, Boston University, Boston.

McWilliams, A. and Siegel, D. “Event studies in management research: Theoretical and empirical issues,” *The Academy of Management Journal* (40:3), 1997, pp. 626-657.

Mitra, S. and Singhal, V. “Supply chain integration and shareholder value: Evidence from consortium based industry exchanges,” *Journal of Operations Management* (26:1), 2008, pp. 96-114.

Moore, G. C., and Benbasat, I. “Development of an instrument to measure the perceptions of adopting an information technology innovation,” *Information Systems Research* (2:3), 1991, pp. 192-222.

Oh, W., Gallivan, M., and Kim, J. “The market’s perception of the transactional risks of IT outsourcing announcements,” *Journal of Management Information Systems* (22:4), 2006, pp. 271-303.

Oxley, J. E., Sampson, R. C., and Silverman, B. S. “Arms race or détente? How interfirm alliance announcements change the stock market valuation of rivals,” *Management Science* (55:8), 2009, pp. 1321-1337.

Patell, J. M. “Corporate rorecasts of earnings per share and stock price behavior: Empirical test,” *Journal of Accounting Research* (14:2), 1976, pp. 246-276.

Pfeffer, J., and Nowak, P. "Joint ventures and inter-organizational interdependence," *Administrative Science Quarterly* (21), 1976, pp.398 - 418.

Porter, M. E. 1980. *Competitive strategy: Techniques for analyzing industries and competitors*, NY: Free Press.

Powell, W. W., Koput, K. W., and Smith-Doerr, L. "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology," *Administrative Science Quarterly* (41), 1996, pp. 116-145.

Ranganathan, C., and Brown, C. V. “ERP investments and the market value of firms,” *Information Systems Research* (17:2), 2006, pp. 145-161.

Reuer, J. J., and Koza, M. P. “Asymmetric information and joint venture performance: Theory and evidence for domestic and international joint ventures,” *Strategic Management Journal* (21:1), 2000. pp. 81–88.

Sabherwal, R. and Sabherwal, S. “Knowledge management using information technology: Determinants of short-term impact on firm value,” *Decision Sciences* (36:4), 2005, pp. 531-567.

Salant, S.W., Switzer, S., and Reynolds, R.J. "Losses from horizontal merger: the effects of an exogenous change in industry structure on Cournot-Nash equilibrium," *Quarterly Journal of Economics* (98:2) 1983, pp. 185-199.

Schumpeter, J.A. 1942. *Capitalism, socialism, and democracy*, NY: Harper.

Sefcik, S. E. and Thompson, R. “An Approach to statistical inference in cross-sectional models with security abnormal returns as dependent variable,” *Journal of Accounting Research* (24:2), 1986, pp. 316-334.

Sharaf, N., Langdon, C. and S. Gosain, “IS application capabilities and relational value in interfirm partnerships,” *Information Systems Research* (18:3), 2007, pp. 320-339.

Shannon, C. E., and Weaver, W. 1949. *The mathematical theory of communication*, Urbana, IL: The University of Illinois Press.

Soh, C., Markus, M. L., and Goh, K. H. “Electronic marketplaces and price transparency: Strategy, information technology, and success,” *MIS Quarterly* (30:3), 2006, pp. 705-723.

Spence, M. 1974. *Market-signaling*, Cambridge, MA: Harvard University Press.

Stillman, R. “Examining antitrust policy towards horizontal mergers,” *Journal of Financial Economics* (11), 1983, pp. 225-240.

Subramani, M., Walden, E. “The impact of e-commerce announcements on the market value of firms,” *Information Systems Research* (12:2), 2001, pp. 135-154.

Swaminathan, V., Murshed, F., and Hulland, J. “Value creation following merger and acquisition announcements: The role of strategic emphasis alignment,” *Journal of Marketing Research* (45:1), 2008, pp. 33-47.

Tirole, J. 1988. *The theory of industrial organization*, Cambridge, MA: MIT Press.

Utterback, J. 1994. *Mastering the dynamics of innovation*, Boston, MA: Harvard Business School Press.

Uzzi, B., Gillespie, J. "Knowledge spillover in corporate financing networks: Embeddedness and the firm's debt performance," *Strategic Management Journal* (23), 2002, pp.595 - 618.

Vessey, I., Ramesh, V., and Glass, R. L. “Research in information systems: An empirical study of diversity in the discipline and its journals,” *Journal of Management Information Systems* (19:2), 2002, pp. 129-174.

West, J. and Lakhani, K. R. “Getting clear about communities in open innovation," *Industry & Innovation* (15:2), 2008, pp. 223 - 231.

Williamson, O. E. “Transaction cost economics: The governance of transactional relations,” *Journal of Law and Economics* (22:2), 1979, pp. 233-261.

Wolff, J. A., Reed, R. “Firm resources and joint ventures: What determines zero-sum versus positive-sum outcomes?” *Managerial Decision and Economics* (21), 2000, pp. 269-284.

Appendix A: Z-Statistic for Testing Significance of Cumulative Abnormal Returns

For hypothesis testing (H1-H3), we use the z-statistic (Patell, 1976) to test whether the standardized mean CARs are significantly different from zero. The same tests have been used in prior studies (Chan et al., 1997; Chatterjee et al., 2001; Dehning et al., 2004). The test statistic, $Z_{T1,T2}$, uses the standardized residual based on the standardized abnormal return, SAR_{jt}, which is derived by dividing firm j's abnormal return (AR_{jt}) by its standard deviation (S_{ARjt}):

$$SAR_{jt} = \frac{AR_{jt}}{S_{AR_{jt}}}$$

The test statistic, $Z_{T1,T2}$, tests whether $CAR_{T1,T2} = 0$. In the case of a three-day window, $T1$ = day –1 to $T2$ = day +1 corresponds to the event period dates. The test statistic, $Z_{T1,T2}$, follows the normal distribution under the null hypothesis in this manner:

$$Z_{T1,T2} = \frac{1}{N}\sum_{j=1}^{N} Z_{T1,T2}^{j},$$

where

$$Z_{T1,T2}^{j} = \frac{1}{\sqrt{Q_{T1,T2}^{j}}}\sum_{t=T1}^{T2} SAR_{jt}$$

and

$$Q_{T1,T2}^{j} = (T2 - T1 + 1)\frac{D_j - 2}{D_j - 4},$$

where D_j is the number of trading-day returns used to estimate the parameters for firm j.

Appendix B: Retesting H1 While Controlling for Announcements Related to the Existing Members

We checked whether our results change when we control for confounding announcements related to the existing members of OIAs. In H1 sample, we checked announcements related to the existing members of an OIA that were made on the event date on which a firm (or multiple firms) made an announcement for joining the OIA. We identified 22 such announcements and removed associated events, reducing the sample size to 172. Using the smaller sample, we re-analyzed CARs and the results are presented in Table B. Although the magnitude of the mean CARs decreased, they are still significant (p<0.05) and qualitatively similar to the results in Table 3 that do not account for the announcements related to the existing members. This implies that the announcements made by the existing members do not significantly influence our results. The H2 sample was not affected because such announcements had already been accounted for. The H3 sample remained intact because H3 is concerned with value effects to rivals, and we had already controlled for all the confounding announcements associated with rivals.

Table B. Abnormal Stock Returns to Allying Firms (*N* = 172)

	Mean	Number of Positive: Negative CARs	Z-Stat
CAR2	0.19%	91:81	1.673**
CAR3	0.33%	91:81	1.838**

***p < 0.01, **p < 0.05, *p < 0.1