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LEARNING FROM COMPETING PARTNERS: OUTCOMES AND DURATIONS OF SCALE AND LINK ALLIANCES IN EUROPE, NORTH AMERICA AND ASIA

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This paper investigates the outcomes and durations of strategic alliances among competing firms, using alliance outcomes as indicators of learning by partner firms. We show that alliance outcomes vary systematically across link and scale alliances. Link alliances are interfirm partnerships to which partners contribute different capabilities, while scale alliances are partnerships to which partners contribute similar capabilities. We find that partners are more likely to reorganize or take over link alliances than scale alliances. By contrast, scale alliances are more likely to continue without material changes. The two types of alliances are equally likely to shut down, at similar ages. These results support the view that link alliances lead to greater levels of learning and capability acquisition between the partners than do scale alliances. Copyright © 2000 John Wiley & Sons, Ltd.

This study investigates the outcomes and durations of strategic alliances among competing firms, using alliance outcomes as indicators of learning by partner firms. We define strategic alliances as arrangements between two or more independent companies that choose to carry out a project or operate in a specific business area by coordinating the necessary skills and resources jointly rather than either operating on their own or merging their operations. This definition of alliances includes equity joint ventures as well as partnerships that did not entail the creation of a separate legal entity. Research on interfirm collaboration has recently begun to explore the issue of alliance dynamics (Singh and Mitchell, 1996; Gulati, 1998; Koza and Lewin, 1998). The main emphasis has shifted from examining conditions that favor alliance formation (Harrigan, 1985; Teece, 1986; Contractor and Lorange, 1988; Hennart, 1988; Kogut, 1988a; Oliver, 1990; Williamson, 1991a) to investigating alliance outcomes and the impact of alliances on the partner firms (Kogut, 1989; Blodgett, 1992; Dussauge and Garrette, 1995; Doz, 1996; Mitchell and Singh, 1996; Park and Russo, 1996; Nakamura, Shaver and Yeung, 1996; Park and Ungson, 1997; Hennart, Roehl and Zietlow, 1999). This paper aims at contributing to the research concerning alliance outcomes. Our arguments focus on the potential for partners to learn about each other's capabilities.

The study views strategic alliance outcomes through an evolutionary lens. Our primary underlying concepts draw from the resource-based view of the firm which suggests that firms' competitive advantages derive from their preferential access to idiosyncratic resources, especially tacit knowledge-based resources (Penrose, 1959; Wernerfelt, 1984; Conner, 1991; Amit and Schoemaker, 1993). Theorists dating to Commons (1934), Coase (1937), Barnard (1938), Simon (1957), Richardson (1972), and others have long recog-

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nized that no one business can create all resources needed to prosper and grow. Instead, collaboration among businesses that possess complementary resources is often necessary for survival and growth, and provides a means of combining resources held by different firms in order to exploit new business opportunities. Collaboration appears to be an effective way of combining resources that are subject to a high degree of knowledge-based market failure (Itami and Roehl, 1987; Mitchell and Singh, 1993, 1996; Gulati, 1998). Moreover, collaboration provides a means for firms to protect the value of their resources through financial and organizational safeguards against opportunistic behavior (Teece, 1986; Hennart, 1988; Bresser, 1988; Kogut, 1988a; Jorde and Teece, 1990; Williamson, 1991a; Chi, 1994). Thus, collaboration provides potential benefits to all partners.

Despite the potential advantages of collaboration, a further argument stresses that collaboration may create favorable conditions for inter-partner learning and thus may allow one partner to appropriate and internalize resources that another partner contributed (Balakrishnan and Koza, 1993; Nakamura *et al*., 1996; Lane and Lubatkin, 1998; Kumar and Nti, 1998). Such appropriation is a particularly critical issue when alliances associate competing firms. When the partner firms in an alliance are also competitors in a product market, there will be many opportunities for inter-partner learning and major competitive consequences of such learning (Pucik, 1988; Hamel, Doz and Prahalad, 1989; Hamel, 1991). Alliances between competitors can lead to the loss of critical proprietary knowledge, to increased dependence of one partner vis-à-vis the other, and even to the takeover of one partner by the other (Bleeke and Ernst, 1995). Distinguishing between alliances that are likely to contribute to all partners and alliances that will tend to favor some partners is both conceptually and managerially important (Hennart *et al*., 1999).

We examine a key aspect of alliances that will influence alliance outcomes. We argue that alliances in which the partners contribute asymmetric knowledge, which we refer to as link alliances, tend to favor skill transfers. In contrast, we argue that alliances in which the partners contribute similar knowledge, which we refer to as scale alliances, are more likely to continue without substantial skill transfer. The analysis focuses on four types of alliance outcomes, including cases in which: (i) partnering companies reorganize responsibility for the activities of the alliances, (ii) one partner takes over the joint activity, (iii) alliances continue within their initial distribution of activities, and (iv) the partners dissolve the alliance. The first two types of alliance outcomes will tend to mark greater capability acquisition than the latter two types of outcomes. Therefore, we expect reorganization and takeover to be more common for link alliances than for scale alliances. We study two aspects of alliance outcomes, including the likelihood that an alliance will undergo each type of outcome and the length of time that the alliance operates before the outcome occurs. The empirical analysis examines 227 alliances among competing firms in several manufacturing industries in Europe, North America, and Asia, covering the period from 1952 to 1996.

BACKGROUND AND PREDICTIONS

Prior research on alliance outcomes

Several perspectives have examined alliance outcomes (see Uzzi, 1996, and Gulati, 1998). A first stream of research has linked alliance stability and duration to conditions surrounding the formation of the partnership. A second stream of research has focused on collaborative processes as a factor in the dynamics and outcomes of alliances.

Most early studies on the outcomes of joint ventures tried to identify factors that influence their duration and stability. Several studies have investigated joint venture equity distribution between the parent companies (Janger, 1980; Killing, 1982, 1983; Beamish, 1984, 1985; Beamish and Banks, 1987; Geringer and Hebert, 1989; Blodgett, 1992), with somewhat contradictory results. Other authors (Harrigan, 1988; Kogut, 1988a, 1988b, 1989; Park and Russo, 1996; Park and Ungson, 1997) examined the influence on joint venture duration and survival of factors such as partner asymmetries, joint venturing experience, joint venture scope, industry structure, R&D intensity, inter-partner rivalry, and governance structure. More recent studies have suggested that it is critical to examine the way in which alliances terminate, discriminating in particular between joint venture dissolution and acquisition (Park

and Russo, 1996; Reuer and Miller, 1997; Dussauge and Garrette (1997–1998); Hennart, Kim and Zeng, 1998; Hennart *et al*., 1999). For instance, it appears that joint ventures between direct competitors are more likely to end in early dissolution than joint ventures between non-competing firms (Park and Russo, 1996; Park and Ungson, 1997). Park and Russo (1996) also showed that acquisitions of jointly owned manufacturing facilities, which they define as integrative joint ventures, tend to take place earlier than acquisitions of ventures in which the partners carried out the joint activities sequentially. In a study of international expansion alliances, Kogut (1991) showed that growth in the targeted market tends to trigger the acquisition of the joint venture by the entering partner. This approach interprets joint ventures as options to invest in new markets. According to this analogy, a firm exercises the option when it acquires the joint venture. In these approaches which distinguish between different forms of alliance termination, joint venture survival no longer stands as an implicit criterion of success. Instead, the more important issue is how the alliance affects the parent firms.

In a more evolutionary perspective, a second stream of research has examined alliance outcomes as the result of collaborative processes and partner interaction (Ring and Van de Ven, 1994; Kumar and Nti, 1998; Larsson *et al*., 1998). In this approach, the focus shifts from the fate of the alliance itself to the consequences of allying for the partner firms. Several studies in this vein have emphasized in-depth case analyses (Hamel, 1990, 1991; Doz, 1996; Arino and de la Torre, 1998). In parallel with the resource-based view of the firm, many of these studies have insisted on the importance of learning and skill acquisition that tend to occur between the allied firms, especially in alliances among competitors (Doz, 1988; Hamel *et al*., 1989; Hamel, 1991; Kanter, 1994). A few larger sample studies have also explored the impact of alliance activity on the ongoing financial performance and survival of the parent businesses (Berg, Duncan, and Friedman, 1982; Hagedoorn and Schakenraad, 1994; Mitchell and Singh, 1996; Singh and Mitchell, 1996). The studies report that parents often benefit from alliances, but that alliance activity also carries the risk of becoming dependent on a partner's capabilities. Khanna, Gulati, and Nohria (1998) stress the impact of learning on the dynamics of alliances, linking the relative competitive or cooperative nature of the relationship to the extent to which the partners could exploit the skills they acquire in the alliance within the context of their own activities. Nakamura *et al*. (1996) identified two contrasted patterns of joint venture evolution that they link to learning. They observe that the parent firms' intangible competitive capabilities tend to either converge or diverge, with the assumption that capability convergence stems from learning. Their study shows that convergence of capabilities reduces the life expectancy of a joint venture, whereas partner specialization leads to longer duration of the joint venture, although the study offers no explanation as to why partner capabilities tend to diverge in some alliances but converge in other partnerships.

Our study aims at contributing to alliance outcome research by linking the outcomes of alliances to the processes through which these outcomes occur and to their implications for the parent firms. In this perspective, we use alliance outcomes as indicators of inter-partner learning and examine the impact of alliances on the partner firms by focusing on new capability acquisition. In doing so, we suggest an explanation for the various possible alliance outcomes based on the varying potential for inter-partner learning offered by different types of alliances. More specifically, we address issues concerning learning by alliance partners in link and scale alliances, and then offer predictions concerning how learning opportunities will influence alliance outcomes.

Learning and capability acquisition in alliances between competitors

Research on inter-organizational learning (Argyris and Schön, 1978; Fiol and Lyles, 1985; Dosi, 1988; Moingeon and Edmondson, 1996) has shown that firms are better able to acquire new capabilities when they already have a competence base that is similar to the new knowledge that they seek. Cohen and Levinthal (1990) use the term absorptive capacity to express this idea. In this view, firms are more likely to graft a new skill successfully to a closely related competence base. Firms operating in the same business typically share a common competence base because they use similar technologies, satisfy similar customer needs, serve similar customers, and offer related products. Building on this idea, Lane and

Lubatkin (1998) argue that firms which share similar concerns and face similar problems, and therefore have similar dominant logics (Prahalad and Bettis, 1986; Bettis and Prahalad, 1995), can more easily learn from one another. Competing firms, because they operate in a similar context, often confront similar issues and, hence, develop overlapping dominant logics. Therefore, alliances between competitors are likely to create a context that favors inter-partner learning (Hamel, 1991). Park and Russo (1996: 878) argue that 'the potential for appropriability in a joint venture setting clearly is higher when the partners are direct competitors' and present empirical evidence that supports elements of this argument.

Although they operate in a similar context, firms that compete in the same industry are also likely to possess specific, idiosyncratic skills and capabilities (Nelson and Winter, 1982; Nelson, 1991; Rumelt, Schendel and Teece, 1991). Differences in the resource endowments of factors such as technologies, engineering and production capabilities, products, and market presence create the potential for firms to combine complementary assets, through alliances, in order to pursue new business opportunities. In addition, firms with complementary resource endowments potentially have significant opportunities to learn from one another. Despite the organizational safeguards that firms often set up to limit uncontrolled information disclosure (Bresser, 1988), firms can use the alliance as a means of acquiring new resources from their partner in those areas where they have deficiencies. If collaboration is to be a mechanism by which firms acquire such resources, then not only do the partners' resource endowments need to differ, but the firms must also make different contributions to the joint endeavor.

Scale and link alliances

Analysts often categorize alliances in terms of the similarity and location of the respective contributions that the partner firms make to the alliance. Porter and Fuller (1986: 336) contrast 'X form' and 'Y form' coalitions between competitors, stating that '… in X coalitions, firms divide the activities within an industry between themselves (for example, one partner manufactures while letting the other market). In Y coalitions, the firms share the actual performance of one or more value activities (for example, a joint marketing agreement)'. Drawing on transaction cost economics, Hennart (1988) identifies scale joint ventures on the one hand and link joint ventures on the other. According to Hennart (1988: 362) 'Scale JVs are created when two or more firms enter together a contiguous stage of production or distribution or new market…[while] in link JVs, the position of the partners is not symmetrical'. Also building on the transaction cost theoretical background, Park and Russo (1996: 878) argue that 'a key factor in joint venture outcomes is the nature of the partners' contributions to the operation'. On this basis, they distinguish sequential from integrative joint ventures. Park and Russo's typology is closer to Porter and Fuller's (1986) X-Y dichotomy than to Hennart's scale-link distinction because the sequential-integrative comparison derives from whether the joint venture activities take place in a jointly-owned location (integrative) or whether the parents undertake the activities themselves (sequential). Our approach in this paper emphasizes Hennart's scale-link distinction between types of parent contributions, although our empirical analysis will also investigate the impact of sequential and integrative organization of activities.

The scale-link distinction tends to reflect different objectives that firms assign to alliances. Scale alliances, in which the partners contribute similar resources pertaining to the same stage or stages in the value-chain, will produce significant economies of scale for those activities that firms carry out in collaboration. That is, scale alliances allow the partners to achieve scale economies and to reduce excess capacity. Such scale alliances can include joint R&D efforts, the joint production of a particular component or sub-assembly, or the manufacture of an entire product. The PRV alliance that Peugeot, Renault and Volvo set up in 1971 to develop and manufacture a common V6 engine falls into the scale category, as does the Airbus consortium associating four European aircraft manufacturers that jointly produce a range of commercial airplanes. Such scale alliances provide a way of avoiding, or at least postponing, mergers in industries undergoing strong concentration processes (Dussauge and Garrette, 1995).

Link alliances, in contrast with scale alliances, aim at combining different and complementary skills and resources that each partner contributes.

Link alliances include partnerships in which one partner provides market access to products that another firm developed, such that the two allies create a form of customer-supplier relationship. The 1971 agreements between Chrysler and Mitsubishi, as well as the agreements linking General Motors to Isuzu in the 1970s and 1980s, correspond to this type of alliance. Link alliances may involve joint manufacturing in some cases, such as in the 1983 NUMMI joint venture between General Motors and Toyota, as long as the other components of the value-chain remain distributed between the partner firms. The distinction between scale and link alliances is similar to Sakakibara (1997), who defines alliances in terms of cost-sharing and skill-sharing motivations and finds that cost sharing tends to involve partners with homogeneous capabilities, while skill-sharing tends to involve partners with heterogeneous capabilities.

One of the main theoretical explanations for why firms form alliances is the transaction cost approach. The use of the transaction cost logic, however, can lead to somewhat contradictory propositions (Bresser, 1998: 472–475). Williamson (1991a) considers that intermediate asset specificity and low uncertainty are conditions that lead to a preference for hybrid forms of governance structure over both arm's length transactions and internalization. By contrast, others have argued that alliance formation may allow firms to reduce high levels of uncertainty that characterize some transactions (Kogut, 1988a; Hennart, 1988). We suggest that the apparent contradictions arise from the fact that cooperative relationships involve heterogeneous forms of purposes and governance structures. Indeed, while some degree of asset specificity appears to be a basic condition for choosing to collaborate, very different levels of uncertainty characterize scale and link alliances. Uncertainty is likely to be much greater in link alliances than in scale alliances. Because partner firms contribute complementary, and hence dissimilar, resources to link alliances, their mutual understanding of each other's contribution and their ability to value the contributions accurately is limited. In scale alliances, on the contrary, the similarity of the partners' contributions reduces the uncertainty surrounding both the exact nature and the value of the resources.

Combining an evolutionary perspective on the resource-based view with these transaction cost premises provides useful insights on the dynamics of alliance evolution (Grant, 1996). By construction, all alliances create a situation of mutual dependence between the partner firms, which may or may not change as the alliance unfolds. In link alliances, mutual dependence associates with the complementary nature of the resource endowments of the partners. The dependence will shift if one of the partners is able to acquire resources that the other partner initially held and/or acquire greater understanding of the partner's resources. While firms will need to undertake explicit exchange in order to acquire tangible resources, they can often acquire intangible knowledge-based resources through an ongoing learning process associated with the alliance activity. Firms involved in link alliances have incentives to reduce their dependence by acquiring the skills and other intangible capabilities that underlie the other partner's contributions, as well as acquiring any new skills that arise as the result of combining the partners' complementary resources. This dependence incentive increases owing to the fact that complex intangible resources are, as suggested by the resource-based view, a more sustainable source of competitive advantage because of causal ambiguity problems (Barney, 1991) and are difficult to exchange outside an organizational context that makes learning possible (Chi, 1994). Because of the causal ambiguity and organizational difficulties, firms may be able to use tacit resources more effectively within a single organization rather than through coordination across organizational boundaries.

In scale alliances, in contrast with link alliances, the very similarity in the resources that each partner contributes limits the extent to which the collaboration will cause the firms to gain new skills and other intangible resources. Therefore, dependence is less likely to shift during the life of a scale alliance than in the case of a link alliance. Hence, the extent to which partner firms learn from each other is likely to vary systematically in scale and link alliances. The learning, in turn, will affect the outcome of inter-firm collaboration.

Hypotheses

The core proposition of this paper is that link alliances lead to greater potential levels of learning and capability acquisition between the part-

ners than do scale alliances. Link alliances, which combine complementary skills possessed by the partner firms, offer more opportunities for learning than scale alliances, in which all allies contribute similar skills and resources to the joint project (Hamel, 1991; Grant, 1996; Mowery, Oxley, and Silverman, 1996; Lane and Lubatkin, 1998). Therefore, partner firms are more likely to derive significant private benefits from link alliances than from scale alliances, that is, to find private applications for the new skills they acquire through the alliance (Khanna *et al*., 1998). Allied firms that are also competitors have even greater incentives to use the alliance to acquire from the other partner capabilities they lack (Hamel *et al*., 1989). By doing so, they will improve their overall competitive position and reduce their dependence vis-à-vis a partner that is also a rival. Thus, we expect that firms are more likely to acquire partner capabilities in link alliances than in scale alliances.

The study uses alliance outcomes as indicators of capability acquisitions, rather than observing inter-partner learning directly. We focus on four types of alliance outcomes: (i) cases in which partnering companies reorganize responsibility for the activities of the alliance, (ii) cases in which one partner takes over the joint activity, (iii) cases in which alliances continue within their initial distribution of activities, and (iv) cases in which the partners dissolve the alliance. The first two types of alliance outcomes will tend to mark greater capability acquisition than the latter two types of outcomes.

We first address alliance reorganization. We define reorganization as a major change in the distribution of functional activities such as R&D, manufacturing, assembly, and marketing among the partner firms. The distribution of activities in an alliance typically reflects the respective capabilities of the partner firms, with partners undertaking tasks for which they are particularly skilled. Although firms might sometimes allocate activities to partners that lack certain capabilities so that the partner can learn by doing, particularly in technology transfer alliances among non-competing firms, this will be an uncommon goal in strategic alliances between competitors. Thus, reorganizations of alliances among competitors are likely to occur when one of the partners has developed the ability to carry out certain activities that the alliance previously allocated to the other partner, i.e., when skill transfers and learning have taken place within the alliance. For instance, let us imagine an alliance between a European and a Japanese firm to market Japanese-made products in Europe. If, after some time, the European firm undertakes local manufacture of products that the Japanese partner designed, this would signal that the European firm had acquired new manufacturing capabilities. Similarly, if the Japanese partner starts marketing the same products in Europe on its own, this would signal that the Japanese firm had acquired new marketing skills.

Consistent with the proposition that link alliances lead to greater potential levels of learning and capability acquisition by the partners than do scale alliances, we predict that partners face greater incentives to reorganize link alliances than scale alliances. The incentive arises because the firm now has greater capability to undertake the activity that the partner once provided.

Hypothesis 1a. Link alliances among competing firms are more likely than scale alliances to undergo reorganization.

As the learning that occurs in link alliances improves the resource endowments of the partner and thus changes their competitive positions, relative to the industry as a whole as well as relative to the partners, firms also have incentives to acquire a partner's valuable capabilities as rapidly as possible. Hamel *et al*. (1989) and Hamel (1991) have described this as a race to learn. This race, in turn, will affect the timing of any reorganization that occurs in scale and link alliances.

Hypothesis 1b. Link alliances among competing firms will tend to undergo reorganization earlier than scale alliances.

We next turn to alliance takeover. Alliance takeover occurs when the alliance ends with one of the partners undertaking all previously collaborative activities itself. Takeovers include cases where one partner buys the joint venture and cases when one partner acquires the other partner. We interpret takeover as an extreme case of reorganization, in which one partner no longer needs to collaborate to carry out what was formerly a joint activity.

Pursuing the logic of capability acquisition, if

partner A acquires key capabilities relating to the joint activity, partner A no longer depends on partner B's contributions and can therefore operate autonomously. When this happens, the value of the joint venture is greater for partner A, which can manage the activity on its own, than for partner B, which still lacks certain of the necessary skills.

Partner A now has two incentives to take over the alliance. First, transaction cost logic suggests that the firm may be better able to protect the value of what it has learned by internalizing the activities of the alliance (Williamson, 1991a). Therefore, partner A has an incentive to take over the alliance and to do this as rapidly as possible in order to limit the risks of partner B behaving opportunistically. Second, Kogut's (1991) option argument about joint ventures suggests that partner A will exercise its option to acquire the joint venture before partner B accesses the capabilities it lacks and the value of the joint venture becomes equal for both partners. In some cases, the firms can build in the possibility of a takeover outcome into the partnership agreement, in which partner A then has a call option on the joint venture while partner B has a put option. Overall, learning and skill appropriation tend to favor the takeover of an alliance by one partner (Balakrishnan and Koza, 1993). Therefore, link alliances, which offer greater opportunities for learning and skill appropriation, are more likely than scale alliances to end in a takeover by one partner. Moreover, takeovers of link alliances are likely to occur earlier than those scale alliance takeovers that occur.

Hypothesis 2a. Link alliances among competing firms are more likely than scale alliances to end in takeover by a partner.

Hypothesis 2b. Link alliances among competing firms will tend to undergo takeover earlier than scale alliances.

We next address alliance continuation without reorganization, which we expect to be most common for scale alliances. In contrast with link alliances, scale alliances primarily provide scale economies rather than combining complementary resources. At the inception, the partners in scale alliances tend to possess similar skills and resources. Therefore, scale alliances offer fewer opportunities for learning than do link alliances, so that capability transfers between the partners of a scale alliance will tend to be quite limited and usually will not require major reorganizations. This argument is consistent with the view that symmetric alliances are more stable than asymmetric partnerships (Harrigan, 1988). As firms cannot determine the distribution of activities within scale alliances on the basis of any preexisting specialization of the partners, the primary motive for choosing an initial organization of an alliance will be the maximization of scale economies (Hennart, 1988). Thus, the primary incentive to reorganize the alliance would be to further increase efficiency, assuming the initial distribution of activities turned out to be sub-optimal. If the organization that the firms adopt initially is sufficiently efficient, then there will even be a disincentive to reorganize, because the reorganization costs will offset potential increases in economies of scale (Williamson, 1991b). We limit our prediction to the likelihood that an alliance will continue, because we do not have a direct argument concerning the length of time that link and scale alliances will continue.

Hypothesis 3. Scale alliances among competing firms are more likely than link alliances to continue without reorganization.

Finally, we turn to alliance dissolution with no takeover or prior reorganization. Dissolution signals that an alliance has failed or, at least, has outlived its purpose (Kogut, 1988b). On the one hand, link alliances might seem more likely than scale alliances to dissolve, for two reasons. First, firms will sometimes dissolve link alliances after learning necessary skills from their partners. Second, the partners in a link alliance might be more likely to misinterpret their partners' complementary capabilities than in scale alliances, where partners contribute similar capabilities. If so, then firms might be more likely to shut down link alliances than scale alliances because link alliances are more likely to fail to meet initial expectations. However, like link alliances, scale alliances also may reach the end of their need or fail to meet expectations. Therefore, we expect scale and link alliances to have similar likelihood of dissolution. We again limit our prediction to the likelihood that an alliance will dissolve.

Hypothesis 4. Scale and link alliances among competing firms are equally likely to dissolve with no takeover or prior reorganization.

In summary, we expect firms in link alliances to have more opportunities to learn from their partners than firms engaged in scale alliances. In turn, the learning potential will make link alliances more likely to undergo reorganization or takeover. Similarly, the learning potential will lead to earlier reorganization or takeover for link alliances than scale alliances. By contrast, scale alliances will be more likely to continue without reorganization or takeover. The two types of alliances will be equally likely to dissolve. Alliance outcomes are indirect indicators of learning that provide useful information about capability transfer between alliance partners.

METHOD

Data

We tested our hypotheses on a set of 227 alliances formed in a range of manufacturing industries.[1] All the alliances in this study involved competing firms, that is, firms that operated in the same industries. The industries in the sample tend to be oligopolistic, open to international trade, R&D intensive, subject to significant economies of scale, and globally competitive. Because alliances in such industries offer a high potential for efficiency gains and few opportunities for limiting competition, most value creating alliances emerge in industries with these features (Jacquemin, Buigues and Ilzkovitz, 1989; Millington and Bayliss, 1995). We selected our sample in industries with these characteristics, similar to prior research on strategic alliances (Ghemawat, Porter and Rawlinson, 1986; Hergert and Morris, 1987; Hagedoorn, 1993; Garrette and Dussauge, 1995). We based industry categorization on descriptions of the alliances' business areas. Although we did not use SIC-type codes, because of the international nature of the data and of inconsistencies and unavailability of different national classification systems, the industry definitions approximate a three-digit to four-digit level in the U.S. Standard Industrial Categorization classification. The three most frequent industries in our sample are automobiles (29 percent), aerospace (19 percent), and telecommunications/electronics (35 percent), which together total 83 percent of the cases. Business areas in the auto industry cases included cars, trucks, engines, and transmissions. Business areas in the aerospace cases included commercial airplanes, military airplanes, airplane engines, helicopters, helicopter engines, missiles, and spacecraft. Business areas in the telecommunications/electronics cases included public switching equipment, PBX, radiotelephone equipment, mainframe computers, personal computers, consumer electronics, and semiconductors. For each alliance, we checked from secondary sources and/or with industry analysts and company executives to determine that each partner firm had prior activities in the alliance business area.

All the alliances in the sample involve partner firms from North America (U.S. and Canada), Western Europe, or Asia (Japan and Korea) and entail operations in one of these three zones. We included only agreements that operated within at least one of the partners' home markets. Thus, we excluded agreements such as the General Motors-Toyota joint venture in Australia and the Autolatina alliance that Ford and Volkswagen formed in Brazil and Argentina. We also did not collect information on agreements concerning the supply of components and sub-assemblies from one manufacturer to another because such exchanges are closer to market transactions than to strategic alliances. In addition, we excluded government-sponsored research consortia, such as those sponsored by the European Commission and by MITI in Japan. The resulting sample focuses on strategic alliances that involve the partners' core businesses and markets.

Each data point in our sample corresponds to an agreement between two or more partners, covering a specific business area. For example, in aerospace we considered agreements involving commercial airplanes, military airplanes, airplane engines, helicopters, helicopter engines, missiles and spacecraft. Each alliance operates in one of

[1] Dussauge and Garrette (1997–1998) used a limited version of the data set that we use in this paper to report descriptive results concerning the relative stability of link alliances (market penetration alliances) and two forms of scale alliances (quasi-concentration alliances and shared supply alliances). The earlier study began to develop the ideas that we investigate in this paper.

the three above-mentioned geographic zones. To identify alliances in which reorganizations occurred, we categorized collaborative activities into four main functions, including R&D, manufacturing, assembly, and marketing. Each alliance corresponds to a specific allocation of R&D, manufacturing, assembly, and marketing activities among the partners. Thus, an alliance between an American and a European telecommunications equipment manufacturer by which they each agree to market one of the other's products in their respective home markets would include two cases: one in which the European partner markets the American system in Europe, and a second in which the American partner markets the European system in North America.

We gathered the data for the study from secondary sources such as industry reports, manufacturer associations' publications, and journals specializing in specific industries. Examples include *Automotive News, Aviation Week,* and *Space Technology*. Reports of all the alliances in the sample occurred in published sources. Trade associations and private research institutes publish annual updates on alliances and collaborative ventures for the industries that account for a significant portion of our sample (automobile, aerospace, electronics and telecommunications), which makes it possible to trace alliance formation, reorganization, and termination on a yearly basis. In addition, when information necessary for our study was not available from these sources, we complemented the data by interviewing industry analysts and company executives. Park and Russo (1996) report using a similar supplementary interview approach to complement secondary source data. To avoid perception biases, we relied on variables describing a factual event or situation.

Variables

We defined four alliance outcome dependent variables. Each outcome measure was a 0–1 dummy variable that denoted whether an alliance underwent reorganization before the end of the study period (REORGANIZE), underwent takeover before the end of the study period (TAKEOVER), continued until the end of the study period without reorganization or takeover (CONTINUE), or shut down without reorganization or takeover (DISSOLVE). For the reorganization variable, we first observed how the partners allocated the four functions (R&D, manufacturing, assembly, and marketing) at the beginning of the alliance. We then considered any major subsequent change in this allocation, such as a partner beginning or ceasing to carry out manufacturing or marketing, to be a reorganization. For the takeover variable, we considered an alliance to have been taken over when one of the partners exited the joint project altogether, thus terminating the partnership, while the other partner took on all the activities relating to the project in question. For those alliances that led to the creation of an equity joint venture that encompasses all collaborative activities, the acquisition of the joint venture is synonymous with the takeover of the alliance.

In categorizing alliance outcomes for the statistical analysis, we treated the first event type as the unique outcome for the case. That is, we classed cases that first underwent reorganization and later underwent a second outcome event as reorganizations. Of the 41 reorganization cases, only 16 underwent a second event. Although we did not attempt to estimate the likelihood of the second event in the statistical analysis, owing to the small number of cases, we report the distribution and assess the implications of post-reorganization outcomes in the conclusion.

Tables 1a and 1b report summary statistics and correlations for the variables. While there are significant correlations among some of the independent variables, the core results that we report later in the paper were robust to eliminating variables.

We also defined an alliance duration dependent variable that recorded the number of years between the formation of the alliance and the first of the four types of outcomes that took place. The four 0–1 outcome variables serve as right-censoring indicators for alliance duration before each type of outcome. That is, the outcome variables denote whether a particular type of outcome occurred at the end of the observed duration (value of 1), or whether some other form of outcome took place (value of 0). For example, at the beginning of an alliance, a Japanese partner supplies cars made in Japan to a U.S. manufacturer for sale in the U.S. If, after five years, the firms manufacture the Japanese cars to be sold in the U.S. in a jointly owned American plant, then duration equals five. The duration is right-

Table 1a. Variable summary statistics (227 cases)

Variable	*Mean*	*s.d.*	*Min.*	*Max.*
1 Continue	0.43	0.50	0	1
2 Dissolve	0.19	0.39	0	1
3 Takeover	0.20	0.40	0	1
4 Reorganize	0.18	0.39	0	1
5 Link alliances	0.52	0.50	0	1
6 Link alliances: Marketing	0.22	0.42	0	1
7 Link alliances: Technical	0.30	0.46	0	1
8 Scale alliances	0.48	0.50	0	1
9 Scale alliances: Final products	0.29	0.45	0	1
10 Scale alliances: Components	0.19	0.40	0	1
11 Marketing alliances	0.23	0.42	0	1
12 Multi-firm alliances	0.11	0.31	0	1
13 JV, integrative, balanced	0.23	0.42	0	1
14 JV, integrative, unbalanced	0.18	0.39	0	1
15 JV, sequential	0.11	0.32	0	1
16 Zone, Europe	0.39	0.49	0	1
17 Zone, North America	0.15	0.35	0	1
18 Zone, Asia	0.15	0.35	0	1
19 Zone, global	0.32	0.47	0	1
20 Later founding year	82.80	8.30	52	96
21 Parent equity holding	0.22	0.41	0	1
22 Competitive asymmetry	0.74	0.44	0	1
23 Prior alliances among partners	0.21	0.41	0	1
24 One partner has alliance experience	0.32	0.47	0	1
25 Parents domestic	0.13	0.33	0	1
26 Parent same continent	0.34	0.48	0	1
27 Parent inter-continent, Asia	0.29	0.46	0	1
28 Parent inter-continent, Eur-NAm	0.24	0.43	0	1
29 Industry auto	0.29	0.46	0	1
30 Industry aerospace	0.19	0.39	0	1
31 Industry telecom/elect	0.35	0.48	0	1
32 Industry other	0.17	0.37	0	1

Alliance duration before outcome (years)	*Mean*	*s.d.*	*Min.*	*Max.*	*Cases*
Reorganize	8.2	7.5	1	36	41
Takeover	6.8	7.0	1	41	45
Dissolve	8.0	7.7	1	30	43
Continue (right-censored cases)	10.5	7.1	1	31	98

censored for all types of outcomes other than reorganization. If the organization of the partnership remains stable during the whole life of the alliance, the duration variable equals the length of the cooperation.

The key independent variable for the empirical analysis is the alliance type. We set a dummy variable equal to 1 for link alliances and 0 for scale alliances (LINK ALLIANCES). We examined each alliance to determine whether to class it as either a scale alliance or a link alliance according to the criteria that we described in the 'Scale and link alliances' section of the paper. To do this, we classified possible contributions to an alliance into three categories that distinguished between technical, production, and marketing activities: (i) research, technology development, and product design, (ii) manufacturing facilities and capabilities, and (iii) marketing and sales networks and capabilities. We then examined the respective contributions of each partner. When, based on the three categories, all the contributions of the partners overlapped, we considered an alliance to be of the scale type. When, in at least one of the three categories, all contributions came from one partner, we considered an alliance to be of the link type. Two authors of this study each coded the variable independently. We then

Table 1b. Product-moment correlations (227 cases)

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Continue	1	–0.42	–0.43	–0.41	–0.27	–0.08	–0.22	0.27	0.20	0.11	–0.05	0.02	0.10	0.05	0.13	–0.15
2	Dissolve	–0.42	1	–0.24	–0.23	–0.08	–0.01	–0.07	0.08	–0.03	0.13	–0.02	0.09	–0.16	–0.14	0.00	0.08
3	Takeover	–0.43	–0.24	1	–0.23	0.21	–0.08	0.30	–0.21	–0.14	–0.10	–0.09	0.01	0.12	0.17	–0.07	0.22
4	Reorganize	–0.41	–0.23	–0.23	1	0.20	0.19	0.04	–0.20	–0.07	–0.17	0.18	–0.12	–0.09	–0.10	–0.10	–0.12
5	Link alliances	–0.27	–0.08	0.21	0.20	1	0.51	0.63	–1.00	–0.66	–0.51	0.48	–0.27	–0.08	0.04	–0.13	0.04
6	Link alliances: Marketing	–0.08	–0.01	–0.08	0.19	0.51	1	–0.35	–0.51	–0.34	–0.26	0.98	–0.15	–0.19	–0.17	–0.06	–0.16
7	Link alliances: Technical	–0.22	–0.07	0.30	0.04	0.63	–0.35	1	–0.63	–0.41	–0.32	–0.36	–0.16	0.08	0.19	–0.08	0.19
8	Scale alliances	0.27	0.08	–0.21	–0.20	–1.00	–0.51	–0.63	1	0.66	0.51	–0.48	0.27	0.08	–0.04	0.13	–0.04
9	Scale alliances: Final products	0.20	–0.03	–0.14	–0.07	–0.66	–0.34	–0.41	0.66	1	–0.31	–0.35	0.16	0.16	0.01	0.17	–0.10
10	Scale alliances: Components	0.11	0.13	–0.10	–0.17	–0.51	–0.26	–0.32	0.51	–0.31	1	–0.21	0.16	–0.08	–0.06	–0.04	0.07
11	Marketing alliances	–0.05	–0.02	–0.09	0.18	0.48	0.98	–0.36	–0.48	–0.35	–0.21	1	–0.15	–0.20	–0.17	–0.06	–0.18
12	Multi-firm alliances	0.02	0.09	0.01	–0.12	–0.27	–0.15	–0.16	0.27	0.16	0.16	–0.15	1	0.02	–0.01	0.24	–0.10
13	JV, integrative, balanced	0.10	–0.16	0.12	–0.09	–0.08	–0.19	0.08	0.08	0.16	–0.08	–0.20	0.02	1	–0.26	–0.20	0.02
14	JV, integrative, unbalanced	0.05	–0.14	0.17	–0.10	0.04	–0.17	0.19	–0.04	0.01	–0.06	–0.17	–0.01	–0.26	1	–0.17	0.24
15	JV, sequential	0.13	0.00	–0.07	–0.10	–0.13	–0.06	–0.08	0.13	0.17	–0.04	–0.06	0.24	–0.20	–0.17	1	–0.09
16	Zone, Europe	–0.15	0.08	0.22	–0.12	0.04	–0.16	0.19	–0.04	–0.10	0.07	–0.18	–0.10	0.02	0.24	–0.09	1
17	Zone, North America	–0.01	0.02	–0.08	0.07	0.30	0.32	0.03	–0.30	–0.23	–0.11	0.31	–0.14	–0.11	–0.06	–0.11	–0.33
18	Zone, Asia	0.02	–0.04	–0.05	0.07	0.32	0.35	0.03	–0.32	–0.21	–0.17	0.37	–0.06	–0.05	0.00	–0.03	–0.33
19	Zone, global	0.14	–0.07	–0.13	0.02	–0.51	–0.34	–0.24	0.51	0.44	0.14	–0.33	0.25	0.10	–0.20	0.20	–0.55
20	Later founding year	0.27	–0.12	–0.06	–0.17	0.05	0.20	–0.13	–0.05	–0.19	0.15	0.23	–0.15	0.04	0.01	–0.17	0.18
21	Parent equity holding	–0.15	–0.04	0.12	0.12	0.18	0.32	–0.09	–0.18	–0.10	–0.12	0.30	–0.01	–0.13	–0.05	–0.05	–0.09
22	Competitive asymmetry	0.01	–0.12	0.14	–0.04	0.21	0.05	0.19	–0.21	–0.05	–0.22	0.06	–0.09	–0.01	0.12	0.06	–0.02
23	Prior alliances among partners	0.04	–0.11	–0.01	0.07	0.06	0.33	–0.24	–0.06	–0.08	0.02	0.37	0.04	–0.10	–0.01	0.06	–0.03
24	One partner has alliance experience	–0.14	0.00	0.15	0.02	–0.04	–0.18	0.13	0.04	0.02	0.02	–0.17	–0.18	0.01	–0.03	0.02	0.07
25	Parents domestic	0.15	–0.02	–0.09	–0.08	–0.13	–0.01	–0.14	0.13	–0.10	0.28	–0.02	0.00	–0.02	–0.01	–0.01	–0.11
26	Parent same continent	0.01	0.10	–0.01	–0.10	–0.44	–0.27	–0.23	0.44	0.40	0.09	–0.24	0.17	0.02	–0.12	0.09	0.13
27	Parent inter-continent, Asia-E/NA	–0.05	–0.19	0.02	0.23	0.42	0.32	0.17	–0.42	–0.30	–0.19	0.30	–0.13	–0.12	0.03	–0.05	–0.15
28	Parent inter-continent, Eur-NA	–0.07	0.10	0.06	–0.07	0.14	–0.02	0.18	–0.14	–0.06	–0.12	–0.03	–0.06	0.11	0.11	–0.04	0.11
29	Industry auto	0.05	–0.14	–0.08	0.15	0.23	0.46	–0.16	–0.23	–0.30	0.05	0.44	–0.03	–0.10	–0.20	–0.02	–0.19
30	Industry aerospace	0.08	0.02	–0.13	0.01	–0.41	–0.26	–0.22	0.41	0.61	–0.18	–0.26	0.24	–0.02	–0.14	0.29	–0.36
31	Industry telecom/elect	–0.23	0.21	0.19	–0.11	0.01	–0.15	0.14	–0.01	–0.16	0.17	–0.16	–0.04	–0.03	0.20	–0.15	0.38
32	Industry other	0.16	–0.13	–0.02	–0.06	0.15	–0.10	0.25	–0.15	–0.08	–0.10	–0.05	–0.15	0.18	0.13	–0.09	0.13

Continued overleaf

Table 1b. Product-moment correlations (227 cases) (continued)

	Variable	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	Continue	–0.01	0.02	0.14	0.27	–0.15	0.01	0.04	–0.14	0.15	0.01	–0.05	–0.07	0.05	0.08	–0.23	0.16
2	Dissolve	0.02	–0.04	–0.07	–0.12	–0.04	–0.12	–0.11	0.00	–0.02	0.10	–0.19	0.10	–0.14	0.02	0.21	–0.13
3	Takeover	–0.08	–0.05	–0.13	–0.06	0.12	0.14	–0.01	0.15	–0.09	–0.01	0.02	0.06	–0.08	–0.13	0.19	–0.02
4	Reorganize	0.07	0.07	0.02	–0.17	0.12	–0.04	0.07	0.02	–0.08	–0.10	0.23	–0.07	0.15	0.01	–0.11	–0.06
5	Link alliances	0.30	0.32	–0.51	0.05	0.18	0.21	0.06	–0.04	–0.13	–0.44	0.42	0.14	0.23	–0.41	0.01	0.15
6	Link alliances: Marketing	0.32	0.35	–0.34	0.20	0.32	0.05	0.33	–0.18	–0.01	–0.27	0.32	–0.02	0.46	–0.26	–0.15	–0.10
7	Link alliances: Technical	0.03	0.03	–0.24	–0.13	–0.09	0.19	–0.24	0.13	–0.14	–0.23	0.17	0.18	–0.16	–0.22	0.14	0.25
8	Scale alliances	–0.30	–0.32	0.51	–0.05	–0.18	–0.21	–0.06	0.04	0.13	0.44	–0.42	–0.14	–0.23	0.41	–0.01	–0.15
9	Scale alliances: Final products	–0.23	–0.21	0.44	–0.19	–0.10	–0.05	–0.08	0.02	–0.10	0.40	–0.30	–0.06	–0.30	0.61	–0.16	–0.08
10	Scale alliances: Components	–0.11	–0.17	0.14	0.15	–0.12	–0.22	0.02	0.02	0.28	0.09	–0.19	–0.12	0.05	–0.18	0.17	–0.10
11	Marketing alliances	0.31	0.37	–0.33	0.23	0.30	0.06	0.37	–0.17	–0.02	–0.24	0.30	–0.03	0.44	–0.26	–0.16	–0.05
12	Multi-firm alliances	–0.14	–0.06	0.25	–0.15	–0.01	–0.09	0.04	–0.18	0.00	0.17	–0.13	–0.06	–0.03	0.24	–0.04	–0.15
13	JV, integrative, balanced	–0.11	–0.05	0.10	0.04	–0.13	–0.01	–0.10	0.01	–0.02	0.02	–0.12	0.11	–0.10	–0.02	–0.03	0.18
14	JV, integrative, unbalanced	–0.06	0.00	–0.20	0.01	–0.05	0.12	–0.01	–0.03	–0.01	–0.12	0.03	0.11	–0.20	–0.14	0.20	0.13
15	JV, sequential	–0.11	–0.03	0.20	–0.17	–0.05	0.06	0.06	0.02	–0.01	0.09	–0.05	–0.04	–0.02	0.29	–0.15	–0.09
16	Zone, Europe	–0.33	–0.33	–0.55	0.18	–0.09	–0.02	–0.03	0.07	–0.11	0.13	–0.15	0.11	–0.19	–0.36	0.38	0.13
17	Zone, North America	1	–0.17	–0.28	0.03	0.21	0.02	0.04	0.01	0.10	–0.25	0.07	0.12	0.20	–0.17	–0.07	0.02
18	Zone, Asia	–0.17	1	–0.28	0.11	–0.06	0.02	0.13	–0.15	–0.05	–0.22	0.48	–0.23	0.34	–0.20	–0.15	–0.02
19	Zone, global	–0.28	–0.28	1	–0.28	–0.02	0.00	–0.10	0.03	0.08	0.22	–0.25	–0.03	–0.21	0.65	–0.23	–0.13
20	Later founding year	0.03	0.11	–0.28	1	–0.07	–0.05	0.10	–0.04	0.07	–0.13	0.01	0.07	0.12	–0.42	0.11	0.16
21	Parent equity holding	0.21	–0.06	–0.02	–0.07	1	0.19	0.39	–0.06	–0.14	–0.02	0.11	0.01	0.11	–0.04	0.04	–0.15
22	Competitive asymmetry	0.02	0.02	0.00	–0.05	0.19	1	0.08	0.02	–0.04	–0.16	0.07	0.14	–0.15	0.08	0.02	0.08
23	Prior alliances among partners	0.04	0.13	–0.10	0.10	0.39	0.08	1	–0.17	–0.07	0.07	0.08	–0.11	0.25	–0.05	–0.10	–0.11
24	One partner has alliance experience	0.01	–0.15	0.03	–0.04	–0.06	0.02	–0.17	1	–0.01	0.06	–0.13	0.08	–0.19	0.10	0.14	–0.06
25	Parents domestic	0.10	–0.05	0.08	0.07	–0.14	–0.04	–0.07	–0.01	1	–0.28	–0.25	–0.21	0.13	–0.08	–0.06	0.01
26	Parent same continent	–0.25	–0.22	0.22	–0.13	–0.02	–0.16	0.07	0.06	–0.28	1	–0.46	–0.40	–0.18	0.31	–0.03	–0.08
27	Parent inter-continent, Asia-E/NA	0.07	0.48	–0.25	0.01	0.11	0.07	0.08	–0.13	–0.25	–0.46	1	–0.36	0.32	–0.28	–0.05	–0.03
28	Parent inter-continent, Eur-NA	0.12	–0.23	–0.03	0.07	0.01	0.14	–0.11	0.08	–0.21	–0.40	–0.36	1	–0.24	0.02	0.13	0.11
29	Industry auto	0.20	0.34	–0.21	0.12	0.11	–0.15	0.25	–0.19	0.13	–0.18	0.32	–0.24	1	–0.31	–0.47	–0.29
30	Industry aerospace	–0.17	–0.20	0.65	–0.42	–0.04	0.08	–0.05	0.10	–0.08	0.31	–0.28	0.02	–0.31	1	–0.36	–0.22
31	Industry telecom/elect	–0.07	–0.15	–0.23	0.11	0.04	0.02	–0.10	0.14	–0.06	–0.03	–0.05	0.13	–0.47	–0.36	1	–0.33
32	Industry other	0.02	–0.02	–0.13	0.16	–0.15	0.08	–0.11	–0.06	0.01	–0.08	–0.03	0.11	–0.29	–0.22	–0.33	1

asked an industry expert to independently classify alliances in the automobile, aerospace, data processing, electronics, and telecommunications industries. After undertaking this process, we dropped eleven ambiguous cases because of conflicting coding.

We defined several control variables based on prior literature. These independent variables address characteristics of the alliances, parents, and industries that might affect alliance outcomes. In particular, as prior studies on alliance typologies suggest that the scale-link distinction relates to other factors, such as alliance purpose and scope, task allocation and organization, industry setting and parents' geographic origins (Garrette and Dussauge, 1995), it is necessary to control for the impact of these factors.

The control variables that address alliance characteristics include alliance purpose, alliance form, geographic coverage, multi-firm alliances, and founding year. We defined two types of variables to investigate the impact of alliance purpose. First, we contrasted alliances that emphasize marketing activities with alliances that include technical activities. We defined a dummy variable to denote alliances focused on marketing activities (MARKETING ALLIANCES), distinguishing between alliances that involved only marketing activities and those that involved technical activities such as research and production (Kogut, 1991; Park and Russo, 1996). We also intersected the alliance emphasis and link alliance variables, to create two new dummy variables (LINK ALLIANCES: MARKETING; LINK ALLIANCES: TECHNICAL). The two interaction variables allow us to determine whether link alliances with different purposes tend to undergo different fates. We follow Dussauge and Garrette (1997–1998) in distinguishing between scale alliances that involved products for end-product markets (SCALE ALLIANCES: FINAL PRODUCTS) and those that produced components (SCALE ALLIANCES: COMPONENTS).[2] End-product alliances might be less stable than component alliances, if they provide greater opportunities to learn about partners' products and market activities.

We defined three variables to distinguish equity joint ventures from collaborative agreements in which the firms did not create a legal entity for the partnership. The joint venture variables differentiated between sequential joint ventures (JV, SEQUENTIAL), integrative joint ventures in which one partner holds a majority share (JV, INTEGRATIVE, UNBALANCED) and integrative joint ventures in which none of the partners holds a majority (JV, INTEGRATIVE, BALANCED). The impact of joint venture status on the outcome of alliances is ambiguous. On the one hand, more formalized governance modes such as equity joint ventures might stabilize the partnership (Williamson, 1991a; Hennart, 1988). On the other hand, the existence of a separate joint venture might make the takeover of the collaborative venture easier (Kogut, 1991). The distinction between integrative and sequential joint ventures follows Park and Russo (1996), and refers to the way in which firms allocate and organize alliance activities. Firms form integrative joint ventures when they assign alliance manufacturing activities to a jointly owned facility. In sequential joint ventures, the firms allocate all activities to individual partners in a sequential path, with no joint operations. Park and Russo predicted that integrative joint ventures would be more likely to fail than sequential joint ventures, but found no empirical support for the prediction. On the other hand, exploratory results of their study found that integrative joint ventures tend to have shorter durations before being acquired than do sequential joint ventures. We also distinguish between balanced and unbalanced joint venture ownership where, in the case of two partner alliances, balanced ownership corresponds to 50–50 joint ventures. As we noted earlier, prior research is unclear concerning whether balanced or unbalanced ownership will associate with greater joint venture stability. In order to create exhaustive and mutually exclusive joint venture variables, we intersected the ownership balance measure with the integrative joint venture measure (almost all sequential joint ventures involved unbalanced ownership).

We also defined variables for geographic coverage, multi-firm alliances, and alliance founding year. We identified the geographic coverage of the alliance, because the geographic, economic

[2] Almost all scale alliances included technical activities, so that it was inappropriate to intersect the scale alliance variable with the technical-marketing distinction. Similarly, almost all link alliances involved end-products, so that it was inappropriate to intersect the link alliance variable with the final product-component distinction.

and political context in which alliances are formed might have an influence on their fate (Gomes-Casseres, 1990; Parkhe, 1991; Agarwal and Ramaswamy, 1992). We determined whether the market of the alliance covered Europe, Asia, North America, or a combination of these zones. Three variables, (ZONE, EUROPE; ZONE, NORTH AMERICA; ZONE, ASIA), denoted alliances, such as the Rover Honda and NUMMI alliances, that sold goods only within a base continent. A comparison variable (ZONE, GLOBAL) denoted alliances, such as Airbus, that also sold their output outside the continent in which the firms based the alliance. A 0–1 dummy variable denoted alliances that had more than two partners (MULTI-FIRM ALLIANCE), which Park and Russo (1996) argue may be less stable than two-firm alliances. We defined a variable to denote the founding year of the alliance (LATER FOUNDING YEAR), because more recent alliances will have less time in which to undergo a reorganization, takeover, or dissolution.

The control variables that address parent characteristics include equity holdings, relative competitive position, alliance experience, and geographic location. A dummy variable identifies cases in which one partner holds a share of the other's equity (PARENT EQUITY HOLDING). As in the case of joint ventures, the impact of equity holding is ambiguous. Equity holdings might stabilize the partnership (Williamson, 1991a; Hennart, 1988) by acting as safeguards against opportunistic behavior (Bresser, 1988), but also might provide a path toward the takeover of the partner (Bleeke and Ernst, 1995).

We defined a variable to denote the relative competitive position of the partners (COMPETITIVE ASYMMETRY). Partner asymmetries may influence alliance stability and performance (Harrigan, 1985, 1988; Doz, 1996). We operationalized the concept of asymmetry by comparing the sales of the partner firms in the industry in which the firms created the alliance. This is an appropriate measure because the alliance partners compete in the same industries and product lines, which we checked from secondary sources, industry analysts, and company executives. We considered a partnership to be asymmetric when, at the time the firms created the alliance, the sales of one of the partner firms were at least twice as large as the sales of the other partner. Franko (1971) and Ravenscraft and Scherer (1987) used similar factors.

We defined two variables to denote alliance experience. One variable noted whether two or more of the partners in an alliance had formed an alliance with each other within the ten years before the formation of the focal alliance (PRIOR ALLIANCES AMONG PARTNERS). Kogut (1989) argues that multiple ties among partners increase the stability of alliances, with reciprocity acting as a deterrent against opportunistic behavior. Also, such alliances might tend to be particularly stable if the partners use their prior experience with each other to assign specialized tasks. Alternatively, firms with joint experience might use individual alliances for short-term activities, planning to form additional alliances if new activities became necessary. A second alliance experience variable noted whether a single partner within the alliance had experience during the past ten years of forming alliances with competitors (ONE PARTNER HAS ALLIANCE EXPERIENCE). Alliances in which one partner has developed greater competitive alliance skills might tend to be particularly unstable.

We defined four 0–1 dummy variables to denote partnerships involving parent firms from the same country (PARENTS DOMESTIC), same continent (PARENTS SAME-CONTINENT), or different continents (PARENTS INTER-CONTINENT, ASIA-E/NA; PARENTS INTER-CONTINENT, EUR-NA). Prior research argues that the geographic origins of the partner firms may influence alliance outcomes (Harrigan, 1988; Nohria and Garcia-Pont, 1991; Hergert and Morris, 1987; Ghemawat *et al.*, 1986; Beamish and Banks, 1987). Many analysts argue that, for cultural and organizational reasons, international alliances create more potential for capturing valuable knowledge through collaboration than domestic alliances (Reich and Mankin, 1986; Hamel *et al*. 1989; Hamel, 1991; Aoki, 1986). Moreover, inter-continental alliances might be more likely to end than domestic partnerships or intra-continental alliances if cultural differences between the partner firms create greater instability (Harrigan, 1985, 1988). We distinguish inter-continental alliances involving Asian firms (PARENTS INTER-CONTINENT, ASIA-E/NA) and those involving European and North American partners (PARENTS INTER-CONTINENT, EUR-NA), owing to the common argument that

Asian firms tend to be particularly likely to use alliances as learning opportunities. We note, however, that recent empirical work challenges the claim that intercontinental alliances, and alliances involving Asian firms in particular, are less stable than domestic alliances (Mowery *et al*., 1996, Hennart *et al*. 1999).

Finally, as control variables to address industry differences, we defined four 0–1 dummy variables to distinguish alliances set up in the aerospace, automobile, telecom/electronics, and other industries (INDUSTRY AUTO, INDUSTRY AERO, INDUSTRY TEL/ELECT, INDUSTRY OTHER). Prior research (Kogut, 1988b; Harrigan, 1985; Lorange and Roos, 1992; Garrette and Dussauge, 1995) suggests that link and scale alliance types will distribute unevenly among industries, so that the industry variable may influence alliance outcomes. In addition, whatever their type, we expect alliances in industries with shorter product lifecycles to be less stable and end earlier, so that we expect telecom/electronics alliances to be less stable than many other alliances. Ideally, it would be desirable also to control for differential industry growth and concentration (Kogut, 1991), but the multi-period and multi-national scope of this study makes such measurement impossible, which Park and Russo (1996) also found to be the case in their study. The focus of our argument is on firm-level issues, however, rather than on industry-level trends. Moreover, the industry variables help address differences across economic sectors, while the alliance founding year and geographic variables help address inter-period and inter-region differences.

Statistical methods

We used two types of statistical methods to test the outcome and duration hypotheses. We tested the outcome hypotheses using four sets of maximum likelihood binomial logistic regression estimates. We calculated one model for each of the four types of outcomes. Each model estimated the influences of the independent variables on the likelihood that an alliance would undergo a particular type of outcome, relative to the likelihood that the alliance would undergo any of the other three outcomes. In the model for each type of outcome, the focal outcome took a value of 1, while the other three types of outcomes took values of 0. In the reorganization analysis, for instance, the dependent variable for cases of reorganization took a value of 1, while cases that ended in takeover, shut down, or continued at the end of the study period took a value of 0.

The logistic regression models took the form $\text{Ln } P_i/(1-P_i) = bX_i$. In this equation, P_i is the probability that alliance i will undergo a particular type of outcome. A vector of covariates X_i with coefficient vector b, including an intercept, linearly affects the log odds of the probability. The effect of a one-unit change of covariate j on the probability that an alliance will undergo a particular outcome is $b_jP_i(1-P_i)$. We obtained the maximum likelihood estimates using the logistic regression procedure of the SAS statistical package.

We tested the duration hypotheses using accelerated event-time regression (Kalbfleisch and Prentice, 1980; Cox and Oakes, 1984; Mitchell, 1989). The accelerated event-time method assumes that the event-times, which are alliance durations in this study, distribute according to a parametric baseline distribution that would hold if all independent variables were zero. The procedure then estimates the effects of covariates as exponentially multiplicative accelerations or decelerations of the baseline distribution. The basic additive logarithmic form of the model takes the form: (1) $\ln T_i = bX_i + se_i$. In this equation, T_i is the observed event time of the ith case, X_i is a vector of intercept and covariates associated with the ith case, and b is a vector of coefficients associated with the independent variables. A positive b coefficient accelerates the baseline distribution of event times and a negative coefficient decelerates the distribution. The error vector e takes an assumed parametric distribution with a variance-related scale factor s. A shape parameter also appears in some distributions, as we discuss below.

The accelerated event-time method suits the duration analysis of this study for two reasons. First, the method incorporates the information that the duration of an alliance outcome is right-censored, that is, the outcome did not occur before the end of the study period. Right censoring includes cases for which an event has not occurred by the end of the study period and cases that leave the sample before an event occurs. The accelerated event-time method uses the right-censoring information by including the value of a censored duration in the estimation of the survival

function, which is the probability that an outcome will occur at some unknown time in the future. A noncensored case, meanwhile, applies to the probability density function, which is the probability that an outcome occurs at the observed time.

The second advantage of the accelerated event-time method is that it takes a flexible set of parametric distributions that can be used to distinguish between constant, monotonically declining or increasing, and nonmonotonically declining hazard rates. The one-parameter exponential distribution can estimate a constant hazard rate. The exponential nests arithmetically within the two-parameter Weibull distribution, which will describe a monotonically declining or increasing rate. The Weibull, in turn, nests within several three-parameter generalized gamma distributions, which will describe both monotonic and nonmonotonic rates. In addition to the gamma families of distributions, the two-parameter log-logistic distribution will take either a monotonic or nonmonotonic form. Together, the logistic and gamma-family distributions describe and estimate many common monotonic and nonmonotonic patterns of organizational outcomes.

The accelerated event-time analysis in this paper employs a gamma distribution. The gamma distribution has the useful property that the shape parameter incorporates heterogeneity in a duration model (Greene, 1990). That is, the shape parameter controls for influences on the outcome distributions of different observations that the independent variables in the model do not explicitly measure. In addition, the gamma distribution will collapse to either a monotonic Weibull model or a nonmonotonic lognormal model if such heterogeneity is not present.

The gamma distribution reported by Greene (1990: 319) has a hazard function, h(t)Gamma, which breaks into the following two multiplicative components

$$(2)\quad h(t)\text{Gamma} = S(t)q \times h(t)\text{Weibull},$$

where

$$(2a)\quad S(t)q = [1+q(Lt)p]-1/q$$

$$(2b)\quad h(t)\text{Weibull} = Lp(Lt)p-1.$$

Equations (2a) and (2b) introduce three parameters, q, L, and p. The parameter q represents the shape parameter of the gamma distribution. As q goes to 0, the limit of S(t) goes to 1, so that h(t)Gamma converges on the Weibull hazard function h(t)Weibull. The parameter L is a transformation of the reported intercept and covariate effects from Equation (1), with values taken at the data means, such that L=exp(bX). The parameter p represents a transformation of the reported scale parameter s from Equation (1), such that p=1/s. The tables of results in this paper report the values of b, s, and q for the coefficients, scale parameter, and shape parameter.

As we noted above, the generalized gamma collapses to the simpler two-parameter Weibull or lognormal distribution if unspecified covariates do not have significant influences. The lognormal distribution, which holds when the gamma shape parameter equals 1, will model cases in which there is an underlying nonmonotonic event rate such that events at first occur slowly, then quickly, and then decline again. The Weibull, which holds when the gamma shape parameter equals 0, is appropriate for monotonically decreasing rates. The Weibull in turn collapses to the exponential distribution if event rates are constant, that is, the Weibull scale parameter equals 1. Thus, the gamma distribution models a general set of underlying distributional patterns.

The two statistical techniques suit the needs of this study. Logistic regression provides a well-accepted technique for estimating the likelihood that discrete outcomes will occur. Accelerated event-time regression provides a robust technique for estimating influences on the duration before an event takes place, allowing the inclusion of right censored cases. The generalized gamma distribution is a particularly flexible form of accelerated event-time regression because it estimates monotonic and nonmonotonic underlying event rates as well as the influence of omitted covariates.

RESULTS

Tables 2 and 3 report the results. Table 2 reports logistic regression estimates of the likelihood that each type of event will occur. Table 3 reports the accelerated event-time estimates of the influences on alliance duration.

The results in Table 2 support the four hypotheses concerning the likelihood of different outcomes that we formulated in this paper. Consistent with Hypotheses 1a and 2a, Table 2 shows

that link alliances are more likely than scale alliances to undergo reorganization (Model 1) or to end in takeover by one partner (Model 2). Consistent with Hypothesis 3, link alliances are less likely than scale alliances to continue without reorganization (Model 3). Consistent with Hypothesis 4, there is no significant difference in the likelihood of scale and link alliances dissolving with no takeover or prior reorganization (Model 4). Overall, these results are consistent with our basic argument that link alliances offer greater opportunities for learning. Link alliances are more likely to lead to capability transfers between the partner firms and, in turn, to changes in the organization of cooperation. Scale alliances, in contrast, provide fewer opportunities for inter-partner learning and, therefore, tend to remain more stable over time.

Columns (a) and (b) within each model in Table 2 explore the impact of alliance purpose. The (a) columns of each model simply contrast link and scale alliances. The (b) columns then determine whether link alliances with technical and market activities and scale alliances that involve final product tend to have different outcomes. Some finer-grained understanding of the outcomes emerges in the (b) columns, particularly with respect to reorganization and takeover. Column 1b shows that the greater tendency for link alliance reorganization, of both technical or market link alliances, arises primarily from a comparison to scale alliances that involve components rather than final products. Scale alliances involving final products also are more likely to undergo reorganization than scale alliances involving only components, suggesting that the greater potential for rivalry in such alliances provides an additional incentive for learning and alliance evolution. Column 2b then shows that firms tend to take over technically-oriented link alliances more than scale alliances but, by contrast, they are not significantly more likely to take over marketing-oriented link alliances, although the coefficient continues to be positive. A possible explanation for the difference in the takeover results across the marketing and technical link alliances is that firms might find it easier to internalize marketing skills through what they have learned during their experience with their partners, without needing to take over the alliance, than in the case of technical skills, which might tend to involve greater organizationally-embedded capabilities. In other words, diffusion of marketing skills may be easier than diffusion of technical skills.

A few of the control variables in Table 2 tend to influence alliance outcomes. The founding year of the alliance has the expected effect, in that younger alliances are less likely to undergo reorganization or dissolution and, also, are more likely to continue without reorganization.

The existence of a distinct joint venture organization also has a significant influence on all four possible outcomes of alliances. As expected, a joint venture makes it more difficult to dissolve the alliance and increases the likelihood of continuation with no major change in organization. The results also show that firms are somewhat less likely to reorganize alliances with equity joint ventures than simple collaborative agreements. This suggests that the existence of a separate legal entity creates organizational constraints that make it difficult to shift activities between the partners and the joint venture. Distinguishing between integrative and sequential joint ventures does not alter these results except in the case of takeover, where our findings confirm Park and Russo's (1996) conclusions and show that partners are more likely to take over integrative joint ventures than sequential joint ventures. These results point to the fact that the scale/link alliance distinction and the integrative/sequential joint venture dichotomy measure different features of alliances. The scale/link distinction refers to the nature of the partners' contributions to the joint endeavor, while the integrative/sequential feature refers to the way in which firms organize activities within the alliance.

The main influence of alliance experience arises in alliances in which only one partner has recent experience in allying with competitors. Such alliances are more likely to end in takeover and less likely to continue; there is also a positive although non-significant influence on reorganization. These results may stem from an asymmetry in alliance management and learning ability among the partners.

Alliances within the telecommunications/electronics industrial sector are less likely than others to continue without major changes in organization and are also more likely to end in dissolution without any prior reorganization. The industry effect is consistent with our expectation, which stemmed from the relative length of product life-

Table 2. Logistic regression estimates of influences on alliance outcomes (positive coefficient indicates outcome is more likely)

		1. Reorganize				2. Takeover			
		1a.		1b.		2a.		2b.	
		coef.	s.e.	coef.	s.e.	coef.	s.e.	coef.	s.e.
Link alliances		1.374	0.689**			1.799	0.591***		
	(a)			2.610	1.064***			1.710	0.724***
Link alliances: Technical	(a)			3.070	1.107***			1.011	0.885
Link alliances: Marketing									
Scale alliances: Final products	(a)			2.062	1.123**			–0.184	0.852
Alliance characteristics									
Marketing alliances		0.607	0.651			–0.727	0.680		
Multi-firm alliances		–1.269	1.147	–0.974	1.160	1.097	0.726*	1.068	0.737*
JV, integrative, balanced	(b)	–0.601	0.603	–0.965	0.651*	1.480	0.545***	1.518	0.562***
JV, integrative, unbalanced	(b)	–0.801	0.740	–1.005	0.757*	1.239	0.595**	1.275	0.608**
JV, sequential	(b)	–1.515	0.843**	–1.691	0.852**	–0.047	0.839*	–0.008	0.849
Zone, Europe	(c)	–1.082	0.678*	–1.422	0.727**	0.615	0.638	0.623	0.637
Zone, North America	(c)	–1.620	0.808**	–2.000	0.857***	–0.552	0.836	–0.543	0.836
Zone, Asia	(c)	–1.679	0.858**	–2.073	0.914**	–0.384	0.875	–0.383	0.874
Later founding year		–0.076	0.029***	–0.081	0.030***	–0.012	0.030	–0.012	0.030
Parent characteristics									
Parent equity holding		–0.207	0.571	–0.406	0.595	1.097	0.537**	1.108	0.539**
Competitive asymmetry		–0.661	0.475*	–0.731	0.488*	0.579	0.564	0.572	0.565
Prior alliances among partners		0.634	0.593	0.907	0.625*	–0.089	0.614	–0.115	0.614
One partner has alliance experience		0.457	0.460	0.537	0.469	0.841	0.430**	0.834	0.431**
Parent same continent	(d)	–0.001	0.822	–0.357	0.844	0.468	0.812	0.509	0.839
Parent inter-continent, Asia-E/NA	(d)	1.086	0.775*	0.914	0.769	0.050	0.828	0.081	0.842
Parent inter-continent, Eur-NA	(d)	0.248	0.855	0.220	0.842	–0.173	0.819	–0.150	0.828
Industry characteristics									
Industry aerospace	(e)	–0.375	0.837	–1.495	1.052*	–0.616	0.936	–0.514	1.038
Industry telecom/elect	(e)	–0.680	0.599	–0.737	0.618	0.029	0.585	0.030	0.585
Industry other	(e)	–0.326	0.695	–0.435	0.719	–0.570	0.698	–0.568	0.698
Intercept		5.114	2.605**	5.056	2.716**	–3.269	2.721	–3.287	2.720
No-covariage loglikelihood		–107.2		–107.2		–113.0		–113.0	
Loglikelihood ratio (d.f.)		44.7	***	48.6	***	53.1	***	53.1	***
		(20)		(21)		(20)		(21)	
Events (227 cases)		41		41		45		45	

Continued overleaf

cycles in the different sectors. The control variables help understand the context in which alliance learning opportunities occur.

The results in Table 3 support the duration predictions concerning reorganization and takeover, while also providing useful insights concerning continuing alliances. Consistent with Hypotheses 1b and 2b, partners reorganize (Model 1) and take over (Model 2) link alliances earlier than scale alliances. Table 3 also shows that link alliances that continue without substantial change tend to continue longer than comparable scale alliances (Model 3). Thus, although Table 2 reported that link alliances are less likely than scale alliances to continue unchanged, those link alliances that do continue tend to do so for particularly long periods. The likely reason is that link alliances in which partners either cannot learn or chose not to learn about their partners' capabilities, and so do not result in reorganization or takeover, provide ongoing value to the partners. Adler (1966) described this long term complementarity as a form of economic symbiosis. Finally, as in Table 2, link and scale alliances that shut down tend to have similar duration in Table 3 (Model 4).[3]

[3] Model three of Table 3 omits the Later Founding Year variable in order to facilitate convergence of the model with the underlying gamma distribution. We obtained similar results for the reported variables with significant effects when we included the founding year variable in the gamma model, but the model achieved only partial convergence. We also obtained similar results when we employed simpler underlying distributions, such as the loglogistic distribution, which omit

Table 2. (Continued)

3. Continue				4. Dissolve				
3a.		3b.		4a.			4b.	
coef.	s.e.	coef.	s.e.	coef.	s.e.	Variable	coef.	s.e.
–1.715	0.540***			–0.493	0.645	LINK		
		–1.807	0.639***			LINK_TCH	–0.785	0.741
		–1.895	0.750***			LINK_MKT	–0.269	0.821
		–0.215	0.651			SCALEFP	–0.533	0.777
–0.041	0.617			0.303	0.677	MKT		
–0.657	0.585	–0.692	0.592	1.028	0.724*	NB	0.948	0.736*
0.857	0.448**	0.905	0.477**	–2.369	0.688***	JV_INT1	–2.207	0.714***
1.220	0.561**	1.257	0.582**	–2.943	0.859***	JV_INT2	–2.853	0.876***
1.648	0.597***	1.687	0.612***	–0.769	0.699	JV_SEQ	–0.669	0.705
–0.592	0.576	–0.553	0.584	0.895	0.762	ZONEEUR	0.940	0.771
0.729	0.729	0.790	0.740	0.972	0.907	ZONENAM	0.982	0.918
–0.131	0.765	–0.070	0.773	2.364	0.981***	ZONEASIA	2.428	0.978***
0.117	0.027***	0.119	0.027***	–0.076	0.030***	YEAR	–0.078	0.030***
–0.490	0.488	–0.467	0.490	–0.195	0.602	EQUITY	–0.172	0.603
0.313	0.407	0.316	0.408	–0.533	0.503	RCP	–0.510	0.503
0.124	0.474	0.110	0.476	–0.646	0.660	PRIOR	–0.714	0.665
–0.631	0.399*	–0.650	0.402*	–0.194	0.452	OTH1	–0.190	0.456
–0.377	0.593	–0.346	0.609	0.277	0.742	ORIG2	0.318	0.734
–0.001	0.604	0.018	0.611	–1.367	0.850*	ORIG3A	–1.390	0.850*
–0.697	0.614	–0.684	0.617	1.331	0.782**	ORIG3EU	1.291	0.776**
0.259	0.759	0.401	0.869	0.375	0.956	IND2	0.691	1.050
–1.070	0.519**	–1.088	0.522**	1.912	0.650***	IND3	1.948	0.658***
0.437	0.593	0.419	0.599	0.353	0.861	IND4	0.408	0.876
–8.981	2.387***	–9.057	2.403***	4.363	2.681*	INTERCPT	4.597	2.663**
–155.2		–155.2		–110.2			–110.2	
84.4 (20)	***	84.5 (21)	***	63.7 (20)	***		64.4 (21)	***
98		98		43			43	

Notes: Compared to (a) Scale alliances: Components; (b) Alliances other than joint ventures; (c) Zone global; (d) Parent domestic; (e) Industry atuo.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$ (one-tailed tests).

The (b) columns in Table 3 provide additional insights concerning the impact of alliance purpose on duration. For alliance reorganization (column 1b), as in the case of alliance outcomes, the main differential impact of link alliances arises from the comparison with scale alliances that focus on components, as final product scale alliances also tend to undergo early reorganization. For alliance takeover (column 2b), the strongest impact of link alliances on early takeover arises from marketing alliances, although technical alliances have a non-significant association with earlier takeover. For alliance continuation (column 3b), meanwhile, we find that scale alliances involving final products are particularly likely to undergo early discontinuation, possibly because of the competitive potential of such alliances. Finally, for alliance dissolution (column 4b), there is a moderate relationship between technical link alliances and early dissolution, possibly because technical learning often occurs quickly and thereby ends the need for the alliance.

The alliance duration results in Table 3 provide useful insights concerning the observations that Nakamura *et al.* (1996) report. These authors observe that alliances in which the partner firms' capabilities tend to diverge last longer than

the control for unobserved heterogeneity that the gamma distribution provides.

Table 3. Accelerated event time regression estimates of influences on alliance outcome durations (negative coefficient indicates earlier outcome)

		1. Reorganize				2. Takeover			
		1a.		1b.		2a.		2b.	
		coef.	s.e.	coef.	s.e.	coef.	s.e.	coef.	s.e.
Link alliances		0.643	0.357**			–0.756	0.305***		
Link alliances: Technical	(a)			–1.543	0.582***			–0.488	0.472
Link alliances: Marketing	(a)			–1.356	0.531***			–0.876	0.396**
Scale alliances: Final products	(a)			–1.147	0.557**			–0.082	0.483
Alliance characteristics									
Marketing alliances		–0.271	0.373			0.360	0.379		
Mult-firm alliances		0.795	0.660	0.669	0.662	–0.871	0.261***	–0.933	0.347***
JV, integrative, balanced	(b)	0.448	0.338*	0.624	0.349**	–0.353	0.292	–0.409	0.320
JV, integrative, unbalanced	(b)	0.744	0.421**	0.835	0.427**	–0.042	0.305	–0.043	0.314
JV, sequential	(b)	1.040	0.539**	1.098	0.529**	0.118	0.616	0.133	0.523
Zone, Europe	(c)	0.352	0.373*	0.593	0.445*	–0.493	0.330*	–0.543	0.376*
Zone, North America	(c)	0.758	0.442**	1.005	0.472**	0.229	0.496	0.234	0.485
Zone, Asia	(c)	0.551	0.463	0.830	0.500**	–0.018	0.425	0.025	0.454
Later founding year		–0.014	0.016	–0.013	0.017	–0.029	0.011***	–0.029	0.011***
Parent characteristics									
Parent equity holding		0.280	0.350	0.419	0.358	–0.387	0.272*	–0.470	0.271**
Competitive asymmetry		0.399	0.264*	0.435	0.261**	–0.005	0.373	–0.010	0.382
Prior alliances among partners		–0.464	0.336*	–0.608	0.349**	0.165	0.328	0.184	0.315
One partner has alliance experience		–0.064	0.289	–0.072	0.309	–0.153	0.205	–0.154	0.213
Parent same continent	(d)	0.019	0.441	0.217	0.452	–0.033	0.506	–0.054	0.500
Parent inter-continent, Asia-E/NA	(d)	–0.460	0.426	–0.390	0.434	0.115	0.515	0.089	0.510
Parent inter-continent, Eur-NA	(d)	–0.388	0.479	–0.475	0.500	–0.189	0.520	–0.158	0.531
Industry characteristics									
Industry aerospace	(e)	0.329	0.476	0.943	0.553*	0.848	0.443*	0.827	0.552*
Industry telecom/elect	(e)	–0.039	0.325	0.029	0.327	–0.290	0.253	–0.324	0.297
Industry other	(e)	0.152	0.401	0.247	0.401	0.361	0.345	0.281	0.372
Intercept		4.087	1.462***	4.178	1.454***	6.624	1.125***	6.835	1.158***
Gamma shape parameter		0.231	0.822	0.123	1.012	20.611	6.364***	17.791	6.806***
Gamma scale parameter		0.942	0.361	0.962	0.405	0.039	0.012	0.043	0.017
No-covariate loglikelihood		–128.3		–128.3		–142.0		–142.0	
Loglikelihood ratio (d.f.)		46.3 (20)	***	50.9 (21)	***	76.0 (20)	***	85.3 (21)	***
Events (227 cases)		41		41		45		45	

Continued overleaf

alliances in which the partners' capabilities converge. In the terms of our study, link alliances represent greater initial difference between firms than scale alliances, so that the longer continuation of link alliances that Model 3 of Table 3 reports is consistent with the Nakamura, Shaver and Yeung result. Our logic, though, suggests that link alliances will often evolve toward partner convergence, because of inter-partner learning, thereby resulting in early alliance takeover when such convergence takes place. Therefore, Nakamura, Shaver and Yeung's results concerning the stability of joint ventures are consistent with our own results concerning the evolution and outcome of link alliances.

The gamma shape parameters in Table 3 provide intriguing information concerning the underlying distribution of reorganization and takeover outcomes. For reorganization, in columns 1a and 1b, the shape parameter is not statistically distinct from 0. As we noted above, this means that the underlying reorganization distribution collapses to a monotonic Weibull distribution. In other words, reorganization events often occur quite early in alliance life as well as during alliance maturation. That is, reorganization is equally likely to occur at any point of alliance life. By contrast, the gamma shape parameter for the takeover duration model in columns 2a and 2b is much larger than 1,

Table 3. (Continued)

3. Continue				4. Dissolve			
3a.		3b.		4a.		4b.	
coef.	s.e.	coef.	s.e.	coef.	s.e.	coef.	s.e.
0.832	0.209***			0.260	0.539		
		–0.324	0.360			–0.502	0.326*
		0.350	0.314			–0.441	0.351
		–0.524	0.269**			–0.111	0.381
–0.879	0.238***			–0.424	0.372		
0.106	0.217	–0.043	0.223	–0.363	0.460	–0.747	0.222***
0.125	0.177	0.254	0.182*	1.221	0.320***	1.166	0.406***
–0.132	0.206	–0.043	0.209	1.266	0.416***	1.590	0.468***
0.015	0.202	0.149	0.193	0.321	0.303	0.481	0.363*
–0.008	0.200	0.111	0.206	–0.357	0.360	–0.416	0.319*
0.010	0.250	0.127	0.267	–0.155	0.395	–0.399	0.316
–0.117	0.258	0.083	0.285	–0.881	0.409**	–1.005	0.487**
				–0.016	0.018	–0.009	0.018
0.591	0.205***	0.646	0.218***	0.143	0.283	0.063	0.224
–0.054	0.159	–0.046	0.151	0.140	0.230	0.124	0.280
–0.164	0.165	–0.282	0.161**	0.226	0.325	–0.034	0.349
0.014	0.151	–0.039	0.151	0.050	0.242	–0.139	0.219
–0.115	0.213	0.040	0.220	–0.195	0.369	–0.265	0.374
–0.097	0.219	0.014	0.211	0.599	0.382*	0.787	0.460**
–0.356	0.226*	–0.320	0.212*	–0.576	0.378*	–0.334	0.342
0.644	0.253**	1.009	0.294***	0.183	0.435	0.085	0.513
–0.122	0.192	–0.043	0.186	–1.127	0.390***	–1.111	0.348***
–0.303	0.200*	–0.213	0.193	–0.057	0.420	0.116	0.413
2.529	0.237***	2.627	0.234***	4.568	1.300***	4.686	1.640***
0.619	0.232***	0.976	0.340***	0.578	1.155	18.743	4.823***
0.615	0.067	0.529	0.089	0.640	0.365	0.034	0.009
–175.1		–175.1		–133.2		–133.2	
58.3	***	55.6	***	85.2		104.4	***
(19)		(20)		(20)		(21)	
98		98		43			

Notes: Compared to (a) Scale alliances: Components; (b) Alliances other than joint ventures; (c) Zone global; (d) Parent domestic; (e) Industry auto.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$ (one-tailed tests)

showing that the underlying distribution takes a complex nonmonotonic form, consistent with the results in Park and Russo (1996).[4] In other words, alliances enjoy an early stage in which takeover is unlikely and then enter a more mature stage during which partners become more likely to take over the alliance. The likely cause of the different underlying distribution of reorganization and takeover durations is that partners usually must wait to assess the value of taking over or selling an alliance, but can react quickly to opportunities to reorganize alliances after learning enough from their part-

[4] Park and Russo (1996) reduce their accelerated event-time estimates of takeover and dissolution to two-parameter nonmonotonic lognormal distributions, reporting no improvement in fit from the three-parameter gamma distribution. In sensitivity analysis of our data, however, we found that the three-parameter gamma distribution provides a better fit for the takeover, continuation, and dissolution analyses, suggesting the presence of other influences in our data. In our analyses, gamma did collapse to the two-parameter monotonic Weibull distribution for the reorganization analysis, as we note in the text (a single parameter, constant rate exponential model, though, provided a weaker fit than the two-parameter model), but we report the gamma-based results for comparability across models. No coefficients in the reorganization models changed materially in the Weibull model.

ners to make the reorganization possible. The over-arching implication of this result is that learning can begin as soon as the partners form the alliance, even if partners usually must wait to take over an alliance.

Together, the results in Tables 2 and 3 strongly support our predictions. Firms are more likely to reorganize alliances in which partners contribute different capabilities. Moreover, reorganizations occur earlier among link alliances than among scale alliances, particularly when compared to scale alliances involving component production. Similarly, takeovers also tend to occur more often and earlier among link alliances. By contrast, link alliances are less likely than scale alliances to continue unchanged, but those that do continue tend to do so longer. In turn, these outcomes support the core arguments that underlie our predictions. Firms that cooperate with partners that have different capabilities gain opportunities to learn from their partners and from their joint activities with their partners. The firms then have incentives to adapt their business activities and boundaries in order to take advantage of what they have learned.

CONCLUSION

Our findings contribute to the understanding of strategic alliances by supporting the proposition that different opportunities for learning, created by different alliance types, lead to different alliance outcomes. Inter-firm learning and skill transfers appear to occur more often in link alliances than in scale alliances. Indeed, by associating partners that contribute different capabilities to the joint endeavor, link alliances create favorable conditions in which such transfers may take place. The observation that firms reorganize link alliances more often and earlier than scale alliances indicates that some of the partners are acquiring new skills. Because firms set up link alliances in order to take advantage of the complementary skills of the partner firms, the fact that the firms reorganize many link alliances by changing the allocation of activities among the partners suggests that the complementarity between the allies tends to shift over time. The changes most likely occur because the partners are acquiring capabilities from one another. The tendency for a partner to take over link alliances earlier and more often provides additional support for the argument that skill and capability transfers often occur in link alliances.

The striking differences in the temporal patterns of reorganization and takeovers also contain important information. Reorganization events often occur quite early in alliance life as well as during alliance maturation, but takeovers are uncommon during early alliance stages. In other words, learning can begin as soon as the partners form the alliance, even if partners usually must wait to take over an alliance.

Post-reorganization outcomes also provide useful information about alliance dynamics. Table 4 provides summary information concerning the initial outcomes and subsequent evolution of alliances. Consistent with our earlier discussion, the first set of columns of the table shows that initial outcomes of takeover and reorganization occur more often for link alliances than for scale alliances (column 1b: 28% versus 11%, and 25% versus 10%). The second set of columns then adds more information, concerning post-reorganization outcomes of alliances that undergo initial reorganization. The second-stage cases include the 11 scale alliances and the 30 link alliances that underwent initial reorganization. The first observation concerning the second-stage results is that they are consistent with the first-stage outcomes. In particular, as column 2b shows, the second-stage link alliances are more likely than the scale alliances to undergo a takeover (23% versus 18%) or a second reorganization (20% versus 0), while slightly more second-stage scale alliances continue without further change (73% versus 57%). A second observation concerning the second stage results in Table 4 is that alliances rarely dissolve after undergoing initial reorganization, whether they are scale or link alliances, with only 1 of the 41 cases undergoing dissolution. The likely reason is that alliances that have sufficient value to reorganize offer enough value to continue or take over.

Overall, the outcomes help assess competing arguments concerning alliance benefits and risks. Some analysts have argued that alliances formed by rival firms are a mechanism by which one of the partners can strengthen its own position while weakening that of its ally, by acquiring skills and valuable resources from its partner (Reich and Mankin, 1986; Hamel *et al*., 1989; Hamel, 1991).

Table 4. Alliance outcome summary, including post-reorganization outcomes of link and scale alliances

Alliance type								
Scale alliances								
1. First outcome	*1a*	*1b*	*2. Post-reorganization outcomes (11 cases)*	*2a*	*2b*	*3. Cumulative outcomes*	*3a*	*3b*
Continue	62	57%	Continue	8	73%	Continue	70	64%
Dissolve	24	22%	Dissolve	1	9%	Dissolve	25	23%
Takeover	12	11%	Takeover	2	18%	Takeover	14	13%
Reorganize	11	10%	Second reorganization	0	0%	*Total cases*	109	100%
Total cases	109	100%						
Link alliances								
1. First outcome	*1a*	*1b*	*2. Post-reorganization outcomes (30 cases)*	*2a*	*2b*	*3. Cumulative outcomes*	*3a*	*3b*
Continue	36	31%	Continue	17	57%	Continue	58	49%
Dissolve	19	16%	Dissolve	0	0%	Dissolve	19	16%
Takeover	33	28%	Takeover	7	23%	Takeover	41	35%
Reorganize	30	25%	Second reorganization	6	20%	*Total cases*	118	100%
Total cases	118	100%	(5 continue, 1 takeover)					
All alliances								
1. First outcome	*1a*	*1b*	*2. Post-reorganization outcomes (41 cases)*	*2a*	*2b*	*3. Cumulative outcomes*	*3a*	*3b*
Continue	98	43%	Continue	25	61%	Continue	128	56%
Dissolve	43	19%	Dissolve	1	2%	Dissolve	44	19%
Takeover	45	20%	Takeover	9	22%	Takeover	55	24%
Reorganize	41	18%	Second reorganization	6	15%	*Total cases*	227	100%
Total cases	227	100%	(5 continue, 1 takeover)					

The underlying interpretation of alliances in this perspective is that of the Trojan horse or the kiss of death (Pucik, 1988; Ohmae, 1989; Hennart *et al*., 1999). Our results suggest that such a view of alliances primarily applies to link alliances. This interpretation of link alliances implies that, in the alliance process, one of the partner firms may lose a competitive battle. Nonetheless, such transfer of skills may sometimes be an explicit objective that the partners carry out over time in order to overcome problems in exchanging tacit capabilities. In turn, the firms may plan to sell the joint venture to one partner when they complete the skill transfer (Kogut, 1991). This is a weaker form of the kiss of death outcome, because it is a mutually-agreed upon kiss and marks the firm's exit from only one business opportunity, but nonetheless indicates that the acquiring partner has acquired greater strength in an area in which both firms possessed competitive capabilities.

Our results show that firms reorganize scale alliances less frequently than link agreements. This supports the view that firms primarily form scale alliances in order to benefit from increased economies of scale while avoiding a merger of the allied firms. As long as the alliance successfully achieves this objective, the partners have little incentive to reorganize the alliance, particularly if the alliance involves only components. The fact that partners take over scale alliances less often than they take over link alliances also suggests that scale alliances help firms avoid or postpone outright industry consolidation.

Our study complements prior studies of alliance outcomes on several dimensions. Previous research on this topic has investigated alliance takeover, dissolution, and survival, with less investigation of alliance reorganization. We show that several learning-related factors have substantively different influences on alliance reorganization and continuation without reorganization. Studies sometimes focus on joint ventures that involve U.S. firms, sometimes within a single industrial sector. We compare and contrast the likelihood and duration of four types of alliance outcomes, for both joint ventures and other forms of inter-firm alliances, among firms from three continents operating in several industrial sectors. We believe that the analysis begins to offer an

explanation for alliance outcomes, based on the potential for inter-partner learning.

We need to outline three limitations that condition our interpretation of the study. First, in a broader sense, our results suggest that firms form link alliances in order to undertake offensive strategies, while scale alliances tend to be more defensive in nature. Therefore, one possible limitation of this study is that the outcomes we observed may be due as much to the underlying strategies of the firms that form the alliances, as they are to the alliances themselves. Indeed, the type of alliance that a firm forms and the outcome of the alliance may both result from the strategies that the participating firms seek to carry out. For example, a firm that is expanding into new markets may form link alliances in order to acquire the resources it needs to succeed in the new markets, while ultimately planning to gain full control of their operations in the new markets. Clearly, though, the form of alliance that firms create will affect the opportunities for the partners to learn from each other and, in turn, will affect the evolution of the alliance and of the firms themselves.

A second limitation of the study is that we do not directly observe learning as it occurs in the alliances. Therefore, it could be argued that the outcomes we report might result from other influences. In particular, our earlier discussion suggested that link alliances are characterized by a greater level of uncertainty surrounding the nature and value of each partner's contribution than are scale alliances. The more frequent and more rapid reorganizations of link alliances that we reported could stem from this greater uncertainty. Because each partner contributes different capabilities, their mutual understanding of the other's contribution may be limited. As the alliance unfolds, the mutual understanding improves, thereby leading to reorganizations in order to optimize the use of the resources that the partners continue to possess individually. This is a form of a learning process but in a more restricted sense of learning than in our argument, because the learning involves increased understanding of what a partner is able to do rather than increased capability to do what a partner once did. In scale alliances, by contrast with link alliances, the initial understanding of each partner's capabilities will tend to be greater because the partners make similar contributions, so that the firms can achieve a more optimal allocation of activities from the beginning. Hennart (1988) made a similar argument, suggesting that the greater uncertainty surrounding the sharing of gains in link alliances creates contractual difficulties which may, in turn, be a factor in the greater organizational instability of link alliances when compared to scale alliances. Our data do not make it possible for us to fully rule out the rival argument based on the different level of uncertainty concerning initial endowments that characterizes scale and link alliances. Nonetheless, although this alternative explanation may hold for the reorganization outcome, the explanation appears less suited to the takeover outcome, which suggests that the capability acquisition argument is a more general explanation. Moreover, both forms of learning processes will occur in many link alliances, as firms both learn about their partners' capabilities and acquire their partners' capabilities.

It is also important to recognize that learning can occur in scale alliances, as well as in link alliances. March (1991: 72) suggested that organizational learning could be divided broadly into 'exploitation' learning, which allows firms to increase the returns derived from their own existing knowledge, and 'exploration' learning, which involves creating new knowledge in order to pursue new business opportunities. Koza and Lewin (1998) applied this notion to alliances, arguing that different types of alliance primarily offer opportunities for either exploration or exploitation learning. Building on this approach, we argue that learning in scale alliances will tend to be more oriented toward exploitation of existing knowledge, while, in link alliances, firms have greater opportunities for learning through exploration of their partners' knowledge.

Finally, a third limitation is that the evolutions and outcomes recorded in our data might result from external, contextual factors rather than from factors endogenous to the alliance itself. For example, in rapidly changing industries or environments, alliance reorganization, takeover or dissolution could be a response to these environmental changes, in particular if the changes suddenly increase or decrease the relative value of the partners' contributions (Kogut, 1989, 1991). Our results show that industry settings affect alliance outcomes. Nevertheless, the impact of alliance type on outcome holds when controlling for industry or geographic setting.

It is also useful to consider the generalizability of our findings. One issue concerns whether one might apply the results comparing scale and link alliances among competitors to alliances between non-competing firms. Outcomes of alliances among non-competitors clearly are conceptually and managerially important (Park and Russo, 1996). Comparing scale and link alliances in such cases would be problematic, though, because scale alliances can, almost by definition, only be formed by firms operating in the same industry. As for learning that might occur between firms operating in different businesses, the organizational learning literature suggests that learning occurs more slowly because of the weaker absorptive capacity resulting from greater dissimilarity in the partners' knowledge bases. Nevertheless, by controlling for the geographic origins of the partners, we also take into account more or less direct forms of competition and show that the geographic proximity or distance between the partners does not significantly impact alliance outcomes.

We conclude with a comment concerning the extrapolated implications of this study of alliances for our more general understanding of business strategy and performance. At its most general level, this study investigates the evolutionary process of business strategy and performance. Nelson and Dosi (1993) and Singh and Mitchell (1996) argue that evolutionary theory in the social domain must identify processes of imperfect learning and discovery by which variations diffuse through an industry. Collaboration between firms provides one important form of route for variations in business capabilities to diffuse among firms. Collaboration is a key method by which firms learn new capabilities. The reorganization of a collaboration, either as a reshaped alliance or a takeover by a partner, then may help firms that have learned new skills protect the value of those skills. At the same time, collaboration is an imperfect learning process, both in the sense that collaborating businesses often incur difficulties in attempting to learn and, indeed, might lose more than they gain. Such losses will often cause performance problems and sometimes lead to business failure. Advancing the theoretical understanding of business strategy and performance requires greater theoretical understanding of the evolutionary role of collaboration. Firms often must collaborate with other businesses that possess complementary resources in order to survive and grow. However, the duality of collaboration, which offers both benefits and risks, helps explain why so many once successful businesses fail. Developing our understanding of the evolutionary roles of interfirm collaboration is an important aspect of developing our understanding of the concept of business strategy.

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