Network Embeddedness and the Dissolution of Joint Ventures

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ABSTRACT

Existing research in the social network and alliance literatures shows that the embedding of alliance activity in the network structure that results from prior partnerships influences patterns of new tie formation, but has not examined whether such network embeddedness affects the failure rate of the ties that are formed. We focus empirically on the unplanned dissolution of joint ventures between competitors to examine whether the informational and reputational benefits that arise from positional embeddedness, as well as the social monitoring benefits associated with structural embeddedness, enhance the longevity of interorganizational ties. We report three main findings. First, in the aggregate, network embeddedness has a reinforcing dual effect on network dynamics: as prior research showed, new ties between partners tend to mirror the pre-existing social structure and, as this paper shows, the ties that the partners form are more likely to persist for a longer period. Second, the benefits of positional and relational embeddedness are to some extent substitutive. Finally, the marginal value of network embeddedness is highest in situations where the economic incentives to behave opportunistically are especially strong. Longitudinal data on joint ventures formed by 97 global chemical firms from 1979 to 1991 provide support for our arguments.
Existing research demonstrates that the embedding of alliance activity in the wider network structure resulting from previous alliances influences patterns of new alliance formation. A central argument in this literature is that firms resort to the network of pre-existing alliances to ascertain the capabilities and reliability of potential partners and, in turn, to mitigate the inherent uncertainty in interorganizational exchange relations (Gulati, 1995b; Walker, Kogut and Shan, 1997; Gulati and Gargiulo, 1999). Several studies have investigated how firms’ embeddedness in a network structure, i.e., the extent to which firms have direct and indirect ties to other actors in the network, affects which alliances the firms create (Powell, Koput and Smith-Doerr, 1996; Walker, Kogut and Shan, 1997; Gulati and Gargiulo, 1999; Rosenkopf, Metiu and George, 2001). However, prior research has paid minimal attention to how network embeddedness might influence the failure of existing alliances. This paper shifts the research focus from how embeddedness influences the genesis of interorganizational ties to how embeddedness affects the mortality of ties. We focus empirically on the dissolution of joint ventures.

Studying tie dissolution helps clarify the mechanisms through which embeddedness exerts its influence on interorganizational relationships, as well as helps identify benefits and limits of embeddedness. Prior research on tie dissolution has generally taken a dyadic perspective and focused on the effects of relational embeddedness (Levinthal and Fichman, 1988; Seabright, Levinthal and Fichman, 1992). The literature on joint venture dissolution has shown that direct ties between partners mitigate collaboration hazards (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997). We approach this issue from a broader network perspective and show how positional and structural embeddedness may also exert distinct effects on tie dissolution. This is theoretically important because in a dyadic perspective the key sociological mechanism for maintaining order in a relationship between two actors is the trust developed between exchange partners and “the shadow of the future”, i.e., the benefits of
continuing the relationship (Gulati, 1995b; Parkhe, 1993). The introduction of structural embeddedness potentially provides an additional sociological mechanism for maintaining order. Order is maintained because of the “shadow of others” as firms behave fairly to allies due to concern for sanctions that may emerge from the partners that they have in common.

Examining the effects of embeddedness on tie dissolution is also important from the perspective of network dynamics. Several studies have argued that the formation of new ties often involves organizations that are already central to the social structure and, as a result, network structures reproduce themselves over time (Powell, Koput and Smith-Doerr, 1996; Walker, Kogut and Shan, 1997; Gulati and Gargiulo, 1999; Rosenkopf, Metiu and George, 2001). However, a given structure of interorganizational relationships changes not only through the formation of new linkages but also through the dissolution of existing ties. Failing to consider patterns of tie dissolution could lead to an inaccurate picture of how network structure evolves. For instance, if more central firms, in addition to their higher mutual alliance formation propensity, are also less likely to dissolve alliances than peripheral firms, we could expect that interorganizational networks evolve into an increasingly stable and interconnected core and unstable and sparsely-tied periphery. If network alliances between central firms are more likely to dissolve than those between peripheral firms, however, this would suggest the gradual emergence of a different, possibly less stable, form of network structure. Since arguments for many of the effects of embeddedness make an implicit assumption that the interorganizational network that engenders such effects is at least somewhat stable, investigating tie dissolution patterns is important as it can help validate or invalidate such a presumption.

In conducting this investigation of tie dissolution we move beyond the existing literature in two ways. First, as noted above, we adopt a network perspective and move beyond a relational perspective on the dissolution of ties (Kogut, 1989; Park and Russo, 1996; Park and
Ungson, 1997) by focusing on the implications of positional and structural embeddedness; this allows us to elaborate on the mechanisms through which embeddedness yields its effects. This elaboration also permits us to highlight the fact that the sources of embeddedness benefits might not be additive. Indeed, we argue and demonstrate that the benefits of positional and relational embeddedness are to some extent substitutive, at least in this context.

Second, research investigating how embeddedness affects tie dissolution in organizations often focuses on vertical ties, such as buyer–supplier relationships or ties between professional services and client firms (Levinthal and Fichman, 1988; Seabright, Levinthal and Fichman, 1992; Baker, Faulkner and Fisher, 1998; Broschak, 2004). Here, we focus on horizontal ties – collaborative relationships between competitors. Focusing on horizontal ties allows us to model three important aspects of relationships between these players simultaneously: the social symmetry (or asymmetry) of their network positions, their competitive intensity, and their structural embeddedness. The first two aspects are important because the hazards of collaboration will increase when the partners are unequal or have antagonistic interests. Since partners that are competitors, and partners with asymmetric structural positions (partners with high social distance between them, such as a central actor allied with a peripheral actor) have strong incentives to behave opportunistically, an investigation of horizontal relationships provides an opportunity to see how the benefits of social structure may vary under conditions where collaborative behavior is subject to significant threats of opportunistic behavior. The third important aspect of this context, structural embeddedness in a network of similar players that compete and collaborate in an industry over time, becomes relevant because the presence of common partners potentially provides a mechanism to attenuate this natural hostility between horizontal players.

We posit and find support for the argument that, when partners have especially strong
economic incentives to cheat, common partners serve as a lubricant for these relationships that are at the greatest risk of opportunistic behavior. Joint ventures between socially asymmetric partners are especially vulnerable to instability and experience higher hazards of dissolution. However, common partners mitigate the collaboration hazards that emanate from social asymmetry and stabilize the relationships. Similarly, common partners reduce the instability stemming from mutual competitive intensity in joint ventures between close competitors. Thus, we observe that the marginal value of social structure and embeddedness is highest in contexts where individual actors have otherwise strong economic incentives to behave opportunistically.

To examine how network embeddedness affects the dissolution of joint ventures, we use longitudinal data on the formation and continuity of technology-related ventures formed among the leading firms in the global chemicals industry. The initiation of an alliance indicates that partners are optimistic about its viability (Levinthal and Fichman, 1988). This optimism is particularly relevant in the case of joint ventures, which require significant relationship-specific investments and imply high exit costs (Gulati, 1995a; Rowley, Behrens and Krackhardt, 2000). Firms often favor joint ventures over other governance structures when collaboration involves technology (Gulati and Singh, 1998). Despite the strategic importance of joint ventures for partnering firms and the significant investments necessary for establishing and operating them, they experience high failure rates (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997). The dissolution of a joint venture, albeit only one measure of performance, commonly reflects either a business failure or irresolvable conflict between partners (Kogut, 1989). Prior studies on the instability of joint ventures focused on the form of dissolution, whether through liquidation, acquisition by one partner, or sale to a third party (Kogut, 1989; Park and Russo, 1996; Dussauge, Garrette and Mitchell, 2000). We focus on unplanned dissolutions, which typically reflect collaboration problems and/or concerns about the joint venture’s value. To identify the
key reasons leading to the dissolution of a joint venture, in order to distinguish between planned and unplanned dissolutions, we analyzed archival stories published by electronic news databases.

Table 1 presents examples of joint venture dissolution. Archival reports suggest that unplanned termination occurs because partners experience difficulties in fulfilling alliance potential, because partners disagree about the viability or strategic fit of an alliance after they start to collaborate, or because one of the partners senses that they can now exploit a particular business opportunity alone rather than share the benefits. For instance, when a change in US legislation in 1988 increased the attractiveness of the aerospace market for structural carbon fiber, Courtaulds exited the joint venture formed with Dexter and bought the remaining partner’s stakes to exploit the venture’s strong position. Similarly, in 1989 UCB and Rhone Poulenc became partners in a joint venture dedicated to the development, production and distribution of radiation-cured resins. Two years later, when demand for jointly developed resins started to grow, UCB decided to pursue this attractive opportunity by itself and bought the partner’s stake in the joint venture. In another illustration of unplanned dissolution, Montedison and Enichem terminated their joint venture one year after its founding because they disagreed about industrial strategy. In a few cases, the dissolution of a joint venture may be a planned event and represent the achievement of alliance goals (Barkema et al., 1997). For example, BASF and Linde terminated their joint venture because the new technology they developed jointly reached commercialization – we exclude such cases of planned dissolution. We develop arguments about the ways in which network embeddedness influences unplanned joint venture dissolution. Our empirical analysis examines how partners’ embeddedness, both at the time of alliance founding and in subsequent years, affects unplanned joint venture dissolution.

********** Insert table 1 about here **********
NETWORK EMBEDDEDNESS AND JOINT VENTURE FORMATION

Joint ventures are a special form of interorganizational collaboration in which the sponsoring firms contribute assets to an independent legal entity that the partners jointly own and control. Joint ventures enable organizations to manage interdependence (Pfeffer and Novak, 1976), coordinate competitive behavior (Kogut, 1988), and/or access complementary resources (Dussauge, Garrette and Mitchell, 2000). Uncertainty about the capabilities and reliability of potential partners is one of the major hindrances to creating collaborative relationships. This obstacle is even more salient in the case of joint ventures, because firms usually need to invest significant amounts of resources in the formation and administration of a joint venture before they are able to reap the benefits of collaboration (Gulati, 1995a; Rowley, Behrens and Krackhardt, 2000). As a means of overcoming such hindrances, firms can use their ties to other organizations to obtain information about alliance opportunities as well as about the capabilities and reliability of potential partners (Gulati, 1995b; Walker, Kogut and Shan, 1997).

The literature on alliance formation emphasizes that embedding alliance activity in a wider network structure provides informational, reputational, and social monitoring benefits that help firms identify partners and deter opportunistic behavior. Firms that are richly embedded in a network structure can use the ties to learn about alliance opportunities and evaluate potential partners. Hence, firms with central network positions are more likely to form new alliances (Gulati, 1995b; Ahuja, 2000a). Central organizations in a network structure also develop reputations as capable and reliable partners (Podolny, 1994; Powell, Koput and Smith-Doerr, 1996). Finally, firms benefit from the existence of indirect ties that contribute to the formation of dense local networks, potentially enabling firms to enforce collaborative behavior (Gulati, 1995b; Walker, Kogut and Shan, 1997; Rowley, Behrens and Krackhardt, 2000).

Although network embeddedness helps firms mitigate interorganizational hazards at the
time of alliance formation, joint venture partners face obstacles to effective collaboration after they create the linkage (Kogut, 1989; Park and Russo, 1996). In the next section, we investigate whether the informational, reputational, and social monitoring benefits that influence alliance formation also confer stability to the alliances formed.

NETWORK EMBEDDEDNESS AND JOINT VENTURE DISSOLUTION

The Effects of Positional and Relational Embeddedness

We argue that the positions of partners within a network structure will affect the longevity of an interorganizational linkage. Firms that are more centrally embedded in a network structure are less likely to experience informational constraints in the search for partners. The information that flows to firms located in central network positions helps them identify viable alliance opportunities and select appropriate partners – those possessing appropriate resources and demonstrating reliable collaborative behavior. Deeper embedding of interorganizational collaboration in social networks leads to enhanced trust between partners based on superior information about each other (Gulati and Singh, 1998; Gulati, Nohria and Zaheer, 2000). As greater joint centrality of two actors indicates a greater span for collecting and disseminating information about each other, these benefits are likely to increase with the partners’ combined network centrality. Because firms with higher network centrality experience fewer informational constraints when forming an alliance, they are more confident about the reliability of other firms and thus more likely to choose the appropriate partner, which helps mitigate the hazards of collaboration and enhances the longevity of their linkage.

In addition to assisting partner selection, relationships between highly embedded actors encourage information flow, which facilitates collaboration and enhances trust (Gulati, 1995b; Walker, Kogut and Shan, 1997). As a result, the richer information available to firms with high network centrality not only increases their confidence about the partner’s capabilities but also
assuages the fear that the alliance will be affected by opportunistic behavior (Bradach and Eccles, 1989; Rosenkopf, Metiu and George, 2001). Trust between partnering organizations is critical for the success of joint ventures because partners need to invest a significant amount of resources in joint venture formation and management before they are able to reap the benefits of collaboration (Gulati, 1995a; Rowley, Behrens and Krackhardt, 2000). When two firms begin a venture with higher levels of interorganizational trust, concerns about the partner’s reliability is less likely to inhibit their collaborative effort, which in turn confers stability to the joint venture.

The informational benefits stemming from partners’ combined network centrality accrue at the time they form a joint venture. Firms with richer information are more likely to form the appropriate tie with the appropriate partner. Also, the enhanced trust resulting from greater knowledge about each other’s capabilities and reliability lowers the risk that the collaboration will be plagued by opportunistic behavior. Thus, network embeddedness at the time of venture founding provides an initial stock of trust that enables partners to collaborate more effectively. This trust associated with richer information about partners is most relevant at the time firms are searching for partners and forming a joint venture. Information gathered after the start of the joint venture has lower marginal value, since it is likely to be redundant with information partners already have. Moreover, even if a firm desires to access further information about its ally after the founding of a joint venture, it can do so directly in the context of the collaboration without the need to resort to network positions. Hence, the informational benefits associated with partners’ network centrality are most relevant at the time of joint venture founding.

**Hypothesis 1a:** The greater the combined network centrality of two firms at the founding of a joint venture, the lower the hazard of unplanned joint venture dissolution at any subsequent point.

From a relational standpoint, the effects of prior direct ties on tie formation are well documented (Gulati, 1995b). Ties build trust and lead to the adoption of less onerous contractual
safeguards. However, the effects of relational embeddedness on the longevity of joint ventures are less clear. On the one hand, prior direct ties between two organizations provide information about each other’s capabilities and reliability, enhance mutual trust, and reduce uncertainty about future collaboration (Gulati, 1995a; Gulati and Singh, 1998; Rowley, Behrens and Krackhardt, 2000). As a result, prior direct ties may enhance the longevity of joint ventures (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997). On the other hand, the reduction in the contractual safeguards may lead to room for enhanced opportunism and easier exit from the relationship as trust proves to be misplaced. Hence, the direct effect of prior ties is ambiguous.

However, several arguments suggest that prior direct ties between partners will create a moderating influence on the relationship between partners’ positional embeddedness or combined centrality and the hazard of joint venture dissolution. Thus, we control for the direct effects of relational embeddedness, while focusing our prediction on its role as a moderator of the relationship between positional embeddedness and joint venture survival.

To understand how relational embeddedness moderates the relationship between positional embeddedness and joint venture dissolution, note that in the absence of a prior direct tie between two firms, their current network position functions as a surrogate for the missing relationship by helping them learn about each other through their allies. When two firms have collaborated prior to the formation of an additional alliance, by contrast, their current network position conveys less novel information because their prior collaboration allowed them to observe each other’s competencies and behavior directly. Hence, network position will have less influence on joint venture dissolution when the partners have prior direct ties.

Moreover, alliances between high-centrality firms with prior direct ties might increase the hazards of tie dissolution, because of redundancy and over-embeddedness. Redundancy arises because firms that have direct ties and also occupy central positions in the network have multiple
ways to access resources. Managing alliances requires substantial investment and managerial attention (Powell, Koput and Smith-Doerr, 1996; Zollo, Reuer and Singh, 2002). As partners develop collaborative routines with multiple partners, they may review the scope of existing alliances in order to accommodate new opportunities and eliminate redundant ties. As a result, joint ventures formed between firms with high combined centrality that also have prior direct ties are more likely to have common ground with other existing alliances. The redundancy involved in such joint ventures increases the chances that the firms will dissolve their ties.

In parallel, over-embeddedness may arise for central firms with prior direct ties. Over-embeddedness results when an actor has so many linkages that it suffers strategically and operationally. Negative consequences of over-embeddedness include diminished ability to pursue instrumental goals (Uzzi, 1997), propensity to form unproductive relationships (Gulati, Nohria and Zaheer, 2000), and restricted mobility outside the pool of existing relationships (Granovetter, 1985). Highly-embedded joint venture partners may encounter such problems after forming an additional joint venture with each other, which may lead them to dissolve their tie.

**Hypothesis 1b**: The presence of prior direct ties between two firms will weaken the degree to which the firms’ combined network centrality at joint venture founding reduces the hazard of unplanned joint venture dissolution.

**Social Asymmetry, Competitive Intensity and the Benefits of Structural Embeddedness**

Previous literature has argued that socially asymmetric organizations will avoid forming ties with each other. Social asymmetry reflects differences in the centrality of two actors. The argument is that firms anticipate some of the difficulties involved in collaboration with socially asymmetric partners and prefer to ally with structurally homophilous firms, that is, firms that occupy similar positions in a network (Podolny, 1994; Gulati and Gargiulo, 1999). Firms in peripheral positions of a network structure have fewer direct and indirect ties through which to disseminate information about their capabilities and reliability to potential allies. Also, the
limited track record of interorganizational collaboration reflected in a peripheral position signals that these firms possess little to offer. Firms occupying central positions in a network structure and, hence, enjoying higher status, may avoid affiliation with peripheral firms due to concern that such affiliation will tarnish their reputation (Podolny, 1994; Chung, Singh and Lee, 2000).

Nonetheless, firms with high network centrality do sometimes ally with peripheral firms to gain access to technology (Gulati and Gargiulo, 1999), inventions (Ahuja, 2000a), or any other resource that it cannot obtain from other organizations (Mitchell and Singh, 1996). An alliance with a central partner can also earn reputational advantages for a peripheral firm, because such collaboration can vouch for its reliability to other potential allies (Podolny, 1994; Stuart, Hoang and Hybels, 1999). We argue that, even in the presence of such instrumental goals that motivate the creation of alliances between socially asymmetric partners, these alliances face higher hazards of dissolution than those between socially symmetric partners.

Asymmetric linkages, once formed, are vulnerable to multiple ongoing problems, including operating difficulties, unbalanced information flow, reputational imbalance, and ambiguous exchange ratios. Structural asymmetry may be paralleled by incompatibility of operating systems and practices, creating operating problems that interfere with the collaboration (Chung, Singh and Lee, 2000). Further, the information flow between the asymmetric partners may be highly unbalanced, in either direction. The more central firm may derive greater private benefits from the alliance than its partner because it has a wider portfolio of relationship skills, collaborative relationships, and absorptive capacity that it can use to realize benefits from the information it receives (Cohen and Levinthal, 1990; Zollo, Reuer and Singh, 2002). Alternatively, the partner’s centrality may provide a larger information pool from which the peripheral firm can draw. The potential for unbalanced information flow can affect the amount of resources partners allocate to the joint venture and increase competition between them, thereby
contributing to the instability of the partnership (Khanna, Gulati and Nohria, 1998).

In terms of reputational benefits, meanwhile, the asymmetry might well favor the less embedded partner, whose reputation can be enhanced through collaboration with a prominent firm. For the prominent firm, that collaboration may entail reputational costs (Podolny, 1994). Joint ventures between partners occupying dissimilar structural positions can also face difficulties in arriving at a mutually-beneficial exchange ratio or restoring exchange balance as the relationship evolves (Emerson, 1972; Cook, 1977). Changes in the degree of interdependence between partners result in joint venture instability (Kogut, 1989). Also, collaboration between asymmetric partners is more likely to lead to bargaining power shifts, which is a source of instability leading to alliance dissolution (Das and Teng, 2000).

Tensions emanating from partners’ social asymmetry affect joint venture stability from the start of the collaboration. The informational constraints involved in partnering with a peripheral firm suggest that joint ventures between socially asymmetric partners start with a higher level of residual uncertainty and lower level of trust. This, coupled with the potential for power shifts inherent in reputational asymmetry, can deter partners from allocating enough resources and managerial attention to the joint venture, making collaboration less effective. Shifts in partners’ social position after venture creation are less likely to affect alliance stability, because the interorganizational attachment resulting from repeated interactions between partners since the start of the collaboration enhances their mutual trust (Levinthal and Fichman, 1988; Seabright, Levinthal and Fichman, 1992). These arguments lead to the following hypothesis:

**Hypothesis 2:** Joint ventures formed between a high-centrality and a low-centrality partner experience greater hazard of unplanned dissolution than joint ventures between partners with similar centrality.

**Social Monitoring Benefits of Common Partners**

The previous section discussed how the informational and reputational benefits
associated with firms’ positions in the network structure at the outset of a joint venture affect the longevity of that tie. Besides promoting trust based on superior knowledge about partners at the time of alliance founding, network structure also provides a basis for monitoring collaborative behavior once an alliance is formed (Gulati, 1995b; Gulati, Nohria and Zaheer, 2000). We focus on the social monitoring benefits stemming from the presence of common partners and their influence on the hazard of unplanned joint venture dissolution. The common partners between two organizations encompass the set of direct ties that are common to both organizations.

The presence of common partners of two organizations at the time they create a joint venture indicates that the allies are regarded as trustworthy by the same organizations and helps allay concerns of opportunistic behavior (Gulati, 1995b; Rowley, Behrens and Krackhardt, 2000). Greater confidence between partners favors collaboration and increases partners’ propensity to allocate resources and managerial attention to the successful operation of the alliance, thus contributing to its stability. Although the network structure at alliance founding helps predict whether partners will act responsibly, firms also need to monitor and encourage responsible behavior during the life of a relationship (Kogut, 1989; Park and Russo, 1996). The presence of common ties with other actors in a social structure contributes to monitoring and helps organizations enforce social norms and obligations.

Common partners are important because they help firms distinguish between reliable actors and opportunistic actors in two ways. First, third party relationships give visibility to norm-breaking behavior. If, in a relationship between two firms, one partner exploits the vulnerabilities of the other, the occurrence of such behavior can be revealed to common partners and, through them, disseminate rapidly and reach a larger number of firms in the network (Walker, Kogut and Shan, 1997). Second, norm-breaking behavior is both more likely to be known by other parties and more likely to be punished (Gulati and Gargiulo, 1999).
presence of third party relationships amplifies the opportunities to impose sanctions for norm breaking. Even if the firm that opportunistic behavior affects is unable to impose sanctions on the partner, because the negative impact arrives through indirect routes, common partners may inflict penalties on the norm-breaker. In many cases such punishment occurs in the form of reputational damage that affects both current ties and also potential future alliances of the norm-breaker, which becomes perceived as an undesired partner (Park and Ungson, 1997). The fear of loss of reputation deters firms linked by common actors from behaving opportunistically. By increasing the cost of opportunism, the existence of common partners mitigates interorganizational hazards.

The presence of common partners reinforces a basic element of joint ventures. Joint ventures help align incentives between partners, because of the joint commitment of resources and the administrative apparatus required for their operation (Kogut, 1988; Gulati and Singh, 1998). The mutual hostage positions implied by the shared equity in a joint venture operate as a surrogate for initial trust between partners. Hence, firms commonly resort to joint ventures as a collaborative governance mode when interorganizational hazards are high (Oxley, 1997; Gulati and Singh, 1998). The formation of a joint venture usually entails the creation of a board of directors with members from the sponsoring firms, which facilitates monitoring of the partners’ activities (Kogut, 1988). By the nature of this type of alliance, the top management of the parent organizations is involved in the administration of the joint venture (Gulati and Westphal, 1999; Steensma and Lyles, 2000). Frictions that endanger the success of a joint venture are likely to be brought to the attention of the top management team of the parent organizations. The mutual hostage position and the superior administrative controls associated with a joint venture allay partners’ concerns about the incidence of opportunistic behavior. The presence of common joint venture partners further allaying those concerns by providing more stability to collaboration. The occurrence of opportunistic behavior by a firm in a joint venture can disseminate through the top
management of its partner to the top management of its partner’s partners, thus amplifying the opportunities for inflicting penalties on the norm-breaking firm.

Whereas informational and reputational benefits are greatest at the time of joint venture founding, by ensuring that partners ally with the right partners, social monitoring benefits accrue throughout alliance life. The partners common to two firms by the time they create a joint venture confer deterrent effects. As the number of common partners linking two firms increases after joint venture formation, meanwhile, social monitoring effects become stronger. Additional common partners enhance firms’ embeddedness in local networks (Gulati and Gargiulo, 1999). This reinforces the concern for local reputation and, as a consequence, further assuages interorganizational hazards. Based on the arguments above, we hypothesize the following:

**Hypothesis 3**: The more common partners that two firms possess at any point of network evolution, the less the hazard of unplanned joint venture dissolution.

The social monitoring benefits of structural embeddedness reduce the hazard of unplanned joint venture dissolution. The benefits that common partners provide are most valuable in relationships especially vulnerable to opportunistic behavior. As a result, common partners, besides having a direct effect on the hazard of unplanned joint venture dissolution, as discussed above, also help attenuate risks of norm-breaking behavior in partnerships that are prone to the incidence of opportunism. As we argued earlier, collaboration between socially asymmetric partners is more likely to incur obstacles to effective collaboration, potentially making such linkages instable. Likewise, collaboration between competitors is vulnerable to higher rates of attrition (Kogut, 1989; Park and Ungson, 1997). We discuss how the presence of common partners helps firms lubricate the friction inherent in these two types of partnership.

**Common partners and social asymmetry.** As we argued in the development of Hypothesis 2, joint ventures involving central and peripheral organizations experience higher hazards of unplanned dissolution than joint ventures between socially symmetric partners. When
socially symmetric firms create ties, the structural similarity of the partners and the attendant relatively congruent routines, processes, and objectives provide a degree of stability to the relationship. The hazards of collaboration are higher in ties between socially asymmetric firms, however, because few of these stability-enhancing factors are active. The benefits that common partners provide are likely to be most valuable in this setting. The existence of common partners increases the costs of opportunistic behavior and, as a result, reduces collaboration hazards. In the presence of common ties between socially asymmetric partners, norms and reputational pressures within the community of related organizations may decrease the likelihood that one partner will exploit the learning vulnerabilities of the other, thereby reducing the instability inherent in socially asymmetric associations. Thus, while multiple factors may protect ties between symmetric partners, fewer of these safeguards are present in ties between asymmetric partners, which in turn enhances the value of common partners as mechanisms of stability.

Hypothesis 4: The more common partners that two firms possess at any point of network evolution, the less that social asymmetry of the two firms at the founding of a joint venture will increase the hazard of unplanned joint venture dissolution.

Common partners and competitive intensity. Alliances with high levels of competitive intensity also face higher dissolution risks. Firms that produce similar products for similar markets represent a competitive threat to each other (Pfeffer and Novak, 1976). They can, for example, enter or reinforce their presence in markets where the competitors operate and, by doing so, affect each other’s performance and viability (Barnett, 1997). Recognizing this competitive intensity, firms may cooperate in order to gain power relative to each other (Thompson, 1967). Consistent with this logic, previous research argued that interfirm ties enhance the likelihood of coordination, tacit or otherwise, and showed that firms exhibiting higher levels of competitive intensity form joint ventures in an attempt to manage their competitive interdependence (Pfeffer and Novak, 1976; Kogut, 1988).
Some scholars argued that two firms operating in the same markets, being aware of their mutual interdependence and fearing retaliation, may curb competitive actions and engage in less vigorous competition (Karnani and Wernerfelt, 1985; Gimeno and Woo, 1996). The stability of such mutual forbearance is fragile, however, in the face of competitive incentives (Stigler, 1964; Baum and Korn, 1999). Therefore, even though firms with high levels of competitive intensity may use joint ventures to manage competitive interdependence, these alliances are less stable and face higher dissolution hazard. Thus, the attempt to manage mutual competitive intensity is both an incentive to form joint ventures and a source of joint venture instability (Kogut, 1989; Park and Russo, 1996).

Competitive intensity can arise at any point of joint venture evolution – firms may be rivals when they form a relationship or may become rivals during the course of collaboration. In either case, competition raises the likelihood of termination. As we discussed above, though, embeddedness through common ties can deter opportunistic behavior by increasing the costs of norm breaking. The social monitoring effects associated with the presence of common partners help firms mitigate the hazards inherent in competitively intense relationships.

After the formation of an alliance with a partner possessing similar resources and operating in similar markets, a firm may learn about the partner’s vulnerabilities and encounter opportunities to exploit those weaknesses. The incentives to engage in such attempts may exceed the potential costs of direct retaliation. The presence of common ties between the firm and its partner can be a more effective deterrent than the threat of direct retaliation, because it magnifies the scope for reprisal. Punishment of aggressive behavior can occur in the form of competitive retaliation by any other common partner. Competitive retaliation usually occurs in the form of price competition and can be costly to both the aggressor and the firms retaliating against the aggressor. Firms may prefer enforcement through common partners. Penalties for norm breaking
can occur in the form of social exclusion. By engaging in opportunistic behavior, a norm-breaker puts at risk not only the relationship with a specific partner, but also any remaining current joint ventures as well as future collaboration. Consistent with the arguments above and highlighting the principle that the social structural lubricant of common partners is most valuable when the incentives to behave opportunistically are especially sharp, we hypothesize that:

**Hypothesis 5a**: The greater the competitive intensity between two joint venture partners at any point of network evolution, the greater the hazard of unplanned joint venture dissolution.

**Hypothesis 5b**: The more common partners that two joint venture partners possess at any point of network evolution, the less that competitive intensity between the two partners will increase the hazard of unplanned joint venture dissolution.

**METHODS**

To test our hypotheses, we used data on the duration of technology-related joint ventures formed amongst the leading firms in the global chemicals industry. We identified the firms from annual lists in trade journals such as *Chemical Week* and *C&E News*. These journals identified 107 firms from Western Europe, Japan, and the United States – the core of the global chemicals industry. Because collecting reliable data on joint venture formation and dissolution in a comprehensive fashion is difficult for smaller firms, past network studies have used a similar strategy of focusing on the leading firms in an industry (Gulati, 1995b, Rosenkopf, Metiu and George, 2001). Financial and other data were not reliably available for 10 of the 107 firms, limiting the analysis to the remaining 97 firms.

Technological collaboration is a significant feature of the chemicals industry and affects firms’ technological performance (Ahuja, 2000b). Joint ventures involving technology are especially vulnerable to opportunism (Gulati, 1995a; Gulati and Singh, 1998) and, hence, constitute an appropriate context for examining how network embeddedness mitigates interorganizational hazards. While firms often do not expect long lives from informal alliances...
such as research agreements, firms incur significant set up and operating costs in the case of joint ventures. Hence, the unplanned dissolution of a joint venture is more meaningful than the discontinuation of other types of interorganizational arrangements and commonly reflects business failure or irresolvable conflict (Kogut, 1989).

Due to the difficulty involved in observing dissolution of interorganizational ties, many previous studies were unable to distinguish between ties formed by the firm and those maintained by the firm at any point in time. Absent data on dissolution, prior research considered all ties formed in the previous 3, 4, or 5 years to represent the network structure in a given year.

Whereas such a procedure can be appropriate to the study of alliance formation, it introduces two problems in the analysis of alliance dissolution. First, it overlooks the fact that the network structure evolves not only through the formation of new ties but also through the dissolution of existing alliances. Second, implicit in that procedure is the assumption that the network structure is renewed after a few years, since ties that are older than 3, 4, or 5 years are not taken into account. In contrast, by considering both ties formed and ties dissolved, we can account directly for changes in the network structure.

We collected data on the joint venture formation activity of the 97 companies between 1979 and 1991. The period of analysis starts in 1979 because that is when data on interfirm collaboration began to be systematically reported by news media databases (Hagedoorn and Schakenraad, 1989; Gulati, 1995b). Moreover, prior studies suggested that alliance activity in the industry was negligible until the early 1980s (Hergert and Morris, 1988; Gulati and Gargiulo, 1999). To identify joint venture formation and dissolution, we used multiple archival sources, including general business news media, government publications, and industry specific electronic databases. We studied over 130,000 news stories to identify the joint ventures the firms formed between 1979 and 1991. A significant effort also was required to trace the life
histories of these joint ventures. In this second phase of data collection, we analyzed news stories dating from 1979 to 2004 to verify either the joint venture’s dissolution by 1991 or its survival to 1992 (the last year of the study) and beyond. Finally, for the statistical analysis of dissolution, we used only the joint ventures formed from 1983 onwards. We used the joint ventures from 1979 to 1982 to create a baseline network (Gulati, 1995b).

The joint venture activity in our sample resulted in the creation of 201 dyadic ties between 1983 and 1991. For 164 of these ties, we were able to establish either the date of dissolution or survival beyond 1992. For the remaining dyads, we found no reference to dissolution even until 2004 and typically were able to identify ongoing activities of joint venture operations. For two reasons, the most accurate assumption to make about these joint ventures is that they continued to be active through the end of the period of analysis. First, success in identifying dissolution in the majority of cases indicates that joint venture dissolution tends to be reported, at least for this set of firms, so that absence of reports on dissolution offers evidence of continuity. Second, the fact that media reported other news on these joint ventures made it likely that their dissolution would have been reported had it occurred. We tested the sensitivity of the results to variations in this assumption and, as we report later, our results are robust.

**Dependent variable**

*Joint Venture Dissolution.* The dependent variable in our study is the hazard of unplanned dissolution of a joint venture by two firms in a given year. We created a dummy variable for each dyad in each year until the year of dissolution or until 1992, whichever occurred first (one if the firms dissolved the joint venture in that year; zero otherwise). Although the longevity of collaboration is only one measure of performance, the duration of joint ventures correlates with partners’ perception of alliance success and with financial performance (Gehringer and Herbert, 1991; Mitchell, Shaver, and Yeung, 1994). Prior work showed that firms almost never plan for
joint ventures to be short-lived (Barkema, et al., 1997). To ensure that dissolution was an indication of collaboration problems unanticipated by partners when they formed the linkage rather than the reflection of successful goal attainment, we checked the conditions of the dissolution as reported by the business press. We identified four cases in which dissolution reflected either goal attainment or fear of violation of U.S. antitrust laws. We did not consider these cases as unplanned dissolutions, as they do not reflect the types of hazards we discuss in the paper. In five cases, we were unable to identify whether the dissolution was planned or unplanned. We assumed these cases to reflect unplanned dissolutions, given that the vast majority of joint venture dissolutions were unplanned. Sensitivity analyses considering these five cases as planned dissolutions produced a similar pattern of results.

**Independent variables**

*Combined Centrality at Founding* (H1a, H1b). We measured the position of each firm in the network using Bonacich’s (1987) eigenvector measure of network centrality. This measure results in higher centrality scores for firms that are linked to many firms, which are in turn linked to many other firms. Consistent with prior studies, we used the centrality score of a firm in a given year relative to the most central firm in that year (Gulati and Gargiulo, 1999) and computed the geometric mean of the centrality scores of the two members of the dyad (Mizruchi, 1993). Our findings are robust to using the arithmetic mean of the centrality scores of the firms in the dyad as an alternative measure of joint centrality. We computed the centrality scores using UCINET 5 (Borgatti, Everett, and Freeman, 1999). To test Hypothesis 1b, we interacted centrality with a dummy set to one if the partners had a direct tie when they created the alliance.

*Socially Asymmetric Dyad at Founding* (H2, H4). Research shows that interorganizational networks display a pattern of core-periphery structures (Gulati and Gargiulo, 1999) and that firms’ behavior is affected by whether they occupy a central or a peripheral
position in the structure (Mizruchi, 1993). Reputational differences arise when actors occupy different status brackets, i.e., when one actor belongs to a high-status group while the other is a member of a low-status group (Podolny, 1993, 1994). We adopted Mizruchi’s (1992) procedure for identifying dyads involving a central and a peripheral firm. We coded the variable Socially Asymmetric Dyad as 1 if one of the firms in the dyad had a centrality score lower than the mean while the other had centrality equal to or greater than the mean observed in a given year, and as 0 otherwise. To test Hypothesis 4, we interacted this dummy variable with the number of firms’ common partners in the previous year. We obtained similar results when defining central firms as those with centrality scores in the top quartile in a given year.

**Common Partners in Previous Year (H3, H4, H5b).** We measured the number of common partners between two firms in the evolving network structure as the number of common partners they had in the network structure in the year preceding the observation year (Mizruchi, 1992; Gulati and Gargiulo, 1999).

**Competitive Intensity (H5a, H5b).** Consistent with the argument of functional equivalence (Pfeffer and Novak, 1976), we measured competitive intensity between two firms as the similarity in their resources, both upstream (technologies) and downstream (product and geographic markets served). To measure two firms’ similarity of technical resources, we considered the distribution of firms’ inventions across 80 technological classes that chemical companies use. Previous studies used patents as indicators of technical resources (Griliches, 1990; Patel and Pavitt, 1995; Hall, Jaffe and Trajtenberg, 2001). For each firm in the sample, we counted the number of patent applications in each technological class in a given year. Then, for each firm, we computed the proportion of all patents in each technological class. The variable took the value $2 - \Sigma_{k=1,80} ((PP_{ikt} - PP_{jkt})^2)$, where $PP_{ikt}$ ($PP_{jkt}$) corresponds to the proportion of patents that firm $i$ (firm $j$) applied for in technological class $k$ in year $t$. To measure similarity of
resources we considered the average of firms’ similarity in terms of both geographic and product markets. For geographic similarity, we considered the number of subsidiaries that each firm owned in each of 156 countries in each year. For each firm, we identified all the subsidiaries it owned in the period between 1983 and 1991 and computed the proportion of subsidiaries in each country. We measured geographic similarity as $2 - \sum_{k=1,156} (PS_{ikt} - PS_{jkt})^2$, where $PS_{ikt}$ ($PS_{jkt}$) corresponds to the proportion of subsidiaries that firm $i$ (firm $j$) owned in country $k$ in year $t$. To capture product-market similarity between two firms, we used the proportion of sales they obtained in each of 120 market segments defined at the level of 4-digit SIC code. This variable took a value equal to $2 - \sum_{k=1,120} (PI_{ikt} - PI_{jkt})^2$, where $PI_{ikt}$ ($PI_{jkt}$) corresponds to the proportion of sales that firm $i$ (firm $j$) obtained in market $k$ in year $t$. The measure of competitive intensity is the interaction between technological and market similarity. Higher scores in this variable indicate higher levels of competitive intensity between firms. This variable was lagged one year. Finally, to test Hypothesis 5b, we interacted the competitive intensity measure with the number of common partners possessed by the two firms in the previous year.

**Control variables**

*Direct Ties at Founding.* Prior research showed that direct ties between partners decrease the hazard of joint venture dissolution (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997). We control for this with a variable that measures the cumulative number of prior joint ventures formed between the partners until the year preceding the founding of a new alliance.

*Resource Similarity.* Because the measure of competitive intensity results from the interaction between technical and market similarity, we added these two measures as control variables to account for the direct effect of resource similarity on alliance dissolution. To avoid multicollinearity, we orthogonalized the measure of competitive intensity (Draper and Smith, 1981; Sine, Shane and DiGregorio, 2003).
Size, Age, and Technological Resources. We control for the possibility that partners’ size and age affect the hazard of joint venture dissolution. “Size” uses total assets possessed by firms in the chemical industry. “Age” uses the difference between partners’ founding year (Park and Ungson, 1997). To control for the possibility that firms’ technological capabilities affect their ability to build durable relationships, we added controls for the combined expenditures in R&D and patents of the two firms. For “Chemical R&D”, we computed the amount invested by firms in chemical industry R&D. For “Chemical Patents”, we included firms’ number of chemical patents possessed in the year before the observation year.

Financial measures. We included measures for performance, liquidity, and debt-equity to account for the possibility that differences in firms’ financial performance or financial resources affect their propensity to dissolve a joint venture. “Performance” subtracted the lesser from the greater value of return on assets (ROA) within each dyad. For “Liquidity” (current assets / current liabilities), and “Debt-Equity” (long term debt / shareholder equity), we used the ratio of the lesser to the greater value within the dyad. We lagged these variables by one year.

Transregional dummy. We included a dummy variable to control for cultural differences (Parkhe, 1993; Barkema, et al., 1997; Park and Ungson, 1997). This variable equals one when the parent firms were based in different regions (US, Europe, or Japan) and zero otherwise.

Table 2 reports descriptive statistics and the correlation matrix for the variables.

********** Insert table 2 about here **********

Model estimation and econometric issues

To examine influences on the hazard of unplanned joint venture dissolution we used the Weibull model, which enables hazard rates to vary monotonically over time. Levinthal and Fichman (1988) found a non-monotonic effect of the age of auditor-client ties on the hazard of tie dissolution. The evidence regarding the effect of the time elapsed since the formation of a
joint venture on its stability has been mixed: some studies showed a non-monotonic effect (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997), whereas others found a monotonic effect (Barkema, et al., 1997; Dussauge, Garrette and Mitchell, 2000). A plot of the Kaplan-Meier survival function suggested a monotonic positive effect of time since founding on the hazard of dissolution of joint ventures in our sample. Hence, we modeled the hazard of joint venture dissolution using the Weibull distribution, which is appropriate for monotonic rates. We obtained similar results when using a Cox model, which makes fewer assumptions about the functional form of hazard rates.

RESULTS

Table 3 presents the results. The natural logarithm of the shape parameter of the Weibull distribution is statistically greater than zero at p-levels < 0.001 in all models, showing that the hazard of dissolution increases monotonically with time elapsed since joint venture founding.

********** Insert table 3 about here **********

Model 1 of Table 3 contains the control variables, while model 2 introduces the combined centrality measure. Model 2 offers initial support for Hypotheses 1a and 1b. Consistent with H1a, the coefficient on “Combined Centrality at Founding” in model 2 is negative and significant, showing that the combined centrality of two firms at joint venture founding reduces the hazard of dissolution of that venture at any subsequent point. Consistent with H1b, the coefficient on the “Combined Centrality at Founding” for dyads which had a direct tie at founding is positive and significant, revealing that, in the presence of direct ties, partners’ combined centrality at founding contributes significantly less to joint venture survival. These results support our argument that the informational benefits of combined embeddedness that accrue to partners at the formation of a joint venture diminish the hazard of dissolution.

The results in model 3 support Hypothesis 2. This model adds “Socially Asymmetric
Dyads at Founding”, with the predicted significant positive results, showing that the social asymmetry between two firms at joint venture formation increases the dissolution hazard.

It is noteworthy that “Combined Centrality at Founding” loses significance in model 3, changing the interpretation of H1a. Partners occupying central positions in the network structure have high combined embeddedness and, at the same time, tend to be socially symmetric. Thus, part of the effect due to combined embeddedness in these cases is captured by the variable “Socially Asymmetric Dyad at Founding”. Hence, once we account for the effect of social asymmetry, firms’ combined centrality at founding is no longer significant. This change suggests that differences in the network position of partners have a stronger effect as a destabilizing factor than the informational benefits associated with combined centrality. Whereas the combined centrality between potential partners is a strong attractor and encourages alliance formation, as prior research showed, our findings reveal that it does not result in more durable relationship once one accounts for other relevant factors. Thus, Hypothesis 1a is not supported in models accounting for social asymmetry, which suggests that problems of redundancy and over-embeddedness partially offset the informational advantages of network centrality.

The results in model 4 support Hypothesis 3. The coefficient on the variable “Common Partners in Previous Year” is negative and significant, showing that the presence of indirect ties between two firms in the evolving network structure mitigates the hazards of alliance dissolution.

The results in models 5 and 6 then reveal that the benefits of common partners are especially salient in the case of relationships most vulnerable to instability. Consistent with hypothesis 4, social asymmetry at founding has less impact on the hazard of dissolution in the presence of common partners. The coefficient on “Socially Asymmetric Dyads at Founding” is significantly positive, as in previous models, while the coefficient on the variable “Socially Asymmetric Dyads at Founding * Common Partners in Previous Year” is significantly negative.
(model 5). This result reveals that although alliances between partners occupying dissimilar structural positions are more likely to be dissolved, the presence of common partners mitigates this impact and makes socially asymmetric dyads less likely to be discontinued.

Model 6 shows that partnerships between firms with higher levels of competitive intensity are subject to higher hazards of dissolution, consistent with hypotheses 5a and 5b. Embeddedness through common partners diminishes the impact of competitive intensity. As predicted, the coefficient on the interaction variable “Competitive Intensity * Common Partners in Previous Year” was negative and significant, offering evidence that competitive intensity between partners contributes less to the hazard of joint venture dissolution when firms are connected through indirect ties.

The results in the full model (model 6) show that the existence of direct ties between partners diminished the hazard of unplanned joint venture dissolution, which is consistent with previous studies (Kogut, 1989; Park and Russo, 1996; Park and Ungson, 1997). Prior examination of the dissolution of international joint ventures found no impact of organizational variables such as firms’ size and age (Barkema, et al., 1997). Consistent with that, we found no significant effect due to firms’ combined size at founding. Additional models showed that partners’ aggregate size and relative size at founding are not significant. Firms that invest more in R&D are more likely to dissolve a joint venture, whereas firms with greater innovation output, as captured by patents, are more likely to maintain the linkage for a longer period of time. We obtained similar results when adding these variables separately, ruling out the possibility that this pattern was affected by correlation between them. Finally, partners exhibiting asymmetric levels of performance and liquidity are more likely to dissolve a joint venture sooner.

**Sensitivity Tests**

Model 7 uses a frailty distribution to examine the robustness of the results. This method
introduces a multiplicative effect on the hazard function to capture the existence of unobserved heterogeneity across dyads in the propensity to discontinue a joint venture (Hougaard, 1986). We used the gamma distribution to estimate the frailty. As the model shows, our results are robust to this specification. Moreover, the parameter of the frailty model is not statistically significant, suggesting that little unobserved heterogeneity is present.

Model 8 checks the robustness of the dissolution data assumptions. As noted earlier, we were unable to unambiguously establish dissolution before 1992 or survival beyond that year for a few of the joint ventures in our sample. We ran additional models, assuming that the 37 dyadic relationships for which we did not find unambiguous evidence of survival beyond 1992 lasted at least 3, 4, or 5 years after the year of formation. Models resulting from these different assumptions about the survival of these joint ventures produced similar results. To avoid making any particular assumption about the duration of these 37 dyadic relationships, model 8 drops the observations from our sample, showing robust results.

We argue that the informational and reputational benefits of positional embeddedness accrue to partners at the founding of a joint venture. We ran additional models with time-varying covariates with partners’ combined centrality and social asymmetry. We found that, consistent with our arguments, combined centrality and socially asymmetry in the evolving network structure do not affect the hazards of alliance dissolution. Moreover, we argue that the social monitoring benefits of structural embeddedness that accrue to partners at alliance founding are reinforced through the life of the partnership. In additional models including the number of common partners at joint venture founding we obtained similar results. Both common partners at founding and common partners in the evolving network structure reduce the hazards of alliance dissolution. The key difference is that, in some models, there was a slight decrease in the significance of the variable “Common Partners in Previous Year”, due to correlation with the
analogous variable at founding.

In assessing alliance longevity, researchers can only observe dissolution for ties that were formed. To the extent that firms decide whether to form an alliance based on the attributes expected to influence tie dissolution, empirical models of tie dissolution that do not account for this decision may be biased. To our knowledge, no previous empirical examination of joint venture dissolution has addressed this issue. As sensitivity analysis, therefore, we adopted Heckman’s (1979) method to estimate firms’ propensity to create joint ventures and used a self-selection correction term in the estimation of the hazards of joint venture dissolution. As the appendix reports, this procedure generated results similar to those presented in Table 3.

DISCUSSION AND CONCLUSION

Our investigation of the hazard of unplanned joint venture dissolution reveals that the structure of network relationships not only affects the pattern of tie formation, as previous research showed, but also influences the longevity of the ties. However, interestingly, how embeddedness influences tie longevity in some cases differs from how it influences tie formation. First, we note that the informational benefits of positional embeddedness do not have a significant effect in the context of tie longevity. Although tie formation is premised on the fact that network centrality should confer informational advantages that enable firms to select better partners, the available evidence suggests that, at least as far as the outcome of tie duration is involved, centrality at founding does not convey a survival benefit for the tie. Whereas the informational benefits derived from network centrality enable firms to select appropriate alliance partners, thus contributing to tie longevity, they may also encourage the formation of safer partnerships characterized by redundancy. In the aggregate, these informational advantages do not result in more durable ties, especially when prior direct ties connect partners. Joint ventures between partners that are deeply embedded in the network structure and that have a history of
previous collaboration are more vulnerable to the problems associated with over-embeddedness, which is a source of instability leading to unplanned dissolution.

The role of relational embeddedness in tie dissolution also suggests a nuanced impact. In the context of tie formation, relational embeddedness in the form of prior ties increases the likelihood of tie formation as presumably such ties are grounded in a more trusting environment. In the context of tie dissolution, we find that such expectations are generally well founded. The main effect of prior ties is in fact to enhance tie longevity. However, we note that the marginal benefits of relational embeddedness are at least to some extent undercut by positional embeddedness. Highly central firms see a lowered benefit from prior ties relative to less central firms. Presumably, the informational benefits of centrality are redundant when it comes to firms that have a prior direct tie. Further, highly central firms may be over-embedded in the network, which may imply that ties formed between partners that already have existing ties are redundant.

Perhaps the most interesting finding of this study relates to the role of structural embeddedness. We note that, while structural embeddedness leads to a generally positive effect on tie duration, this positive effect is most notable in the cases where economic incentives to behave selfishly are highest. The existence of common partners between socially asymmetric firms mitigates the effect of structural asymmetry on the hazard of unplanned joint venture dissolution. Similarly, the presence of common partners between firms with higher competitive interdependence alleviates the impact of competitive intensity on tie mortality. Not only do common partners mitigate interorganizational hazards, but they also attenuate the friction typical of certain relationships, such as those between actors with asymmetric levels of embeddedness in the social structure and those with high levels of competitive intensity. While economic interests induce partners to behave opportunistically, sociological influences help temper economic instincts. Thus, common partners make the shadow of the future in a relationship between two
actors more dramatic by casting their own shadow over that relationship.

The results of this study have implications for the dynamics of networks. Prior studies have argued that networks are self-reinforcing because ties are more likely to be formed between firms that are already deeply embedded in the pre-existing network structure (Powell, Koput and Smith-Doerr, 1996; Walker, Kogut and Shan, 1997; Gulati and Gargiulo, 1999). The results of this study both reinforce and nuance that finding. Our findings reveal that firms’ reliance on combined network centrality as a guide in partner selection does not necessarily lead to the formation of more durable ties, especially when partners are already connected through direct ties. Prior studies showed that firms are less likely to form ties with partners in dissimilar structural positions (Podolny, 1994; Chung, Singh and Lee, 2000). Our results show that alliances between socially asymmetric firms are not only less likely to be formed, as prior research showed, but also likely to dissolve sooner. Furthermore, our empirical analysis suggests that common partners help firms enforce collaborative behavior and, as a result, enhance the longevity of joint ventures. In the aggregate, embeddedness has a reinforcing dual effect on network dynamics: as prior research showed, new ties tend to mirror the pre-existing social structure; in addition, as this paper shows, the ties are more likely to persist for a longer period. The only exception to that pattern refers to ties between highly embedded firms, which although more likely to be formed are not necessarily more stable.

The finding that alliances between high-centrality firms do not experience lower hazards of dissolution does not necessarily contradict the evidence of the stability of networks. It is possible that as firms become highly embedded in a network structure and develop relational capabilities (Zollo, Reuer, and Singh, 2002) they learn to substitute existing ties. For instance, these firms may be able to change the scope of existing alliances to accommodate new collaboration opportunities, thus making some of the existing ties redundant. Besides this
substitution effect, a tie-reconstitution effect may also arise. Previous research has analyzed the propensity of organizations to reconstitute accidentally broken interlock ties (Palmer, 1983; Stearns and Mizruchi, 1986). An analogous effect might be in place in the case of ties resulting from the formation of joint ventures. It is plausible that firms reconstitute some of the ties that they have dissolved by creating new joint ventures with the same partners.

The findings of this study suggest that to fully capture the effects of network embeddedness on the longevity of alliances it is important to consider both the network structure at the time of joint venture founding and the network structure at different points throughout the life of an alliance. The results show that the informational and reputational benefits of positional embeddedness accrue at the formation of a joint venture, whereas the social monitoring advantages of structural embeddedness have both an initial and an on-going effect. The presence of common partners enhances the longevity of interorganizational alliances even when the indirect ties between partners emerge after the outset of an alliance. Hence, it is important to distinguish between *ab initio* embeddedness, i.e., embeddedness in the network structure at the formation of a tie, and evolving embeddedness, i.e., embeddedness in the network structure at different points during the life of a tie. The distinction enables researchers to build synchronic measures of firms’ position in network structures to avoid mis-attributing time-varying effects that actually associate with the conditions in which a social exchange is initiated, or vice-versa (Zaheer and Zaheer, 1999; Soda, Usai and Zaheer, 2004).

This paper suggests issues for future research. A natural next step would be to examine how tie dissolution, in its turn, affects tie formation. As discussed above, it is possible that ties between highly-embedded organizations, when dissolved, are replaced by other ties. Future research can also further investigate the social monitoring benefits of structural embeddedness and examine whether, following the dissolution of an alliance, a firm faces more obstacles to
forming new ties with the partners of its partner.

Future studies can examine the impact of social factors on the dissolution of other types of interorganizational ties. We focused on technological joint ventures because of the interest of partners in the continuation of such collaborations, which makes the termination of these ties a meaningful event. Besides this theoretical motivation, the predominance of the focus on joint ventures in the literature on alliance dissolution (Park and Russo, 1996; Park and Ungson, 1997; Dussauge, Garrette and Mitchell, 2000) has an empirical motive: both the formation and the dissolution of joint ventures by leading companies tend to receive attention in the media, which enables researchers to identify both events. One avenue for future work is to analyze whether our findings generalize to other kinds of interorganizational relationships.

Another area for future inquiry relates to the extent to which social factors affect other alliance outcomes. Firms’ concern with partners’ collaborative behavior can affect not only the hazard of alliance dissolution but the effectiveness of interorganizational collaboration. Future studies can, for example, investigate whether partners with prior direct ties that are also richly connected by indirect ties are better able to exchange knowledge and learn from each other. The informational, reputational, and social monitoring benefits associated with network embeddedness may not only affect the patterns of alliance formation and dissolution, but also enhance the flow of resources through network ties. Social considerations can affect network dynamics by influencing what flows through a given network structure at different points in time, even if the ties of such structure remain relatively stable over time. Whereas this study expands our understanding of network dynamics by shifting the focus from the genesis to the mortality of ties, one next step is to consider the dynamics in the content of networks.
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## Table 1 - Examples of Reasons Leading to Joint Venture Dissolution

<table>
<thead>
<tr>
<th>Joint Venture</th>
<th>Summary of Archival Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unplanned</strong></td>
<td></td>
</tr>
<tr>
<td>Courtaulds Grafil</td>
<td>A 1988 change in US legislation increased the attractiveness of the aerospace market for structural carbon fiber. Following that shift, Courtaulds exited the least attractive technology of the joint venture formed with Dexter in 1983 and later bought the partner's remaining stake to exploit the venture's strong position in the carbon fiber business.</td>
</tr>
<tr>
<td>Radcure Specialites</td>
<td>In 1989 UCB and Rhone Poulenc became partners in a joint venture dedicated to the development, production and distribution of radiation-cured resins. Two years later, when demand for the jointly developed resins started to grow, UCB bought Rhone Poulenc’s stake in the joint venture.</td>
</tr>
<tr>
<td>Enimont</td>
<td>In 1989 the joint venture between Montedison and Enichem, formed in 1988, was dissolved because partners could not agree over an industrial strategy.</td>
</tr>
<tr>
<td>Sclavo</td>
<td>In 1990 Enichem bought Du Pont's stake in their joint venture, formed in 1987, following Du Pont's ultimatum that the partner either buy the JV or cede control. Du Pont claimed that the alliance had become blocked.</td>
</tr>
<tr>
<td><strong>Planned</strong></td>
<td></td>
</tr>
<tr>
<td>BASF-Linde</td>
<td>In 1990 the joint venture between BASF and Linde, formed in 1988, was dissolved because the technology joint developed by partners reached commercialization stage.</td>
</tr>
</tbody>
</table>
Table 2
Descriptive Statistics and Correlation Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
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<th>3</th>
<th>4</th>
<th>5</th>
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<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<tbody>
<tr>
<td>1. Joint Venture Dissolution</td>
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<td>0.19</td>
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<td>2. Combined Centrality at Founding</td>
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<td>0.24</td>
<td>-0.08</td>
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<td>692</td>
<td>692</td>
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</tr>
</tbody>
</table>

† p<0.10; ‡ p<0.05; * p<0.01; *** p<0.001; one-tailed tests for hypotheses.
Robust standard errors in parentheses.
Appendix. Sensitivity test with sample selection analysis

We used Heckman’s (1979) procedure to account for potential sample selection bias in the analysis of the influences of network embeddedness on joint venture dissolution. For each pair of firms, we calculated the propensity of joint venture formation using a probit specification and created the term to correct for self-selection. This term captures the likelihood of a given dyad being observed in our sample of ties at risk of dissolution; its inclusion in the analysis of tie dissolution eliminates the potential specification error. A similar approach has been used in the examination of alliance formation by previously connected firms (Li and Rowley, 2002) and in the study of survival of foreign entries (Shaver, 1998). The addition of the correction for propensity of joint venture formation in the survival analysis should give us an indication as to whether the results are influenced by potential selection bias. In the equation estimating the likelihood of joint venture formation we included year dummies to account for the effects of temporal unobserved heterogeneity on firms’ propensity to ally. In the equation estimating the hazard of joint venture dissolution we included both the time-varying and time invariant covariates used in the analysis reported in Table 3.

Table A1 presents the estimates of joint venture formation. Overall, the results are consistent with arguments advanced in prior studies. The formation of a joint venture is more likely between firms that are already deeply embedded in the pre-existing network structure and between firms that are connected by prior direct ties. The results also indicate that firms sometimes ally with socially asymmetric partners. The findings reveal that the indirect ties between firms in our sample decrease their propensity to create a joint venture. This result is consistent with the evidence that firms resort to joint venture as the alliance-preferred governance mode when hazards to collaboration are higher (Oxley, 1997; Gulati and Singh, 1998). The presence of common partners allays partners’ concern with opportunistic behavior and reduces firms’ need to resort to a formal governance structure. In additional analyses, we found that in the presence of common partners firms are more likely to form less hierarchical alliances, such as research agreements, and less likely to form a joint venture. Also, our findings confirm the evidence found in prior studies that resource similarity is an important driver of alliance formation, either because it indicates interdependence (Pfeffer and Novak, 1976) or because it facilitates mutual learning (Cohen and Levinthal, 1990; Lane, Salk and Lyles, 2001). Firms possessing more resources are more likely to engage in technological collaboration and less likely to do so when they already invest relatively more in R&D. The year dummies are jointly significant, indicating that the model captures important temporal unobserved heterogeneity.

As the results reported in Table A2 show, we obtained results similar to those reported in Table 3, even after accounting for potential selection bias.
### Table A1

**Probit Regression: Estimates of Influences on Joint Venture Formation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Centrality</td>
<td>1.32</td>
<td>(0.22)</td>
<td>***</td>
</tr>
<tr>
<td>Socially Asymmetric Dyads</td>
<td>0.05</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>Common Partners</td>
<td>-0.22</td>
<td>(0.07)</td>
<td>**</td>
</tr>
<tr>
<td>Competitive Intensity</td>
<td>-0.81</td>
<td>(0.79)</td>
<td></td>
</tr>
<tr>
<td>Direct Ties</td>
<td>0.20</td>
<td>(0.08)</td>
<td>**</td>
</tr>
<tr>
<td>Similarity Technological Resources</td>
<td>0.61</td>
<td>(0.22)</td>
<td>**</td>
</tr>
<tr>
<td>Similarity Market Resources</td>
<td>0.48</td>
<td>(0.19)</td>
<td>**</td>
</tr>
<tr>
<td>Size</td>
<td>0.00</td>
<td>(0.00)</td>
<td>**</td>
</tr>
<tr>
<td>Age</td>
<td>-0.00</td>
<td>(0.00)</td>
<td></td>
</tr>
<tr>
<td>Chemical R&amp;D</td>
<td>-0.00</td>
<td>(0.00)</td>
<td>†</td>
</tr>
<tr>
<td>Chemical Patents</td>
<td>0.00</td>
<td>(0.00)</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>-0.78</td>
<td>(1.18)</td>
<td></td>
</tr>
<tr>
<td>Debt-equity</td>
<td>0.06</td>
<td>(0.11)</td>
<td></td>
</tr>
<tr>
<td>Liquidity</td>
<td>0.10</td>
<td>(0.16)</td>
<td></td>
</tr>
<tr>
<td>Transregional Dummy</td>
<td>-0.05</td>
<td>(0.07)</td>
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</tr>
<tr>
<td>Constant</td>
<td>-4.50</td>
<td>(0.45)</td>
<td>***</td>
</tr>
<tr>
<td>Year Dummies</td>
<td>jointly significant</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Log pseudo-likelihood</td>
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<td></td>
</tr>
<tr>
<td>Wald $\chi^2$</td>
<td>305.61</td>
<td>***</td>
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</tr>
<tr>
<td>Observations</td>
<td>37824</td>
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</tbody>
</table>

† p<0.10; * p<0.05; ** p<0.01; *** p<0.001; one-tailed tests for hypotheses.
Robust standard errors in parentheses.
### Table A2

**Weibull Regression: Estimates of Influences on Joint Venture Dissolution**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Centrality at Founding (H1a: -)</td>
<td>1.23</td>
<td>(2.63)</td>
<td>0.408</td>
</tr>
<tr>
<td>Combined Centrality at Founding * Dummy Direct Ties at Founding (H1b: +)</td>
<td>9.55 **</td>
<td>(3.64)</td>
<td>0.002</td>
</tr>
<tr>
<td>Socially Asymmetric Dyads at Founding (H2: +)</td>
<td>2.25 ***</td>
<td>(0.62)</td>
<td>0.002</td>
</tr>
<tr>
<td>Common Partners in Previous Year (H3: -)</td>
<td>-1.96 †</td>
<td>(1.30)</td>
<td>0.160</td>
</tr>
<tr>
<td>Socially Asymmetric Dyads at Founding * Common Partners in Previous Year (H4: -)</td>
<td>-13.70 ***</td>
<td>(1.47)</td>
<td>0.002</td>
</tr>
<tr>
<td>Competitive Intensity (H5a: +)</td>
<td>14.26 **</td>
<td>(6.18)</td>
<td>0.002</td>
</tr>
<tr>
<td>Competitive Intensity * Common Partners in Previous Year (H5b: -)</td>
<td>-13.73 *</td>
<td>(8.40)</td>
<td>0.002</td>
</tr>
<tr>
<td>Direct Ties at Founding</td>
<td>-2.77 **</td>
<td>(1.08)</td>
<td>0.002</td>
</tr>
<tr>
<td>Similarity Technological Resources</td>
<td>-1.52</td>
<td>(1.78)</td>
<td>0.594</td>
</tr>
<tr>
<td>Similarity Market Resources</td>
<td>2.43</td>
<td>(1.65)</td>
<td>0.002</td>
</tr>
<tr>
<td>Size</td>
<td>6.56E-5</td>
<td>(7.7E-5)</td>
<td>0.999</td>
</tr>
<tr>
<td>Age</td>
<td>-0.01</td>
<td>(0.01)</td>
<td>0.666</td>
</tr>
<tr>
<td>Chemical R&amp;D</td>
<td>0.003 *</td>
<td>(0.002)</td>
<td>0.001</td>
</tr>
<tr>
<td>Chemical Patents</td>
<td>-0.007 *</td>
<td>(0.005)</td>
<td>0.001</td>
</tr>
<tr>
<td>Performance</td>
<td>17.50 **</td>
<td>(5.96)</td>
<td>0.001</td>
</tr>
<tr>
<td>Debt-equity</td>
<td>0.30</td>
<td>(1.28)</td>
<td>0.900</td>
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<tr>
<td>Liquidity</td>
<td>-2.21 †</td>
<td>(1.27)</td>
<td>0.055</td>
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<tr>
<td>Transregional Dummy</td>
<td>1.09</td>
<td>(0.77)</td>
<td>0.222</td>
</tr>
<tr>
<td>Correction for Propensity of Joint Venture Formation</td>
<td>-0.46</td>
<td>(1.04)</td>
<td>0.700</td>
</tr>
<tr>
<td>Constant</td>
<td>-6.32 *</td>
<td>(2.59)</td>
<td>0.010</td>
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<tr>
<td>Ln(Weibull Shape Parameter ( \rho ))</td>
<td>0.76 ***</td>
<td>(0.18)</td>
<td>0.001</td>
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<td>Log pseudo-likelihood</td>
<td>-51.18</td>
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<td></td>
</tr>
<tr>
<td>Wald ( \chi^2 )</td>
<td>1514.00 ***</td>
<td></td>
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</tr>
<tr>
<td>Observations</td>
<td>692</td>
<td></td>
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</tbody>
</table>

† p<0.10; * p<0.05; ** p<0.01; *** p< 0.001; one-tailed tests for hypotheses.

Robust standard errors in parentheses.