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2011, Vol. 54, No. 1, 203–223.

# WHEN THE SOCIAL STRUCTURE OVERSHADOWS COMPETITIVE INCENTIVES: THE EFFECTS OF NETWORK EMBEDDEDNESS ON JOINT VENTURE DISSOLUTION

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**The embeddedness of interfirm relationships in a social structure can engender order in new tie formation, but competitive incentives may undermine the order that firms seek to achieve and lead to tie dissolution. We examine how relational embeddedness (history of interactions), positional embeddedness (network centrality), and structural embeddedness (common partners) influence tie stability, focusing on unplanned joint venture dissolution. Prior work suggests that relational embeddedness facilitates alliance stability. This study shows that positional embeddedness does not promote stability, but structural embeddedness does help sustain alliances, particularly when partners have strong incentives to pursue self-interest at the expense of joint benefits.**

The network structure that encompasses firms' commercial alliances creates both potential strategic benefits and potential risks for collaborative activities. Extant literature shows that the embedding of alliance activity in a preexisting network structure when selecting partners produces informational, reputational, and social monitoring benefits that help firms mitigate collaboration hazards (Gulati & Gargiulo, 1999; Hitt, Dacin, Levitas, Arregle, & Borza, 2000; Walker, Kogut, & Shan, 1997). However, firms face obstacles to effective collaboration even after they create seemingly desirable linkages (Brass, Galaskiewicz, Greve, & Tsai, 2004; Gulati, Nohria, & Zaheer, 2000). Network embeddedness is relevant to alliance success because, in addition to assisting partner selection, embeddedness promotes cohesion between partners during the course of collaboration (Kogut, 1989; Levinthal & Fichman, 1988; Park & Russo, 1996). In many cases, though, the frictions that occur during alliance life are so severe that the cohesive effects of embeddedness are not sufficient to ensure alliance stability (Greve, Baum, Mitsuhashi, & Rowley, 2010). Despite researchers' growing understanding of the cohesive and frictional forces affecting alliance longevity, the literature remains silent about the reasons that many alliances experience frictions if embeddedness helps firms avoid forming such alliances in the first place. Further, research has not examined the possibility that the cohesive effects of embeddedness are stronger in relationships that are more vulnerable to collaboration problems.

To further understanding of how network embeddedness influences alliance instability, we examine unplanned joint venture dissolution. Although partners invest significant relationship-specific resources in the formation of a joint venture with the goal of reaping joint benefits (Gulati, 1995a; Rowley, Behrens, & Krackhardt, 2000), firms have incentives to compete with their partners, which can eclipse the benefits of collaboration and lead to joint venture dissolution (Kogut, 1989; Park & Russo, 1996; Park & Ungson, 1997). Partners may dissolve a joint venture for a variety of reasons, including the achievement of their goals or the demands of antitrust authorities. We focus explicitly on unplanned joint venture dissolutions that occur because of problems arising during the course of the alliances. Such problems are particularly likely to occur when partners are close competitors (Park & Russo, 1996; Park & Ungson, 1997), when they perceive inequity in contributions to their venture (Arino & Torre, 1998), or when changes in the market make the venture more attractive for one of the partners (Kogut, 1991; Li,

We gratefully acknowledge the valuable comments and suggestions by Wenpin Tsai and three anonymous reviewers.

Dhanaraj, & Shockley, 2008). In our empirical methods section, we detail the procedure we used to identify unplanned joint venture dissolution.

To date, the literature on alliance dissolution has focused primarily on relational embeddedness[1]—that is, on how the history of interactions between two partners influences the quality and strength of their direct ties (Moran, 2005; Nahapiet & Ghoshal, 1998). Direct ties provide partners with superior information about each other, engender knowledge-based trust (Gulati, 1995b; Uzzi, 1997; Zaheer & Venkatraman, 1995) and, as a result, mitigate tie instability (Kogut, 1989; Park & Russo, 1996; Uzzi, 1996). In this study, in contrast, we consider the influences of the broader network of interfirm alliances and investigate how the informational and reputational benefits of positional embeddedness (partners' positions in the network structure [e.g., Gulati & Gargiulo, 1999; Powell, Koput, & Smith-Doerr, 1996]) and the social monitoring advantages of structural embeddedness (partners that collaborating firms have in common [e.g., Coleman, 1988; Gulati, 1995b; Walker et al., 1997]) affect the hazard of unplanned joint venture dissolution.

When examining how network embeddedness affects unplanned joint venture dissolution, this study highlights the trade-off that firms face between incentives to form an alliance and problems that can arise during the life of the alliance. In general, before forming an alliance, a firm can be expected to balance problems that might arise during collaboration against potential alliance benefits and to only form the partnership if the anticipated problems are not severe enough to offset the projected benefits. However, this interpretation ignores the possibility that new and only partially predictable circumstances arising during the course of collaboration may shift the balance of partners' incentives, thereby engendering unexpected instability.

This study shows that many alliances turn out to be unstable because the expectation of deriving substantial benefits sometimes leads firms to create alliances that also have a substantial chance to be unstable. For instance, although the reputational imbalance inherent in asymmetric relationships is a source of instability, firms sometimes form asymmetric partnerships with the expectation of accessing complementary resources (Ahuja, 2000; Gulati & Gargiulo, 1999; Mitchell & Singh, 1996). Likewise, although firms that exhibit greater resource similarity and market commonality have greater propensity to engage in interfirm rivalry (Chen, 1996), which is a source of instability, firms sometimes ally with partners that have a high level of competitive overlap in order to manage mutual competitive interdependence or enjoy scale benefits (Gimeno, 2004; Kogut, 1988; Park & Ungson, 2001; Pfeffer & Nowak, 1976). Network embeddedness becomes relevant during the course of collaboration because it mitigates collaboration hazards, especially in alliances that have high risk of experiencing implementation problems.

This study furthers network research by showing that the effects of network embeddedness on alliance dissolution are not simply the mirror image of its effects on alliance formation. Typically, network embeddedness affects alliance formation by indicating partnerships that are less likely to experience collaboration problems. In contrast, some forms of network embeddedness influence alliance dissolution because they provide stability to relationships that, although expected to be attractive, are prone to instability. Hence, although examination of alliance formation shows that network embeddedness helps firms minimize potential collaboration problems, examination of alliance dissolution reveals that some types of network embeddedness enable firms to pursue alliances that have attractive potential benefits despite the presence of obstacles to collaboration.

With respect to research on joint ventures, this study shows how the aggregate network of relationships among a set of firms affects joint venture survival, moving this literature beyond the traditional dyadic level of analysis. According to the dyadic perspective taken in prior work, the key social mechanisms for maintaining order in an alliance are the mutual trust that partners develop and "the shadow of the future" (Axelrod, 1984: 124), which reflects the benefits of continuing the relationship (Gulati, 1995b; Heide & Miner, 1992; Parkhe, 1993b). By adopting a broader network perspective, we emphasize the "shadow of others" that arises from structural embeddedness as an additional social mechanism for maintaining order in joint ventures. The shadow of others arises because partners have incentives to behave fairly with allies because of concern for sanctions that common partners may impose. Thus, although prior work has shown that competitive tensions increase the hazard of joint venture dissolution, this study shows that it is precisely in such high-risk relationships that embedding alliances in a network of common partners most contributes to mitigating this

[1] Greve et al. (2010), who examined the influences of positional and structural embeddedness on member withdrawal from interfirm alliances, have provided a notable exception.

hazard, a finding of both theoretical and practical importance.

## NETWORK EMBEDDEDNESS AND JOINT VENTURE DISSOLUTION

Extant literature has indicated that relational, positional, and structural embeddedness influence alliance formation (Gulati & Gargiulo, 1999) and has also demonstrated that relational embeddedness mitigates tie instability (Broschak, 2004; Kogut, 1989; Levinthal & Fichman, 1988; Park & Russo, 1996; Uzzi, 1996). Hence, though controlling empirically for the influence of relational embeddedness, we focus on how the informational and reputational benefits of positional embeddedness (e.g., Gulati & Gargiulo, 1999; Powell et al., 1996) and the social monitoring advantages of structural embeddedness (e.g., Coleman, 1988; Gulati, 1995b; Walker et al., 1997) affect the hazard of unplanned joint venture dissolution.

### Informational and Reputational Benefits of Positional Embeddedness

Positional embeddedness relates to the extent to which organizations occupy a central position in a network structure (Gulati & Gargiulo, 1999). Firms in central network positions have greater scope than noncentral firms for collecting and disseminating information. The information that flows to central firms helps them identify alliance opportunities and select partners that possess appropriate resources and demonstrate reliable collaborative behavior (Ahuja, 2000; Gulati, 1995b). The greater the combined centrality of two firms, the fewer informational constraints they face when searching for partners, which, in turn, suggests that if these firms ally, it is because they knowingly regard each other as appropriate partners. Further, the informational benefits accruing to central firms also enhance trust between partners (Gulati et al., 2000; Gulati & Singh, 1998) and can be thought of as providing an initial stock of trust that enables partners to collaborate more effectively during the course of an alliance.

Simply extending the argument proposed in the alliance formation literature to its logical conclusion, we argue that the informational benefits that network-central firms possess enhance the stability of the alliance that they form. If two central firms choose each other as partners, they can ex ante expect to have made better partnering choices that will lead to a more stable alliance than partnering with noncentral firms. In other words, if firms' ex ante expectations about the value of their network in helping them choose partners are true, we should expect centrally positioned firms to form more stable alliances than noncentral firms.

The informational benefits of centrality are most relevant when firms are searching for partners and forming joint ventures. Information gathered after the start of an alliance has less value because it is likely to overlap with information partners already possess. Moreover, even if a firm needs further information about its ally after joint venture founding, its own tie with the partner can provide this information, without reference to network positions.

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

Relational embeddedness refers to the presence of prior direct ties between two firms, which enable the exchange of information about each other's capabilities and reliability, enhance mutual trust and, in turn, mitigate the hazard of joint venture dissolution (Kogut, 1989; Park & Russo, 1996; Park & Ungson, 1997). Although controlling for the direct effect of relational embeddedness, we argue that because relational embeddedness (like positional embeddedness) produces informational benefits, it is likely to moderate the impact of positional embeddedness.

To understand the moderating effect of relational embeddedness, note that in the absence of a prior direct tie between two firms, their current network positions function as partial surrogates for the missing relationship and help 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 positions convey less novel information because their prior ties allowed them to observe each other's competencies and behavior directly.

Although the information that a firm collects directly from its partner may not fully overlap with the information that stems from positional embeddedness (Burt, 1992; Gulati, 1995b), it reduces the marginal value of the information the firm obtains through its network position. Moreover, the knowledge-based trust resulting from superior information that two central partners have prior to forming a joint venture partly overlaps with the knowledge-based trust stemming from prior direct ties. Hence, partners' centrality in the network structure will have less influence on joint venture dissolution when the partners have prior direct ties.

*Hypothesis 1b. The combined network centrality of two partnering firms at joint venture founding (positional embeddedness) contributes less to mitigating the hazard of unplanned joint venture dissolution when they are connected by prior direct ties (relational embeddedness).*

In addition to informational benefits, positional embeddedness also offers reputational advantages. Central firms are perceived to be more capable and reliable partners than firms that occupy peripheral network positions (Powell et al., 1996). Centrally positioned firms generally prefer to ally with organizations that occupy similar positions to mitigate the hazards of collaboration and to avoid diminishing their reputations (Chung, Singh, & Lee, 2000; Gulati & Gargiulo, 1999; Podolny, 1994). Further, the positional imbalance between a central and a peripheral actor creates power imbalance between them (Mizruchi, 1982). Although the reputational imbalance inherent in asymmetric relationships is a source of instability, firms sometimes form asymmetric partnerships with the expectation of accessing complementary resources (Ahuja, 2000; Gulati & Gargiulo, 1999; Mitchell & Singh, 1996). Peripheral firms, in turn, have incentives to ally with central partners because such collaboration can vouch for their reliability and enhance their reputations (Podolny, 1994).

Again, a strict interpretation of the instrumental goals associated with reputational imbalance is that if positionally asymmetric partners form an alliance, it is because they expect benefits to outweigh potential collaboration problems, yet the fact remains that over time new and only partially predictable circumstances can shift the balance of benefits that partners can derive from their alliance, thus creating tension between the partners. The more central firm may derive greater private benefits than its partner expected because its wider portfolio of relationships, skills, and absorptive capacity allows it to leverage the benefits from the information it receives (Cohen & Levinthal, 1990; Zollo, Reuer, & Singh, 2002), well beyond what its partner anticipated. Alternatively, the asymmetry might well favor the less embedded partner, because the affiliation ends up providing a reputation enhancement that goes beyond what the central partner predicted, or the less embedded partner uses the affiliation to obtain relationships with additional relatively central partners (Ahuja, Polidoro, & Mitchell, 2009).

By shifting the balance of benefits that positionally asymmetric partners can derive from an alliance, partners' reputational imbalance at the outset of collaboration increases their tendency to revisit the terms negotiated for the alliance in an attempt to restore exchange balance (Cook, 1977; Emerson, 1972) and affects the amount of resources they allocate to their joint venture (Khanna, Gulati, & Nohria, 1998). These factors, along with shifts in bargaining power during the course of the alliance, create alliance instability (Das & Teng, 2000; Kogut, 1989).

*Hypothesis 2. Joint ventures formed between a high-centrality firm and a low-centrality firm (positional asymmetry) experience greater hazard of unplanned dissolution than joint ventures between firms with similar centrality (positional symmetry).*

### Social Monitoring Benefits of Structural Embeddedness

We now turn to structural embeddedness, which refers to partners that collaborating firms have in common (Coleman, 1988). The partners common to two organizations encompass the set of direct ties common to both of them. Prior studies on alliance formation have shown that firms that have partners in common exhibit increased propensity to ally with each other (Gulati, 1995b; Gulati & Gargiulo, 1999).

Besides referral advantages, structural embeddedness also produces social monitoring benefits that help organizations monitor and enforce collaborative behavior (Coleman, 1988). The presence of common partners engenders deterrence-based trust by giving greater 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, reach a larger number of firms in the network of interfirm collaboration. The presence of common partners produces social monitoring benefits because it amplifies opportunities to sanction norm breaking. Even if the firm that faces opportunism is unable to impose sanctions on the ally, common partners may inflict penalties on the norm breaker. The deterrence-based trust stemming from commonality of partners helps mitigate the incidence of collaboration problems between two firms.

An alternative way in which partners can deter opportunistic behavior is by resorting to formal governance structures, such as joint ventures, to govern collaboration. Firms commonly resort to joint ventures to organize collaboration when they perceive high interorganizational hazards at the time they create their alliance (Gulati & Singh, 1998). Because of the joint commitment of re-

sources and the administrative apparatus required for their operation, joint ventures help align incentives between partners (Kogut, 1988). The "mutual hostage" positions implied by the shared equity in a joint venture engender deterrence-based trust between partners.

The social monitoring benefits of structural embeddedness reinforce the deterrence-based trust inherent in the governance structure of joint ventures. Even if partners form a joint venture under the presumption that the benefits will supersede potential collaboration problems, new circumstances arising during the course of the alliance can shift the balance of partners' incentives and, as a result, engender instability. Structural embeddedness, however, helps firms deter opportunistic behavior. If a firm behaves opportunistically in the context of a joint venture, it faces the risk of punishment not only by the venture partner but also by all other partners they have in common.

Additionally, common partners may impose reputational damage on the norm-breaking firm and refrain from forming future alliances with that firm (Park & Ungson, 1997). The fear of loss of reputation deters firms linked by common partners from behaving opportunistically (Gulati & Gargiulo, 1999; Gulati & Westphal, 1999). Hence, common partners increase the cost of opportunism by affecting not only the current ties but also the potential future ties of the norm breaker. The joint venture between Kuwait's Petrochemicals Industries Co. and Dow Chemical illustrates that firms, when responding to collaboration problems, consider the effect of such response on their current and future ties. In December 2008, Petrochemicals Industries decided to pull out of its joint venture with Dow. Although the contract specified that in such an event Dow Chemical should receive $2.5 billion from the partner, industry observers noted that Dow was reluctant to launch litigation procedures because of concern that such behavior could jeopardize its other joint ventures and its attempts to strengthen ties with the Kuwaiti investment authorities (*National Post*, 2009; *Times*, 2008).

Whereas informational and reputational benefits of positional embeddedness are greatest at the time of joint venture founding, by ensuring that firms ally with the right partners, the social monitoring benefits of structural embeddedness can accrue at any point of network evolution. When two firms create a joint venture, the partners they have in common confer deterrent effects. During the course of the alliance, as the number of common partners linking the two firms increases, the social monitoring effects become stronger. Additional common partners enhance firms' embeddedness in local networks (Gulati & Gargiulo, 1999), reinforce firms' concern for local reputation and, as a consequence, further mitigate interorganizational hazards.

*Hypothesis 3. The more common partners that two firms forming a joint venture possess at any point of network evolution (structural embeddedness), the less the hazard of unplanned joint venture dissolution.*

Because the presence of common partners increases the costs of opportunism, we expect the deterrent benefits that common partners provide to be more pronounced when the edge of incentives to behave opportunistically is especially sharp. Firms sometimes form alliances that are prone to instability because the formation incentives go hand in hand with factors that increase the chance of shifts in the balance of partners' incentives, which is a source of instability. For instance, as we argued earlier, although firms form positionally asymmetric ties with the expectation of accessing complementary resources, partners' reputational imbalance increases their propensity to behave opportunistically after alliance formation. Likewise, although firms have incentives to ally with partners exhibiting competitive overlap in order to manage mutual competitive interdependence (Gimeno, 2004; Kogut, 1988; Park & Ungson, 2001; Pfeffer & Nowak, 1976), partners exhibiting competitive overlap are more likely to let competitive incentives overrule the benefits of collaboration (Chen, 1996; Kogut, 1989; Park & Ungson, 1997). We argue that the deterrent effects of common partners mitigate collaboration hazards especially in these types of alliances that, despite the expected benefits, have high risk of experiencing collaboration problems.

***Common partners and positional asymmetry.*** As Hypothesis 2 predicts, partners' reputational imbalance at joint venture founding increases the chances that they will experience collaboration problems during the course of their alliance, which in turn exacerbate the importance of common partners as a stabilizing mechanism. When positionally symmetric firms create a tie, their structural similarity and relatively congruent attendant routines, processes, and objectives provide a degree of stability to the alliance. But when asymmetric partners form a tie, fewer of these stability-enhancing factors are present, which in turn enhances the value of common partners as mechanisms of stability. Hence, in joint ventures created between positionally asymmetric partners, the norms and reputational pressures associated with the presence of common partners in the ongoing network structure become more relevant to mitigating collaboration

problems than they are in joint ventures formed between positionally symmetric partners, which are less likely to experience collaboration hazards in the first place.

*Hypothesis 4. The number of common partners between two joint venture partners (structural embeddedness) contributes more to mitigating the hazard of unplanned joint venture dissolution when one firm has high centrality and the other has low centrality (positional asymmetry) than when firms have similar centrality (positional symmetry).*

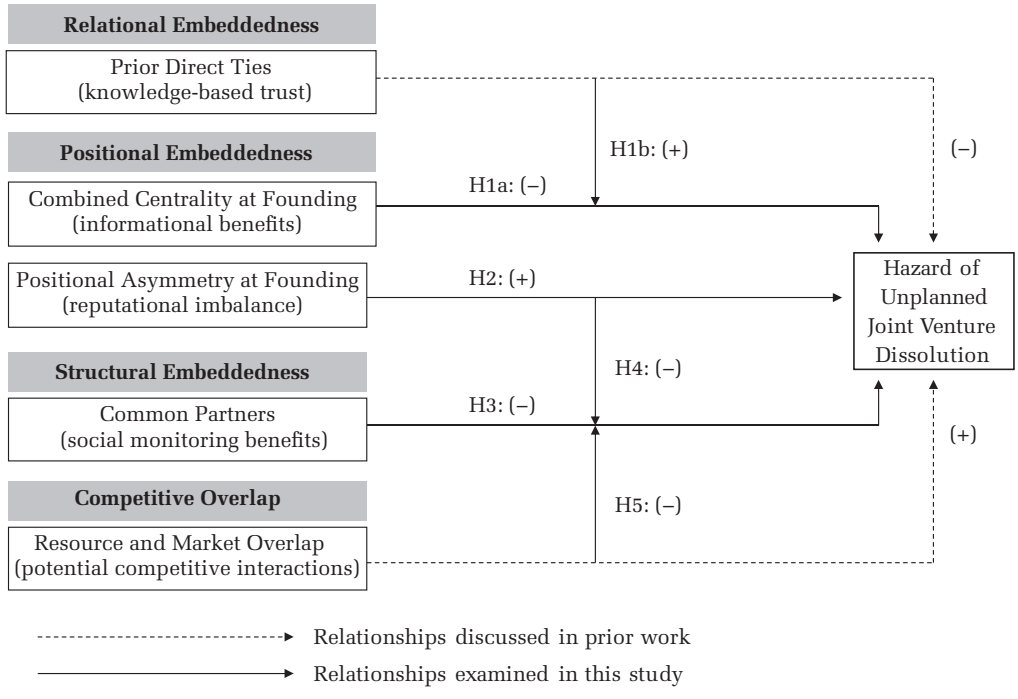
***Common partners and competitive overlap.*** Researchers have argued that interfirm ties enhance the likelihood of coordination, tacit or otherwise, and has shown that firms with high levels of competitive overlap form joint ventures in an attempt to manage their competitive interdependence (Kogut, 1988; Pfeffer & Nowak, 1976). However, the attempt to manage mutual competitive intensity is both an incentive to form joint ventures and a source of instability (Kogut, 1989; Park & Russo, 1996). Firms that exhibit greater resource similarity and market commonality have high propensity to engage in interfirm rivalry (Chen, 1996) and represent a competitive threat to each other (Pfeffer & Nowak, 1976). They can, for example, enter or reinforce their presence in markets in which competitors operate and, by doing so, affect each other's performance and viability (Barnett, 1997).

Some scholars have argued that firms with high levels of competitive overlap, fearing retaliation, may curb competitive actions and engage in less vigorous competition (Gimeno & Woo, 1996; Karnani & Wernerfelt, 1985). However, the stability of such mutual forbearance is fragile in the face of competitive incentives (Baum & Korn, 1999; Stigler, 1964). When partners exhibit high competitive overlap, there is a high probability that one will learn about the other's vulnerabilities and encounter opportunities to exploit those weaknesses. Direct retaliation between firms with high competitive overlap may lead to escalation of mutual rivalry and become either ineffective or overly costly. As a result, enforcement through common partners becomes even more important in relationships between firms that have high competitive overlap.

*Hypothesis 5. The number of common partners between two joint venture partners (structural embeddedness) contributes more to mitigating the hazard of unplanned joint venture dissolution when the firms have high competitive overlap than when they have low competitive overlap.*

Figure 1 summarizes our hypotheses about the

**FIGURE 1**
**Influences of Network Embeddedness on Unplanned Joint Venture Dissolution**



influence of different aspects of network embeddedness on unplanned joint venture dissolution.

## METHODS

We used data on the duration of technology-related joint ventures formed among the leading firms in the global chemicals industry. Although joint ventures constitute formal interfirm ties (Contractor & Lorange, 1988; Gulati & Singh, 1998) that require significant relationship-specific investments and imply high exit costs (Gulati, 1995a; Rowley et al., 2000), partners often dissolve alliances before reaping the joint benefits (Kogut, 1989; Park & Russo, 1996; Park & Ungson, 1997). Joint ventures involving technology are especially vulnerable to opportunism (Gulati, 1995a; Gulati & Singh, 1998) and, hence, constitute an appropriate context for examining the influence of network embeddedness on unplanned alliance dissolution.

Using trade journals such as *Chemical Week* and *C&E News*, we identified a primary sample of 107 firms from Western Europe, Japan, and the United States—the core of the global chemicals industry. Because collecting reliable, comprehensive data on joint venture formation and dissolution among smaller firms is difficult, past network studies have used a similar strategy of focusing on the leading firms in an industry (Gulati, 1995b; Rosenkopf, Metiu, & George, 2001). Reliable financial and other data were not available for 10 firms, limiting the analysis to 97 firms.

We collected data on the joint venture activity of the 97 companies between 1979 and 1991. The period of analysis started in 1979 because that is when news media databases began to systematically report data on interfirm collaboration (Gulati, 1995b; Hagedoorn & Schakenraad, 1989). Prior studies have suggested that alliance activity was low until the early 1980s (Gulati & Gargiulo, 1999; Hergert & Morris, 1988).

We adopted a two-stage data collection procedure. In the first stage, we identified joint ventures between firms in the sample that included the creation of new technologies or the sharing of an existing technology or manufacturing process by the partners. To do so, we used (1) general business news media electronic databases, such as Dow Jones News Retrieval Text Index and Lexis-Nexis, and sector-specific electronic databases, such as METADEX, (2) general business print media, such as the Frost and Sullivan Predicasts index, as well as industry-specific publications such as *Chemical Week* and *C&E News*, and (3) government publications and consultants' reports for the industry over the relevant period. In the second stage, we searched the above media to collect all relevant news stories about each joint venture. We analyzed news stories dating until 2006 to ascertain whether the joint ventures survived beyond 1992. These two stages involved studying over 130,000 news stories and took several years.

Although we had data on joint ventures formed since 1979, we needed to use data about the first few years to construct the network emerging from prior joint ventures to capture the network structure at joint venture founding. We used data on joint ventures formed between 1979 and 1982 to construct a baseline network. We then identified 201 dyadic ties resulting from 168 joint ventures formed between 1983 and 1991 and examined the hazard of unplanned dissolution of these ties between 1984 and 1992.

From the search described above, we unambiguously identified the dissolution of 36 dyads and the survival beyond 1992 of 128 dyads. To establish either the date of dissolution or survival beyond 1992 for the other 37 dyads, we contacted the companies and obtained information on 13 additional dyads, all of which survived beyond 1992. For the remaining 24 dyads, we were unable to unambiguously determine survival or dissolution. Given our relatively high rate of success in identifying dissolution, we believe that the most accurate assumption is that these 24 dyads survived beyond 1992; otherwise, their dissolution would have been reported. As we report later, we obtained robust results when we tested the sensitivity of the analysis to this assumption.

A joint venture ceases to exist when partners liquidate it, when one firm acquires the stake of the partner, or when partners sell their stake to a third party (Dussauge, Garrette, & Mitchell, 2000; Kogut, 1989; Park & Russo, 1996). Although dissolution represents only one form of alliance performance, it usually reflects a business failure or irresolvable conflict between partners (Gehringer & Herbert, 1989; Kogut, 1989). To ascertain whether the cases of dissolution in the sample reflected collaboration problems, we examined the news stories about each dissolved joint venture. In a few cases, dissolution reflected goal attainment or changes in the business landscape unrelated to partners' opportunistic behavior. We did not consider these cases to be unplanned dissolution, as they do not reflect the types of interfirm hazards we discuss above. In the vast majority of cases, unplanned joint venture dissolution reflected either partners' difficulty in collaborating or an attempt by one of the partners to exploit a particular business opportunity alone

rather than share the benefits. Appendix A presents examples of joint venture dissolution.

### Dependent Variable

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; this variable was coded 1 if the firms dissolved the joint venture in that year and 0 otherwise. Our analysis of the reasons leading to joint venture dissolution enabled us to identify 31 cases of unplanned dissolution.[2] The average duration of joint venture dyads that experienced unplanned dissolution was 3.5 years, with a standard deviation of 2.2 years.

### Independent Variables

***Combined centrality at founding (positional embeddedness).*** In line with prior studies, we measured each firm's position in the network structure in which it was embedded (i.e., the aggregate network of joint ventures among a set of partnering firms) using Bonacich's (1987) eigenvector centrality scores (e.g., Chung et al., 2000; Gulati & Gargiulo, 1999; Podolny, 1994). This measure suits our analysis because it takes into account that a firm has greater scope for collecting and disseminating information when it is linked to a greater number of partners and when partners are themselves well connected in a network structure—that is, this measure results in higher centrality scores for firms that are linked to many firms, which are in turn linked to many other firms. The combined centrality of the two firms in a dyad is the geometric mean of the two firms' scores in a given joint venture founding year (Mizruchi, 1993), each firm's score being normalized relative to the most central firm in that year (Gulati & Gargiulo, 1999). Our findings are robust to using the arithmetic mean of the centrality scores. We computed the centrality scores using UCINET 5 (Borgatti, Everett, & Freeman, 1999). To test Hypothesis 1b, we split observations into two groups, one with, and the other without, prior direct ties.

[2] Additionally, in 5 cases we were unable to identify whether the dissolution was planned or unplanned. Given that the vast majority of dissolutions were unplanned, we assumed these cases to reflect unplanned dissolutions. Sensitivity analyses considering these 5 cases as planned dissolutions produced similar results.

***Positionally asymmetric dyads at founding (positional asymmetry).*** Interorganizational networks display a pattern of core-periphery structures (Gulati & Gargiulo, 1999), and firms' behavior is affected by whether they occupy central or peripheral network positions (Mizruchi, 1993). Reputational imbalance arises when partners occupy different status brackets—that is, when one partner belongs to a high-status group while the other is a member of a low-status group (Podolny, 1993). We adopted Mizruchi's (1992) procedure to identify dyads between a central and a peripheral firm. For each dyad we coded a dummy variable as 1 if one firm in the dyad had a centrality score lower than the mean and the other had centrality equal to or greater than the mean observed in the founding year, and as 0 otherwise. We obtained similar results when defining central firms as those with centrality scores in the top quartile.

***Common partners in previous year (structural embeddedness).*** We measured the number of common partners two firms shared in the evolving alliance network as the number of common partners they had in the year before the observation year (Gulati & Gargiulo, 1999; Mizruchi, 1992). To test Hypotheses 4 and 5, we interacted this variable with the measures capturing positionally asymmetric dyads at founding and competitive overlap, respectively.

### Control Variables

Prior research has shown that relational embeddedness between partners reduces the hazard of joint venture dissolution (Kogut, 1989; Park & Russo, 1996; Park & Ungson, 1997). We controlled for this influence with a variable that contains the cumulative number of prior joint ventures formed between two partners until the year preceding a focal joint venture's founding. We also added a variable with the number of ties that partners formed since the founding of the focal joint venture to control for the possibility that firms may need to dissolve the focal joint venture to free up resources and use them to seize emerging alliance opportunities.

Because firms exhibit high propensity to engage in mutual competitive behavior when they have a high degree of similarity in both the resources that they possess and the markets where they operate (Chen, 1996), we measured competitive overlap as a dummy variable set to 1 if the firms in the dyad had high technical resource overlap and high mar-

ket overlap, and to 0 otherwise.[3] We considered overlap along each dimension to be high if the respective score for firms in the dyad was above the sample mean. Sensitivity analysis yielded robust results using above-the-median and top-quartile measures of high overlap.

To measure firms' overlap along each dimension in a given year, we used the Euclidean distance between them (Sohn, 2001), which takes the value $(\Sigma_{k\,=\,1,\,n}\,[P_{ikt} - P_{jkt}]^2)^{1/2}$, where $P_{ikt}$ ($P_{jkt}$) captures the proportion of firm *i*'s (firm *j*'s) resources in each of *n* areas where resources might overlap. We used patent data to measure firms' technical resources (Griliches, 1990; Hall, Jaffe, & Trajtenberg, 2001). To measure technical resource overlap, we used the proportion of firms' patent applications in each of the 80 technological classes that chemical companies use. To measure overlap of market resources, we considered the average of firms' overlap in both geographic and product markets. For geographic overlap, we used the proportion of subsidiaries that firms owned in each of 156 countries, and for product-market overlap, we used the proportion of sales they obtained in each of 120 market segments defined at the level of four-digit SIC codes. These measures vary between 0 (complete overlap) and the square root of 2 (no overlap). To facilitate the interpretation of results, we linearly transformed these measures and subtracted them from the square root of 2.

Several variables address other possible influences. We controlled for the possibility that partnering firms' ages affect the hazard of joint venture dissolution (Kim, Oh, & Swaminathan, 2006) by including a variable with the difference between the firms' founding years (Park & Ungson, 1997). To control for the possibility that the total amount of firms' technical resources affects the stability of their relationship, we added controls for firms' combined R&D expenditures and patents in the chemical industry. Further, we included measures to account for the possibility that differences in firms' financial performance or financial resources affect their propensity to dissolve a joint venture. We calculated performance asymmetry by subtracting the lesser from the greater value of return on assets (ROA) within each dyad. To measure asymmetry in liquidity (current assets/current liabilities) and in debt-equity (long term debt/shareholder equity), we used the ratio of the lesser to the greater value within a dyad. We included a dummy variable to control for cultural differences (Barkema, Shenkar, Vermeulen, & Bell, 1997; Park & Ungson, 1997; Parkhe, 1993a). This variable equals 1 when parent firms are based in different regions (U.S., Europe, or Japan) and 0 otherwise. We lagged all control variables.

Table 1 reports descriptive statistics and the correlation matrix for the variables.

### Model Estimation and Econometric Issues

Because the time elapsed since tie formation may influence the hazard of tie dissolution (Levinthal & Fichman, 1988), we chose a parametric survival function that enables the baseline hazard function to vary as a function of time and then estimates the influences of the covariates as multiplicative effects that either increase or decrease the baseline hazard. We used the Weibull distribution, which accounts for a monotonic effect of time (Barkema et al., 1997; Dussauge et al., 2000; Park & Russo, 1996). Our results are robust to the lognormal and gamma distributions that prior work has used as alternatives (e.g., Dussauge et al., 2000; Park & Russo, 1996). We used robust standard errors adjusted for clustering at the joint venture level to allow for nonindependence of observations and correct for groupwise heteroskedasticity (Greene, 2003).

## RESULTS

Table 2 presents the results of the regression analyses. The natural logarithm of the shape parameter of the Weibull distribution is statistically significant in all models, showing that the hazard of dissolution increases monotonically with time elapsed since joint venture founding. Model 1 contains the control variables; model 2 introduces the main effects; and model 3 adds the interactions.

Hypothesis 1a predicts that firms' combined centrality at joint venture founding reduces the hazard of unplanned dissolution, and Hypothesis 1b predicts that this effect is smaller when firms have prior direct ties. The logic drew on arguments about the informational benefits of positional embeddedness. In contrast to the predictions, however, model 3 shows that firms' centrality does not affect unplanned joint venture dissolution when partners are forming their first direct tie ($\beta = 1.47$, n.s.) but increases the hazard of dissolution when partners have prior direct ties ($\beta = 12.58$, $p < .001$).

[3] Results are robust to an alternative measure for competitive overlap considering the interaction between technical resource overlap and market overlap. A concern with the interpretation of these results is that the addition of several interaction terms may create multicollinearity problems. The simplified variable, although it implies some loss of information, allows for easier interpretation.

**TABLE 1**
**Descriptive Statistics and Correlation Matrix**

| Variables | Mean | s.d. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Joint venture dissolution | 0.03 | 0.18 | | | | | | | | | | | | | | | | | | | |
| 2. Combined centrality at founding | 0.24 | 0.25 | −.08 | | | | | | | | | | | | | | | | | | |
| 3. Combined centrality at founding in dyads with no direct ties | 0.17 | 0.22 | −.08 | .64 | | | | | | | | | | | | | | | | | |
| 4. Combined centrality at founding in dyads with direct ties | 0.07 | 0.20 | −.02 | .55 | −.28 | | | | | | | | | | | | | | | | |
| 5. Positionally asymmetric dyads at founding | 0.33 | 0.47 | .11 | −.38 | −.29 | −.16 | | | | | | | | | | | | | | | |
| 6. Common partners in previous year | 0.71 | 1.16 | −.11 | .66 | .38 | .40 | −.21 | | | | | | | | | | | | | | |
| 7. Common partners in previous year × positionally asymmetric dyads at founding | 0.12 | 0.45 | −.05 | −.12 | −.08 | −.06 | .39 | .25 | | | | | | | | | | | | | |
| 8. Common partners in previous year × competitive overlap | 0.36 | 1.01 | −.07 | .43 | .21 | .32 | −.14 | .76 | .16 | | | | | | | | | | | | |
| 9. Direct ties at founding | 0.20 | 0.45 | −.02 | .38 | −.34 | .84 | −.03 | .23 | −.03 | .16 | | | | | | | | | | | |
| 10. Ties formed since founding | 7.31 | 5.29 | −.06 | .44 | .43 | .09 | −.11 | .50 | .19 | .34 | .01 | | | | | | | | | | |
| 11. Competitive overlap | 0.33 | 0.47 | .00 | .11 | .02 | .12 | −.12 | .25 | .08 | .52 | .04 | .07 | | | | | | | | | |
| 12. Technical resource overlap | 0.84 | 0.13 | −.04 | .19 | .14 | .08 | −.08 | .13 | .07 | .25 | .06 | .22 | .41 | | | | | | | | |
| 13. Market overlap | 0.77 | 0.16 | −.06 | .22 | −.03 | .30 | −.07 | .34 | .13 | .36 | .23 | .19 | .58 | .14 | | | | | | | |
| 14. Age asymmetry | 35.54 | 34.02 | −.01 | .08 | .15 | −.06 | .01 | −.18 | −.13 | −.17 | −.05 | .03 | −.05 | .18 | −.18 | | | | | | |
| 15. Combined chemical R&D | 430.84 | 409.14 | .01 | .01 | .08 | −.08 | .06 | −.13 | −.03 | −.08 | −.02 | .13 | .12 | .37 | .06 | .54 | | | | | |
| 16. Combined chemical patents | 187.30 | 166.93 | −.03 | .05 | .09 | −.04 | .05 | −.08 | −.01 | −.02 | .01 | .17 | .19 | .44 | .10 | .57 | .90 | | | | |
| 17. Performance asymmetry | 0.03 | 0.03 | .12 | −.11 | −.03 | −.10 | −.06 | −.25 | −.12 | −.19 | −.02 | −.16 | −.11 | .07 | −.33 | .17 | .09 | .08 | | | |
| 18. Debt-equity asymmetry | 0.55 | 0.23 | −.05 | .06 | .01 | .07 | −.02 | .03 | .03 | .02 | .01 | −.05 | .03 | .05 | .05 | .16 | .11 | .14 | −.23 | | |
| 19. Liquidity asymmetry | 0.75 | 0.18 | −.05 | .19 | .13 | .09 | .01 | .19 | .11 | .10 | .03 | .15 | .02 | −.01 | .10 | −.05 | −.12 | −.16 | −.11 | .31 | |
| 20. Transregional dummy | 0.50 | 0.50 | .10 | −.21 | −.08 | −.17 | .08 | −.41 | −.15 | −.33 | −.10 | −.17 | −.40 | .07 | −.68 | .37 | .20 | .17 | .40 | .02 | −.14 |

**TABLE 2**
**Weibull Estimates of Influences on the Hazard of Unplanned Joint Venture Dissolution[a]**

| | | | | | | | Robustness Tests | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Gamma Frailty | | Dropping Dyads without Data on Dissolution | |
| **Variables** | **Model 1** | | **Model 2** | | **Model 3** | | **Model 4** | | **Model 5** | |
| Combined centrality at founding (H1a: < 0) | | | 3.03* | (1.84) | | | | | | |
| Combined centrality at founding in dyads with no direct ties at founding (H1a: < 0) | | | | | 1.47 | (2.23) | 1.31 | (2.93) | 0.94 | (2.23) |
| Combined centrality at founding in dyads with direct ties at founding (H1b: > H1a) | | | | | 12.58*** | (3.79) | 12.81*** | (3.75) | 10.10*** | (3.33) |
| Positionally asymmetric dyads at founding (H2: > 0) | | | 1.76*** | (0.54) | 2.05*** | (0.58) | 2.07*** | (0.61) | 2.03*** | (0.60) |
| Common partners in previous year (H3: < 0) | | | −1.52* | (0.88) | −1.39† | (0.96) | −1.39† | (0.93) | −1.36† | (0.91) |
| Common partners in previous year × positionally asymmetric dyads at founding (H4: < 0) | | | | | −14.43*** | (1.20) | −20.93*** | (1.31) | −16.86*** | (1.34) |
| Common partners in previous year × competitive overlap (H5: < 0) | | | | | −12.23*** | (0.97) | −18.71*** | (0.89) | −14.65*** | (0.89) |
| Direct ties at founding | 0.21 | (0.62) | −0.35 | (0.68) | −2.95** | (1.09) | −3.05* | (1.34) | −2.17* | (0.88) |
| Ties formed since founding | −0.06 | (0.05) | −0.03 | (0.06) | −0.04 | (0.08) | −0.04 | (0.08) | −0.03 | (0.07) |
| Competitive overlap | 1.07 | (0.74) | 1.52* | (0.79) | 1.32† | (0.75) | 1.34† | (0.81) | 1.03 | (0.72) |
| Technical resource overlap | −3.04 | (2.17) | −3.70† | (2.31) | −4.11† | (2.20) | −4.17† | (2.28) | −3.87† | (2.16) |
| Market overlap | −0.63 | (2.16) | 0.08 | (2.36) | 0.23 | (2.37) | 0.16 | (2.61) | 0.57 | (2.46) |
| Age asymmetry | −0.01 | (0.01) | −0.01 | (0.01) | −0.01 | (0.01) | −0.01 | (0.01) | −0.005 | (0.01) |
| Combined chemical R&D | 0.002† | (0.001) | 0.002* | (0.001) | 0.003** | (0.001) | 0.003† | (0.002) | 0.002* | (0.001) |
| Combined chemical patents | −0.005 | (0.005) | −0.006 | (0.004) | −0.007 | (0.004) | −0.007 | (0.005) | −0.006 | (0.004) |
| Performance asymmetry | 7.95 | (5.17) | 10.14* | (5.30) | 14.41** | (4.58) | 14.71** | (4.75) | 15.10** | (5.32) |
| Debt-equity asymmetry | −0.20 | (1.01) | 0.09 | (1.28) | 0.34 | (1.28) | 0.32 | (1.29) | 0.26 | (1.31) |
| Liquidity asymmetry | −0.84 | (1.18) | −2.06 | (1.27) | −2.17† | (1.21) | −2.17† | (1.24) | −1.82 | (1.24) |
| Transregional dummy | 1.32† | (0.75) | 1.47* | (0.72) | 1.14† | (0.66) | 1.18 | (0.76) | 0.84 | (0.65) |
| Constant | −1.81 | (2.17) | −2.70 | (2.45) | −2.64 | (2.32) | −2.64 | (2.37) | −3.08 | (2.50) |
| ln(Weibull shape parameter ($\rho$) | 0.53*** | (0.15) | 0.70*** | (0.18) | 0.75*** | (0.20) | 0.78* | (0.33) | 0.79*** | (0.20) |
| ln(Overdispersion parameter frailty model ($\theta$) | | | | | | | −2.08 | (9.45) | | |
| Log pseudo-likelihood | −65.14 | | −55.79 | | −51.71 | | −51.70 | | −47.58 | |
| Δ log pseudo-likelihood | | | 9.35 | | 4.08 | | | | | |
| Observations | 692 | | 692 | | 692 | | 692 | | 585 | |

[a] Robust, heteroskedasticity-adjusted standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$
One-tailed tests for hypotheses.

We note that caution is in order in interpreting the latter effect, because of the substantial correlation with direct ties at founding, so that the negative impact of direct ties at founding partially offsets the positive impact of the combined centrality measure for firms with direct ties. Nonetheless, the findings do not support our predictions. Although positional embeddedness may facilitate tie formation, premised on informational advantages that enable firms to select better partners, it does not decrease the hazard of unplanned joint venture dissolution. Instead, positional embeddedness can actually increase the hazard of unplanned dissolution when firms have prior direct ties. This unexpected result might stem from the formation of redundant alliances that generate fewer benefits to partners, which makes collaboration vulnerable to the emergence of more attractive opportunities.

The results support Hypothesis 2, which predicts that joint ventures between a high-centrality and a low-centrality firm experience greater hazard of unplanned dissolution than those between firms with

similar centrality. This prediction built on arguments about the reputational benefits of positional embeddedness. As expected, results show that the partners' positional asymmetry at joint venture founding increases the dissolution hazard ($\beta = 2.05$, $p < .001$).

The results support Hypothesis 3, which predicts that the number of common partners connecting two firms reduces the hazard of unplanned joint venture dissolution. This prediction drew on arguments concerning social monitoring benefits of structural embeddedness. As expected, the presence of common partners shared by two firms in the evolving network structure mitigates the hazard of alliance dissolution ($\beta = -1.52$, $p < .05$, in model 2, before adding interactions; $\beta = -1.39$, $p < .10$, in model 3, after adding interactions).

The findings support Hypotheses 4 and 5, which predict that the benefits of having common partners are increased in the relationships most vulnerable to instability, including joint ventures between positionally asymmetric partners and between partners with competitive overlap. Supporting the predictions, the coefficient on common partners is significantly more negative in positionally asymmetric dyads ($\beta = -14.43$, $p < .001$) and in dyads with high competitive overlap ($\beta = -12.23$, $p < .001$). Moreover, the statistical significance of the main effects of both common partners and competitive overlap declines once the analysis adds the interactions, highlighting the importance of the contingent effects (although the main effect of positional asymmetry remains highly significant in model 3).

Figures 2 and 3 show the multiplicative effect of social asymmetry and competitive overlap relative to a baseline group in which all covariates are 0. As the slopes in Figure 2 indicate, common partners contribute to reducing collaboration hazards more dramatically for positionally asymmetric firms. Similarly, the slopes in Figure 3 show that the stabilizing effects of common partners are more notable when firms exhibit competitive overlap.

Several control variables in model 3 affect alliance dissolution. The presence of direct ties at founding (relational embeddedness), technical resource overlap, and liquidity asymmetry at least moderately reduce dissolution risk. Firms' combined R&D expenditures, performance asymmetry, and alliance transregional span at least moderately increase dissolution hazards.

### Sensitivity Tests

To rule out the possibility that unobserved heterogeneity across observations affects our findings, we ran a model with a frailty distribution (Hougaard, 1986), based on a gamma distribution. Model 4 shows that the findings we reported earlier are robust to this specification. Moreover, the parame-

**FIGURE 2**
**Effects of Common Partners Relative to Baseline Group in Positionally Symmetric and Asymmetric Dyads**

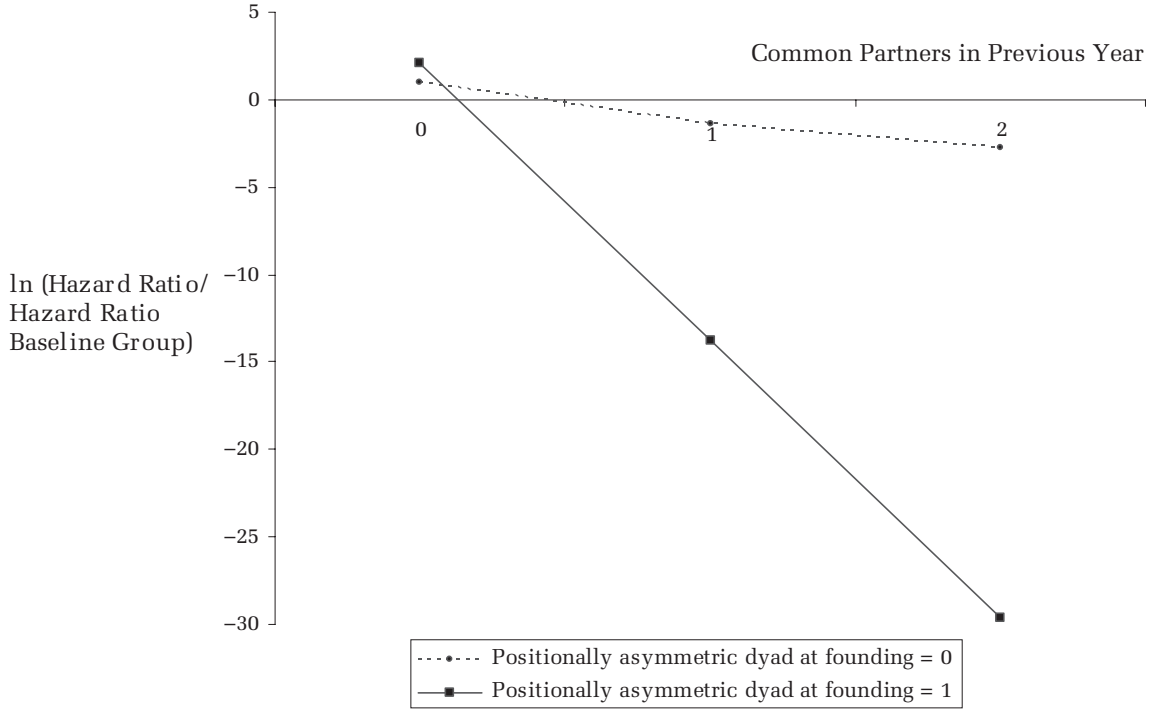
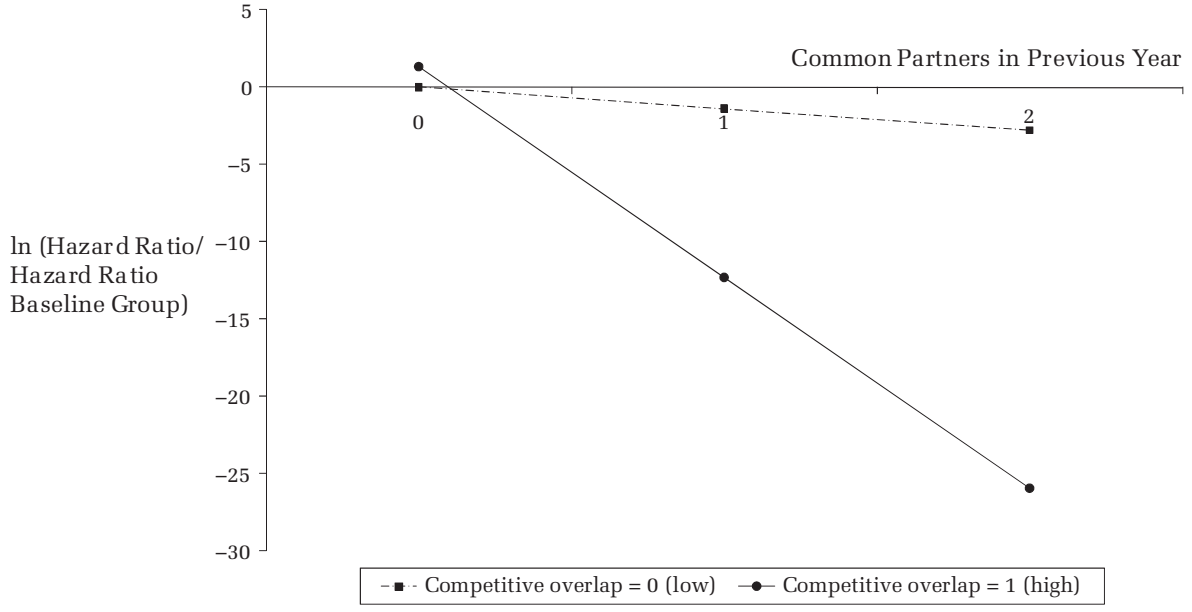


**FIGURE 3**
**Effects of Common Partners Relative to Baseline Group in Dyads with High and Low Competitive Overlap**




ter of the frailty model is not statistically significant, suggesting that little unobserved heterogeneity is present.

As noted earlier, we were unable to unambiguously establish dissolution or survival for 24 dyads in the sample and assumed that they survived beyond 1992. We obtained similar results in models assuming that these dyads lasted only three, four, or five years after the year of formation. Further, to rule out the possibility that particular assumptions about the duration of these dyads affected the results, in model 5 we drop them from the sample and obtain robust results.

Because of multicollinearity among the variables capturing firms' age asymmetry, combined chemical R&D, and combined chemical patents, we ran additional models with orthogonal measures for these variables (Rhee & Haunschild, 2006; Sine, Shane, & DiGregorio, 2003). This procedure purges variables from information contained in the other measures. These models produced similar results. Results were robust when we dropped these variables in additional models, ruling out the possibility that multicollinearity affected the findings.

We argue that the informational and reputational benefits of positional embeddedness accrue to partners at joint venture founding, whereas the social monitoring benefits of structural embeddedness that accrue at alliance founding are reinforced through the life of the partnership. In sensitivity analyses, we added time-varying covariates with partners' combined centrality and positional asymmetry, as well as the number of common partners at joint venture founding. Consistently with our arguments, we found that partners' combined centrality and positional asymmetry in the evolving network structure do not affect the hazard of alliance dissolution.

Further, we conducted a post hoc analysis to examine whether results were robust to models in which the influences of embeddedness could vary with time elapsed since alliance founding (Greve et al., 2010). We advise caution in the interpretation of such an analysis, since it entails the addition of interaction terms that compound multicollinearity.[4] The analysis showed robust results. Moreover, it did not show that the effects of partners' combined centrality and positional asymmetry varied significantly over time. Addition of the interaction between common partners and time since founding, on the other hand, indicated that the influence of common partners on tie dissolution became weaker over time. Nonetheless, although this interaction was statistically significant, the main effect for common partners became more robust in both magnitude and statistical significance ($p < .001$).

Finally, we conducted sensitivity tests with sample selection analysis. If firms decide to form an alliance on the basis of the factors expected to influence dis-

[4] The fact that the analysis uses information on the duration of joint ventures to estimate dissolution hazards increases the concern with potential multicollinearity.

solution, 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. For our 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 hazard of unplanned dissolution. As Appendix B reports, this procedure showed robust results.

## DISCUSSION AND CONCLUSION

This study reveals that the network structure in which firms are embedded, besides affecting which ties the firms create, as prior research has shown, also affects the hazard of unplanned tie dissolution. Perhaps most strikingly, we find that positional embeddedness and structural embeddedness have distinct effects on alliance stability. Positional embeddedness arising from combined network centrality does not stabilize alliances and may even contribute to instability. By contrast, structural embeddedness via having partners in common stabilizes alliances, especially joint ventures between positionally asymmetric firms and between firms with high competitive overlap. Thus, common partners constitute a social mechanism for maintaining order, especially in risky interfirm activities.

### Theoretical Implications and Potential for Future Research

By showing how different aspects of network embeddedness influence joint venture dissolution, this study furthers both network research and the literature on joint ventures.

***Network research.*** Our work highlights and empirically demonstrates several ways in which the effects of network embeddedness on tie dissolution differ from its effects on tie formation. First, prior research has shown that firms tend to form repeated ties. Our study shows that the benefits of relational embeddedness (repeated ties) partly overlap with the informational benefits of positional embeddedness (network centrality) and, as a result, repeated ties between central partners can in some cases result in increased hazard of unplanned dissolution.

Second, this study reveals that the informational benefits of positional embeddedness, although they facilitate tie formation, fail to provide stability during alliance life. Superior information stemming from firms' positions in the alliance network does not help partners manage the tensions that occur during the life of a collaboration.

Third, previous research has also shown that, despite firms' overall preferences to form positionally symmetric relationships, they sometimes have incentives to form ties with partners in asymmetric network positions. This study demonstrates that, despite the presence of instrumental goals motivating such alliances, the reputational imbalance inherent in those ties makes the resulting alliances more vulnerable to unplanned dissolution.

Fourth, the literature on tie formation indicates that the presence of common partners allays firms' concerns about the reliability of potential partners and, as a result, generally has a positive impact on tie formation. Research has also shown that alliance governance mode is an alternative mechanism for mitigating collaboration hazards: firms prefer to structure alliances as joint ventures when they perceive greater collaboration hazards. Our study, however, shows that firms benefit from overlapping these two mechanisms: joint venture partners that have common partners enjoy more stable collaboration than allies lacking common partners.

This study also demonstrates a previously unidentified contingency, showing that the sociological benefits of embeddedness are more valuable when the incentives for competitive or opportunistic behavior are greater. Our findings indicate that social monitoring through common partners has a greater effect as a stabilizing factor precisely in situations in which partners have otherwise strong incentives to behave opportunistically, such as in joint ventures between positionally asymmetric partners and between partners with high competitive overlap.

These findings, summarized in Appendix C, highlight the tension that firms face between alliance formation incentives and collaboration challenges. Sometimes the potential benefits of a partnership go hand in hand with factors that are conducive to collaboration problems. Whereas network embeddedness affects tie formation by indicating which alliances have lower collaboration hazards, it affects tie dissolution by providing stability to alliances that, despite the expected benefits, are more vulnerable to collaboration challenges. Examining how different forms of embeddedness jointly affect alliance stability furthers understanding of embeddedness by questioning the implicit assumption in prior research that different types of embeddedness are additive and reinforce each other. Our study shows that the benefits of relational and positional embeddedness undercut each other and that structural embeddedness can partly substitute for asymmetries in positional embeddedness.

Further, our study, when juxtaposed with prior work, draws attention to the fact that structural embeddedness provides two related but distinct types of benefits and that these benefits map differently onto the outcomes of tie formation and tie dissolution. The first benefit is that of referrals, whereby firms are knowledgeable about their partners and refer them to a focal firm (Burt, 1992; Gulati, 1995b). The second benefit is that of social restraint (Coleman, 1988; Dore, 1983). Alliance formation mainly reflects the referral benefits of having common partners, perhaps combined with some ex ante expectation of social restraint. Alliance dissolution, on the other hand, offers an opportunity for a closer test of the social restraint mechanism. At the time that firms consider the decision to terminate a relationship with a partner, the referral advantage is no longer relevant; the social restraint is, meanwhile, a valid consideration. Forming a tie with its partner's partner does not require the firm to subordinate its immediate economic interests. However, systematically staying in a relationship longer, even in the face of competitive incentives to break the relationship, reflects the suppression of an atomistic, transactional calculus in favor of a longer-term, relational perspective. Thus, tie formation and tie dissolution are not mirror images of each other; rather, they reflect distinct decision processes and offer opportunities to evaluate the efficacy of different embeddedness mechanisms.

Finally, this study draws attention to the dynamics leading to tie instability (Yan & Zeng, 1999) and sheds light on the appropriate time scales for social network research (Granovetter, 1992; Soda, Usai, & Zaheer, 2004). The informational and reputational benefits of network embeddedness are more prevalent at the time of tie formation, by helping firms choose partners who are more likely to engage in responsible collaborative behavior. By contrast, social monitoring benefits accrue even after alliance formation, by providing deterrents to opportunism.

Future research on how changes in network structure over time accentuate or diminish the benefits of network embeddedness can further expand scholars' understanding of network dynamics. An interesting opportunity in this line of inquiry is the investigation of how tie dissolution, in turn, affects subsequent tie formation. Another fruitful opportunity for further inquiry would be to examine the circumstances under which structural embeddedness may lead firms to jointly behave in ways that appear to undermine network stability, in light of the unexpected finding in the study by Greve et al. (2010) showing that firms connected by common partners are more likely to jointly withdraw from liner shipping alliances. The stabilizing effects of structural embeddedness are centered on the premise that firms connected by common partners refrain from behaving opportunistically owing to concern with their other ties. In keeping with that logic, a firm's decision to engage in opportunistic behavior despite the potential for sanctions by common partners may induce those partners to concomitantly discontinue ties with the norm-breaking firm. Hence, what appears as firms' joint withdrawal from alliances may indeed reflect common partners' decisions to inflict penalties on norm-breaking firms.

***Research on joint ventures.*** Prior studies have approached joint venture dissolution from a dyadic perspective and highlighted the effects of partners' prior ties, cultural differences, and competitive rivalry (e.g., Hennart & Zeng, 2002; Kogut, 1991; Park & Russo, 1996). This study, in contrast, approaches joint venture instability from a broader network perspective and shows that the aggregate network of ties among a set of firms affects joint venture dissolution.

Complementing the dyadic perspective with a network approach has important implications for the management of joint ventures. The normative implication of the literature on alliance formation is that managers, if they can, should embed their search for alliance partners in their social context to avoid forming alliances with considerable potential to turn out badly. But, as this study highlights, managers can only partially foresee shifts in industry dynamics that can engender alliance instability. Prior research has suggested that managers can resort to the administrative apparatus of joint ventures, coupled with contractual safeguards, to align partners' incentives and deter opportunism. However, because managers are unable to fully anticipate partners' future behavior, the formality of joint venture governance and the shadow of the future between partners are insufficient mechanisms for stability. By shifting from a dyadic approach to a network approach, this study highlights an additional mechanism through which managers can mitigate joint venture instability: common partners make the shadow of the future more dramatic by casting their own shadow over the relationship between two firms. The deterrence-based trust that common partners promote overshadows the incentives that partners have to pursue self-interest at the expense of joint benefits and, as a result, reduces joint venture instability.

Future research can expand the literature on joint ventures by examining how network embeddedness, besides affecting tie dissolution, also affects other collaboration outcomes, such as resource exchange and

knowledge flow between partners during the course of an alliance. The informational, reputational, and social monitoring benefits associated with network embeddedness may affect not only the patterns of joint venture formation and dissolution, but also the thickness of resource flow through network ties. Social considerations can affect network dynamics by influencing what flows through a given network at different points in time even if the ties in that structure remain relatively stable over time. Whereas this study expands understanding of network dynamics by shifting the focus from tie formation to tie dissolution, one next step is to consider the dynamics in the content of network ties.

### Limitations

Similarly to prior researchers looking at joint venture dissolution, we were unable to control for joint venture characteristics such as size or performance (Barkema et al., 1997; Dussauge et al., 2000; Kogut, 1989; Park & Russo, 1996; Park & Ungson, 1997). Obtaining reliable data on specific joint venture attributes such as size and financial performance is extremely difficult, especially in a longitudinal study. However, our analysis does account for joint venture age, because the Weibull model enabled the baseline hazard function to vary with time elapsed since founding.

To the extent that longitudinal data on specific characteristics of alliances become more easily available, researchers will have the opportunity to expand research on network embeddedness in new ways. Availability of these data would enable the investigation of how embeddedness affects other alliance outcomes, such as innovations that partners jointly create or alliances' financial performance. Additionally, such data would enable further examination of the argument that network embeddedness may prevent partners from discontinuing poorly performing alliances (Kim et al., 2006; Seabright, Levinthal, & Fichman, 1992).

Overall, the study highlights the challenges that even intendedly rational decision makers face in creating and managing successful alliances. Firms have many incentives to form alliances. However, the same social and economic forces that create formation incentives sometimes undermine the subsequent performance of the alliances and lead to their unplanned dissolution. We believe that our study provides a base for further work exploring these tensions.

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## APPENDIX A

**TABLE A1**
**Examples of Reasons for Joint Venture Dissolution**

| Dissolution Type and Joint Venture | Summary of Archival Stories[a] |
|---|---|
| Unplanned | |
| Courtaulds Grafil | 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 JV 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. |
| Radcure Specialites | In 1989 UCB and Rhone Poulenc became partners in a JV 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 JV. |
| Enimont | In 1989 Montedison and Enichem dissolved the JV formed in 1988 because they could not agree on an industrial strategy. |
| Sclavo | In 1990 Enichem bought Du Pont's stake in the JV 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. |
| Planned | |
| BASF-Linde | In 1990 BASF and Linde dissolved the JV formed in 1988 because the technology they developed jointly reached commercialization stage. |

[a] "JV" is joint venture.

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## APPENDIX B

### 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 (JV) dissolution. For each pair of firms, we calculated the propensity of JV formation using a probit specification and created the term to correct for self-selection. This term captured the likelihood of a given dyad in our sample of ties being observed to be at risk of dissolution; its inclusion in the analysis of tie dissolution eliminated the potential specification error. Li and Rowley's (2002) examination of alliance formation by previously connected firms and Bae and Gargiulo's (2004) research on the effects of network participation on organizational profitability used a similar approach.

In the equation estimating the likelihood of JV formation, we included year dummies to account for the effects of temporal unobserved heterogeneity. We used a random-effects probit regression to account for the possibility of random effects across dyads. Further, to ensure that the selection equation included at least one variable with a nonzero coefficient that did not affect the second equation, we did not include firms' combined size (partners' assets in the chemical industry) in the estimation of JV dissolution, since additional analysis showed that this variable had no significant effect on JV dissolution, thus echoing findings of prior examination (Barkema et al., 1997). As Table B1 shows, the results are consistent with prior research. Firms' positions in their network structure and firms' prior direct ties increased the likelihood of JV formation. As do the findings of prior research, the results indicate that firms sometimes ally with positionally asymmetric partners (Gulati & Gargiulo, 1999). Indirect ties between firms in our sample decreased their propensity to create a joint venture. This result corroborates the argument that firms resort to JV as the preferred alliance governance mode when the hazards of collaboration are higher (Gulati & Singh, 1998; Oxley, 1997). The presence of common partners allays partners' concern with opportunism and reduces firms' need to resort to a formal governance structure. The findings reveal that resource overlap and market overlap encourage alliance formation, which is consistent with the argument that similarity reflects partners' interdependence (Pfeffer & Nowak, 1976) and facilitates mutual learning (Cohen & Levinthal, 1990; Lane, Salk, & Lyles, 2001). Firms possessing more resources are more likely to engage in technological collaboration, and they are less likely to do so when they already invest more in R&D. Table B2 shows robust results.

**TABLE B1**
**Random-Effects Probit Estimates of Influences on Joint Venture Formation**

| Variables | *b* | s.e. |
|---|---|---|
| Combined centrality at founding | 1.60*** | (0.24) |
| Positionally asymmetric dyads at founding | 0.05 | (0.06) |
| Common partners in previous year | −0.22*** | (0.07) |
| Direct ties at founding | 0.20* | (0.10) |
| Competitive overlap | −0.26 | (1.43) |
| Technical resource overlap | 0.86** | (0.27) |
| Market overlap | 0.52† | (0.28) |
| Age asymmetry | −0.00 | (0.00) |
| Combined size | 0.00*** | (0.00) |
| Combined chemical R&D | −0.00* | (0.00) |
| Combined chemical patents | 0.00 | (0.00) |
| Performance asymmetry | −0.99 | (1.17) |
| Debt-equity asymmetry | 0.06 | (0.13) |
| Liquidity asymmetry | 0.12 | (0.18) |
| Transregional dummy | −0.07 | (0.08) |
| Constant | −4.07*** | (0.36) |
| Random-effects parameter | 0.12* | (0.06) |
| Log-likelihood | −1,022.03 | |
| Observations | 37,824 | |

† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$
Two-tailed tests.

**TABLE B2**
**Weibull Estimates of Influences on Joint Venture Dissolution[a]**

| Variables | *b* | s.e. |
|---|---|---|
| Combined centrality at founding in dyads with no direct ties at founding | 0.67 | (2.60) |
| Combined centrality at founding in dyads with direct ties at founding | 11.55** | (4.09) |
| Positionally asymmetric dyads at founding | 2.05*** | (0.59) |
| Common partners in previous year | −1.25† | (0.99) |
| Common partners in previous year × positionally asymmetric dyads at founding | −15.27*** | (1.26) |
| Common partners in previous year × competitive overlap | −12.98*** | (0.94) |
| Direct ties at founding | −2.88** | (1.06) |
| Ties formed since founding | −0.05 | (0.08) |
| Competitive overlap | 1.27† | (0.73) |
| Technical resource overlap | −4.34† | (2.24) |
| Market overlap | 0.07 | (2.25) |
| Age asymmetry | −0.01 | (0.01) |
| Combined chemical R&D | 0.003* | (0.001) |
| Combined chemical patents | −0.007 | (0.004) |
| Performance asymmetry | 13.82*** | (4.34) |
| Debt-equity asymmetry | 0.33 | (1.24) |
| Liquidity asymmetry | −2.36† | (1.33) |
| Transregional dummy | 1.21† | (0.75) |
| Correction for propensity of JV formation | −0.49 | (1.03) |
| Constant | −1.83 | (2.08) |
| ln(Weibull shape parameter) | 0.79*** | (0.23) |
| Log pseudo-likelihood | −51.57 | |
| Observations | 692 | |

[a] Robust, heteroskedasticity-adjusted standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$
One-tailed tests for hypotheses.

## APPENDIX C

### TABLE C1
**Summary of Effects of Network Embeddedness on Alliance Formation and Unplanned Dissolution**

| Factor | Effects on Alliance Formation from Prior Research | Effects on Alliance Dissolution in This Study | Effects on Alliance Formation vs. Effects on Alliance Dissolution |
|---|---|---|---|
| Positional embeddedness | Positional embeddedness provides informational and reputational benefits, resulting in ties (a) between central firms and (b) between positionally symmetric (positionally homophilous) firms.<br>However, instrumental goals can also motivate the formation of positionally asymmetric alliances. | Positional embeddedness (at founding) fails to mitigate alliance instability.<br>Further, relational embeddedness moderates the effect of positional embeddedness.<br>Despite the presence of instrumental goals motivating the formation of positionally asymmetric alliances, the reputational imbalance inherent in these alliances increases collaboration hazards. | Positional benefits at founding may not translate into ongoing alliance benefits.<br>The informational benefits of positional embeddedness partly overlap with superior information stemming from relational embeddedness.<br>Combining positional with relational embeddedness can actually decrease alliance stability, possibly due to information redundancy and overembeddedness. |
| Relational embeddedness | Relational embeddedness produces trust and encourages the formation of repeated ties between firms. | Benefits of positional and relational embeddedness are not additive. | Positional embeddedness moderates the effects of relational embeddedness. |
| Structural embeddedness | Structural embeddedness provides referral benefits that mitigate collaboration hazards and encourage the formation of alliances between firms that have partners in common.<br>The governance structure of joint ventures is an alternative mechanism to mitigate collaboration hazards. | Structural embeddedness discourages dissolution by providing social monitoring benefits.<br>Positional asymmetry is destabilizing but structural embeddedness mitigates this effect. | Different mechanisms come into play in formation versus dissolution (referrals versus structural constraint).<br>Structural embeddedness moderates the effects of positional embeddedness. |

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