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Research paper

Triadic embeddedness, sources of relational rents, and interfirm performance

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ABSTRACT

Interorganizational research has largely ignored how dyadic relationships are embedded in a wider network context. Responding to this research gap, we study how triadic embeddedness – cooperating firms structurally and mutually embedded in a network of triads – affects the sources of relational rents and interfirm performance. Using a unique combination of interfirm network- and survey data, we find that triadic embeddedness affects two sources of relational rents – relationship learning and trust-based governance. Learning and trust-based governance, in turn, increase two indicators of interfirm performance – cost reductions and end-product enhancements. The study contributes to a broader understanding of the relational view by showing that triadic embeddedness has direct positive effects on the sources of relational rents and indirect positive effects on interfirm performance.

1. Introduction

Studies on interorganizational relations have traditionally been dominated by a focus on dyadic (and often) buyer-supplier relationships, but researchers suggest that the focus should be extended to examine triadic relationships (Choi & Wu, 2009a; Gao, Xie, & Zhou, 2015; Wu, Choi, & Rungtusanatham, 2010; Wynstra, Spring, & Schoenherr, 2015). Triads enable studying the network embeddedness of dyadic relationships, which is of great importance for understanding competitiveness, performance, and value creation (e.g., Swierczek, 2019). The essence is reflected by Choi and Wu (2009a, p. 265), who state that "[w]e need to study how in a network, a dyad is affected by another dyad" to fully account for the relational characteristics of the two firms in a dyad.

Some empirical studies focusing on triads have emerged. For example, Wu et al. (2010) show that buyers exert influence on supplier-supplier coopetition, and Dubois and Fredriksson (2008) and Wilhelm (2011) show that buyers develop supplier strategies that exceed the dyadic level. Hartmann and Herb (2015), furthermore, show that different dyadic relationships affect each other. However, a review by Wynstra et al. (2015) documents that research on triads in supply contexts is almost exclusively conceptual, based on explorative case studies, or using secondary data. Thus, quantitative empirical studies looking at the relationship between triads and dyadic characteristics are virtually non-existent.

To address how dyadic characteristics are affected by other dyads in the network, we elaborate on Dyer and Singh's (1998, p. 662) view of relational rents. A relational rent, they assert, is "a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners". We study three sources of relational rents: (1) relation-specific investments, (2) knowledge-sharing routines and interfirm learning, and (3) effective governance primarily through self-enforcing, trust-based governance. Taking an interfirm perspective, we first examine if the three sources of relational rents are a function of the triadic, embedded network structure surrounding the partners. We draw on the perspectives of network closure (Coleman, 1988; Galaskiewicz, 2011) and Simmelian ties (Krackhardt, 1998; Simmel, 1950), which imply that both actors in a dyad have a relationship to a common third party. Second, we examine if the sources of relational rents have subsequent effects on interfirm performance in terms of cost reductions and end-product enhancements. In sum, we study if triadic embeddedness directly affects the sources of relational rents and indirectly affects interfirm performance.

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We study our research questions in a coproducing network of tourism firms operating across multiple mountain destinations in Norway. Here, a network of individual firms delivers various products and services through cooperation that the tourists perceive as the total destination product or experience (Murphy, Pritchard, & Smith, 2000). We consider the context ideal as coproduction of tourism services, provided by autonomous yet interdependent actors, requires extensive interfirm cooperation (Gomes-Casseres, 2003). The study relies on a unique combination of interfirm network- and survey data. We first collected network data from tourism firms, and about a year later, we surveyed the same firms and their relationships with one partner. By merging the datasets, we have information about dyadic relationships and the structural embeddedness of these relationships in a larger network context.

The study contributes to the research literature as follows. First, we extend our knowledge of how dyadic characteristics are associated with the dyad's structural embeddedness in extended networks (Gulati, 1998; Wilhelm, 2011). Dyads and networks are usually studied separately, probably due to different theoretical perspectives and a need for different types of data. The combination of dyadic and network data allows us to explore and enhance our understanding of how dyads are structurally embedded in larger networks (Choi & Kim, 2008). Second, the process of relational rent generation is primarily studied at the dyadic level in extant research, assuming that the realized benefits in a dyadic relationship can be traced back to the partners and how they organize the relationship (Choi & Wu, 2009a). Therefore, we address the extent to which a dyad's embeddedness in triads affects the organizing characteristics of the dyad. Third, commenting on Choi and Wu (2009a), Dubois (2009) argues that dyadic ties should be understood as embedded in a wider network. I.e., not only as one dyad embedded in one triad, but as one dyad embedded in a set of triads. Hence, we contribute to the network view of structural embeddedness as we empirically address dyads in a set of triads. We extend the traditional dyadic view and investigate the dyad's triadic network embeddedness and its effect on the sources of relational rents and interfirm performance. Our approach enables a better understanding of how the network structure may facilitate the realization of benefits at the dyadic level. Finally, investigating how dyadic characteristics are affected by sets of triadic links is challenging (Choi & Wu, 2009a; Dubois, 2009), and we provide an example of how we can address these issues in empirical research.

2. Theory

2.1. Triadic embeddedness

"In order to capture the essence of a network", according to Choi and Wu (2009a, p. 263), "two things must be examined, at a minimum: how a node [network member] affects another node and how a link affects another link. The smallest unit of network arrangement where this occurs is a triad". Studying a triad as the smallest and simplest network structure provides knowledge beyond the study of dyads and single actors (Vedel, Holma, & Havila, 2016). The core argument is that a dyadic relationship changes its qualitative character upon introducing a third party as it amends the members' individuality and uniqueness (Simmel, 1950).

Vedel et al. (2016, p. 142) define triads as follows: "When relationships between three directly or indirectly associated actors are connected, the structure constitutes an inter-organizational triad". According to this definition, the three actors do not all have to be directly linked; a triad can consist of a dyad where only one of the actors is linked to the third actor, termed as an open triad, whereas all three actors are directly linked in a closed triad.

Other constructs related to the concept of triads are network closure (Coleman, 1988; Galaskiewicz, 2011) and Simmelian ties (Krackhardt, 1998; Simmel, 1950). Both constructs describe similar processes. Network closure implies that triadic relationships are formed around a dyad, which increases embeddedness (Tortoriello, McEvily, & Krackhardt, 2015). Increasing embeddedness promotes common expectations, trustworthiness, rich information sharing, shared norms, and efficient sanctioning of unwanted behavior curbing opportunism (Coleman, 1988; Galaskiewicz, 2011).

A Simmelian tie implies that both actors in a dyad have a relationship to a third common actor, and that the individual relationships are mutual and strong (Krackhardt, 1998; Simmel, 1950). Hence, it represents a triadic relationship formed around a dyad. It is similar in connotation to the concept of network closure, and embeddedness increases as the number of triadic relationships is formed around a dyad. According to Krackhardt (1999), Simmelian ties have the following three benefits: (1) actors are less prone to pursue individual interests but instead focus on group interests, (2) actors have less bargaining power because if one actor threatens to withdraw from the triad, the actor will be isolated, and (3) conflicts are better managed and resolved in triads because one actor can act as mediator. In line with Coleman (1988), Krackhardt (1999) argues that being a member of a triad fundamentally restricts an actor's behavior in its interaction with the other members. Hence, the relationship in a dyad where the actors have a relationship with a third party will be qualitatively different from the relationship in an isolated dyad (Tortoriello & Krackhardt, 2010). We use the term triadic embeddedness to capture the extent of relationships to third parties shared by two actors in the dyad.

2.2. Triadic embeddedness and the sources of relational rents

The relational view outlines originally four sources of relational rents: complementary resources, relation-specific investments, knowledge-sharing routines (relationship learning), and effective governance (self-enforcing, trust-based governance) Dyer & Singh, (1998), p.662). In proposing a dynamic perspective on the relational view, Dyer, Singh, and Hesterly (2018, p. 3143) argue that "complementary resources as a driver of cooperation typically precedes the other three determinants of value creation at the alliance formation stage". While complementary resources act as an initial source of relational rents at start-up, the other three sources will dynamically co-evolve during the cooperation. As we are studying ongoing interfirm cooperation and are unable to assess resource complementarity at start-up, we develop hypotheses for possible effects of triadic embeddedness on (1) relation-specific investments, (2) knowledge-sharing routines and relationship learning, and (3) self-enforcing, trust-based governance.

2.2.1. Relation-specific investments

Relation-specific investments, often termed as asset specificity, refer to "durable investments that are undertaken in support of particular transactions" (Williamson, 1985, p. 55). Such investments are tailored to a specific relationship and have a lower value if the relationship is terminated. A key challenge is thus to safeguard them against potential opportunistic behavior (Williamson, 1985). Relation-specific investments can be made in production equipment, human capital, logistics and transportation systems, administrative routines, etc. and are undertaken to enhance value creation.

A dyad having relationships with a common third party is likely to prohibit or reduce conflicts and preserve a dyadic relationship as each actor is less powerful, less independent, and more interdependent (Krackhardt, 1998). A common third party is likely to play a mediating role, lowering each actor's bargaining power, promoting effective social sanctioning of unwanted behavior, and thereby curbing opportunistic actions (Coleman, 1988). Taken together, a common third party decreases the likelihood of conflicts and opportunistic behavior, which in turn may facilitate relation-specific investments. Ness and Haugland (2005) find that the presence of a third party can be instrumental in establishing shared investments in joint routines and problem-solving actions.

We furthermore argue that investments in relation-specific assets will increase as an interfirm dyad has relationships with an increasing number of common third parties. The reason is that indirect information sharing increases and consequently alters the direct dyadic interaction. In other words, increasing triadic embeddedness is likely to facilitate investments in relation-specific assets at the dyadic level. In a qualitative study of the better-dress firms in the apparel industry, Uzzi (1997) finds that embedded ties are associated with a concentrated exchange with partners and strong incentives for quality. Furthermore, embedded informants do not perceive small-numbers bargaining as risky; on the contrary, they report embedded ties to promote allocative efficiency and shared investments at the network level. Although Uzzi (1997) did not explicitly study triadic embeddedness, his findings show that embedded ties are a catalyst for avoiding conflicts, reducing risk, and enabling shared investments. In sum, we hypothesize that triadic embeddedness increases relation-specific investments in the dyad.

Hypothesis 1. Triadic embeddedness increases relation-specific investments in the dyad.

2.2.2. Knowledge-sharing routines and relationship learning

Dyer and Singh (1998, p. 665) define knowledge-sharing routines as "institutionalized interfirm processes that are purposefully designed to facilitate knowledge exchanges between alliance partners". The purpose of knowledge-sharing routines is to increase organizational and dyadic level learning through partner-specific absorptive capacity (Dyer & Singh, 1998). Knowledge-sharing routines do not in isolation provide outcomes but act as a carrier of relationship learning. Muthusamy and White (2005) emphasize that relationship learning concerns the partners' ability to comprehend the cooperative process and the amount of knowledge, skills, and competencies transferred between them.

Coproduction requires interfirm coordination and information sharing about related activities (Ramirez, 1999). In such a context, a dyad with a relationship to a common third party might be more likely to agree on their idiosyncratic roles and the coproducing structure than a dyad with no common third party. Wu et al. (2010) find that a buyer can influence supplier-supplier interactions. The buyer acting as the common third party contributes to an increased mutual understanding of the firms' division of cooperative tasks and role development. Similarly, Dubois and Fredriksson (2008) show that Volvo's suppliers, through triadic sourcing, become more interwoven in the supply chain.

An interfirm dyad can, in this way, experience learning through their common third party. A reason is that the third party alters the knowledge-sharing process between two cooperating firms. For instance, if two firms cooperate on a particular issue, it is likely to assume that the third party, implicitly or explicitly, is involved in the process. Knowledge, skills, and competencies will be exchanged directly between the two cooperating firms and indirectly through the third party. The third party may contribute with additional, novel, and complementary perspectives. Wilhelm (2011) finds that Toyota engages in supplier association meetings, supplier consultancy practices, and providing supplier learning groups. She observes that "it is Toyota's unique organizational capabilities that account for the intensity of supplier association activities, support suppliers' abilities to learn about each other through a process-oriented form of supplier development, and provide the authority to set up and manage multilateral learning groups. Toyota's results also demonstrate how deeply the organizational and network level are interwoven" (Wilhelm, 2011, p. 672).

Uzzi (1997) illustrates how embedded ties facilitate rich information sharing and joint problem-solving, and in a study of destination development, Ness, Aarstad, Haugland, and Grønseth (2014) find that more ties between firms and more varied types of ties (public sector, tourism firms, consultants, and service providers) enable learning benefits. Similarly, we argue that an increasing number of common third parties will increase the embedded structure and thereby facilitate relationship learning. Therefore, increasing triadic embeddedness is likely to facilitate relationship learning at the dyadic level.

Hypothesis 2. Triadic embeddedness increases relationship learning in the dyad.

2.2.3. Effective self-enforcing governance and trust

Benevolence-based trust, or goodwill trust, concerns expectations that the partner will not take advantage of the other actor or intentionally damage the other actor's interests (Dyer & Singh, 1998; Mayer, Davis, & Schoorman, 1995; Muthusamy & White, 2005). At the interfirm level, such trust orientation is assumed to be collectively held (in an organization) toward a partner firm (Dyer & Singh, 1998; Zaheer, McEvily, & Perrone, 1998).

Coleman (1988, p. 107–108) argues that network closure is not only important "for the existence of effective norms" but also "creates trustworthiness in a social structure". The claim is empirically supported by Ness and Haugland (2005), finding that forming a triadic relationship with a mutually trusted third actor can greatly enhance dyadic trust. Cooperating with a common third party is associated with cognitive agreement (Krackhardt, 1998, 1999; Krackhardt & Kilduff, 2002), which strongly anchors a dyad in a relationship with shared norms (Krackhardt, 1998; Simmel, 1950). It promotes the trust-building process since third party cooperation reduces the probability of gaining and exploiting information control. Furthermore, it serves as a control mechanism to prevent, alleviate, or solve potential disputes in the dyad. Parallel arguments are related to network embeddedness (Granovetter, 1985; Uzzi, 1997), and Galaskiewicz (2011) similarly asserts that closed structures of supply chains increase trust among actors in a network.

Taken together, we assume that having a relationship with a common third party increases benevolence-based trust in the dyad. Increasing the number of common third parties will induce an increased embedded structure that further increases benevolence-based trust. In sum, increasing triadic embeddedness is likely to facilitate benevolence-based trust at the dyadic level.

Hypothesis 3. Triadic embeddedness increases benevolence-based trust in the dyad.

2.3. Sources of relational rents and interfirm performance

We have so far hypothesized how triadic embeddedness increases the sources of relational rents. In the following, we hypothesize how the sources of relational rents increase interfirm performance. We include two measures of interfirm performance – cost reductions and end-product enhancements. Cost reductions refer to lower production and administrative costs realized through cooperation with the partner (Ghosh & John, 2005). End-product enhancements refer to increased utility of products and services realized through cooperation with the partner (Ghosh & John, 2005).

2.3.1. Relation-specific investments and interfirm performance

Actors making relation-specific investments develop something unique as they expect them to yield a premium value. For example, actors in buyer-supplier relationships invest in tailor-made transportation and logistics systems to increase efficiency and reduce costs, and actors may jointly develop differentiated products by specialized investments in research and development and production technology. Lunnan and Haugland (2008, p. 545), following 100 alliances in engineering industries over 5 years, find that "long-term performance is related to specific investments in human capital combined with the partners' ability to develop and expand alliance activities over time". Comparing different perspectives on performance in interorganizational relationships, Palmatier, Dant, and Grewal (2007) find that commitment-trust and relationship-specific investments are parallel and equally important as drivers of exchange performance. Furthermore, in a meta-review, Palmatier, Dant, Grewal, and Evans (2006) find that sellers' relation-specific investments directly affect their profit. Thus,

relation-specific investments should enable the actors to realize cost reductions and to increase the utility of products and services.

Hypothesis 4. Relation-specific investments will result in (a) cost reductions and (b) end-product enhancements.

2.3.2. Relationship learning and interfirm performance

Research shows the importance of learning and knowledge transfer between business partners as catalysts for firms' competitiveness (e.g., Becerra, Lunnan, & Huemer, 2008; Muthusamy & White, 2005; Selnes & Sallis, 2003). Furthermore, studies confirm that relationship learning has a positive effect on relationship performance (Hernández-Espallardo, Rodríguez-Orejuela, & Sánchez-Pérez, 2010; Selnes & Sallis, 2003), relationship satisfaction (Liu, Ghauri, & Sinkovics, 2010), and product development performance (Yen & Huang, 2013). Wilhelm and Sydow (2018), studying tensions in coopetitive relationships in the automobile industry, describe how learning and joint developmental processes between carmakers and their supplier networks can potentially contribute to both cost reductions and product development. As relationship learning increases, the dyadic partners are better equipped to exchange and integrate information and resources that enable them to achieve efficiency gains in terms of cost reductions and increase the utility of products and services.

Hypothesis 5. Relationship learning will result in (a) cost reductions and (b) end-product enhancements.

2.3.3. Benevolence-based trust and interfirm performance

Trust as a governance mechanism has low costs and reduces transaction costs compared to formal contracts (Dyer & Singh, 1998). The positive association between trust and performance is reported in several studies (e.g., Krishnan, Martin, & Noorderhaven, 2006; Palmatier et al., 2007; Selnes & Sallis, 2003). Similarly, Robson, Katsikeas, and Bello (2008) find that trust is positively associated with performance in international alliances and the effect of trust on performance increases when the size of the alliance declines. In a study of supplier-automaker relationships, Dyer and Chu (2003) find that trust significantly reduces ex-post transaction costs and leads to greater information sharing, which is important for product and process innovations. Wilhelm and Sydow (2018, p. 34) observe that "higher levels of supplier (goodwill) trust makes open book policies more likely", which should further contribute to cost reductions and value creation. Although the effect of trust on performance may vary depending on additional factors such as, for example, alliance size, the overall positive effect of trust on interfirm performance is widely supported in the literature.

Hypothesis 6. Benevolence-based trust will result in (a) cost reductions and (b) end-product enhancements.

Fig. 1 depicts the conceptual model reflecting the hypotheses.

3. Research methods

3.1. Context and data collection

Testing the hypotheses requires that we are (1) able to identify a dyad's triadic embeddedness; this means that we must be able to identify common network ties shared by the two dyadic partners and (2) measure the sources of relational rents and interfirm performance. We collected network data to identify common network ties and applied a survey approach to measure a dyad's sources of relational rents and interfirm performance. We chose service firms located at tourism destinations as our empirical context. Tourism destinations are characterized by coproduction through network structures where actors deliver various products and services such as transportation, accommodation, food, and beverages. (Murphy et al., 2000). Well-functioning tourism destinations require not only dyadic cooperation, but each firm needs to find its position within the broader destination network (Haugland, Ness, Grønseth, & Aarstad, 2011).

We first identified all firms operating at nine mountain destinations in Southern and Eastern Norway based on register data. Next, we deleted firms not operating in the tourism industry, one-person firms (sole proprietorship), and firms that had ceased operating. We then compared the identified firms with the destinations' websites to include non-identified firms, and finally, we contacted well-informed local representatives to review our lists of firms. The final lists of firms at the destination level ranged from 23 (the smallest destination) to 103 (the largest destination), and a total of 568 firms were identified. These firms represent a variety of actors commonly operating at winter sports destinations. Examples are hotels, ski lift operators, restaurants, destination marketing organizations, stores and malls, activity providers, local sports organizations, public actors, and museums.

The collection of the network data started by contacting the general managers of the 568 firms by telephone. From a complete list of tourism firms at their destination, they were asked to identify firms they were currently cooperating with or had previously cooperated with. Next, they were asked to identify cooperation with firms at other destinations. Finally, they were asked to identify cooperation with regional or national organizations outside of the destinations; examples are public sector actors, air- and ferry lines, and niche actors such as consulting firms specializing in the tourism industry and booking platform providers. Thus, the identified actors could be located at the respondents' destinations, at the other destinations, or outside any of the nine destinations. Some firms did not respond to the telephone call despite several recalls, some refused to participate, and others dropped out of the telephone interview due to its length. We received 202 useful responses (35.6%). Since the responding firms reported ties to non-responding firms, 434 of the 568 identified firms are represented in the network data representing 76.4% of the initial sample. The remaining 134 firms that we were unable to model are likely to be isolates, marginal, or inactive actors since other firms have not reported cooperative ties despite receiving complete lists of firms for each destination. As the responding firms also identified relations to firms outside the nine destinations, the total network consists of 550 firms.

We model a tie between firm *i* and *j* if one or both firms reported that they cooperate or have previously cooperated. We include terminated collaborations as they can have long-term effects on network members (Aarstad, Haugland, & Greve, 2010). Considering that we identified 76.4% of the sampled firms, provided complete lists of firms for all destinations, modeled ties to cooperating firms outside our sample frame, and made three attempts to reach the remaining firms, we believe that the identified network bears a close resemblance to the actual

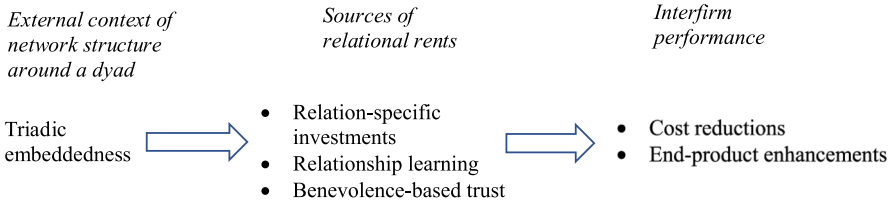

Fig. 1. Conceptual model reflecting the hypotheses.

network. The 550 firms are connected via 2686 interfirm ties.

The survey data were collected about 1 year after collecting the network data. Again, we contacted the same 568 firms by telephone and asked if they were willing to participate in a survey. 325 firms agreed to participate, and we asked for the email address of the manager most knowledgeable of the firm's cooperative relationships with other firms. By using a web-based questionnaire, each responding firm (ego) was asked to choose one firm (alter) they were currently cooperating closely with at their destination and of which they had good knowledge. A network tie was modeled between ego and alter, and the measures used to model the sources of relational rents and interfirm performance refer to ego's responses of its relationship to alter. After reminders, we received 72 usable responses. Finally, we merged the two datasets and identified 48 responses with matching network and survey data. (Appendix 1 provides further details about the data collection procedure and the sampled firms.)

3.2. Measures

3.2.1. Independent and dependent variables

For the 48 dyads, we measured triadic embeddedness as the number of common third-party relationships. I.e., if both ego and alter cooperate with A, they have one common third party cooperation and if both cooperate with A and B, they have two. The variable is modeled by the network data, and the analyses were carried out in Ucinet 6 (Borgatti, Everett, & Freeman, 2002).

Five items in the survey data measured relation-specific investments, which reflect investments dedicated to the dyadic relationship. These are based on Rokkan, Heide, and Wathne (2003), and Reve, Haugland, & Grønhaug, 1995. The fifth item is also based on Rokkan et al. (2003), but we made some adaptations to adapt the item to the context. Relationship learning was measured by six items reflecting the extent to which the firm has learned to exchange skills, knowledge, and technologies with the partner, accessed techniques, competencies, and technologies from the partner, developed new ideas or skills in cooperation with the partner, learned to perform common activities with the partner, and the extent of tacit knowledge transfer between the partners. Four items are based on Muthusamy and White (2005) and two on Becerra et al. (2008). Benevolence-based trust, reflecting the fact that the partners care for each other's interests and are not willing to purposefully harm each other, was measured by four items based on Muthusamy and White (2005). We measured cost reductions as whether the cooperation has resulted in cost reductions and efficient routines and procedures within the firm and cost reductions in the cooperative relationship via implementing efficient systems and methods. The scale consists of three items based on Ghosh and John (2005). The variable end-product enhancements was measured as the extent to which the cooperation has contributed to increased sales, better customer evaluations of products and services, and new products and services. Two items are based on Ghosh and John (2005), and one has been developed for this study.

3.2.2. Control variables

We included structural equivalence, power asymmetry, and relationship duration as control variables when testing H1–H3. Two firms are structurally equivalent if they have interfirm ties with exactly the same other firms (Lorrain & White, 1971). Structurally equivalent firms are likely to compete for similar resources. The reason is that structural equivalence indicates that they are affiliated with, for instance, similar suppliers, customers, and other external stakeholders. Consequently, structural equivalence may reduce collaborating firms' willingness to make relation-specific investments, learn from each other, and trust each other. It is rare that two firms are exactly structurally equivalent. Following Wasserman & Faust, 1994, we measured the concept by correlating each dyad's networking pattern with other firms. The correlation coefficient measures a dyad's structural equivalence (a theoretical measure of 1 shows that two firms are exactly structurally equivalent). The analyses were carried out in Ucinet 6 (Borgatti et al., 2002).

Power asymmetry can lead to an unbalanced relationship where one actor uses its power to gain benefits at the partner's expense. It can cause tension in the dyad and make it more challenging for the partners to commit relation-specific investments, reduce the potential for learning, and make it more difficult to develop trust. We control for power asymmetry by measuring the difference in degree centrality between the dyadic partners. Degree centrality indicates a firm's network activity and can be viewed as a proxy for the firm's power relative to other firms in the network (Freeman, 1979; Ibarra, 1993; Nieminen, 1974). "[P]ower derived from network centrality is grounded in structural dependencies… [and m]uch empirical evidence is available to support the theory that network centrality is a significant source of power in a variety of contexts" (Merlo, Whitwell, & Lukas, 2004, p. 210). We measure degree centrality by counting each firm's number of interfirm ties and model two different indicators of power asymmetry: (1) difference in degree centrality between ego and alter, and (2) absolute value of the difference in degree centrality between ego and alter. The degree centrality variable was skewed, so we log-transformed it before calculating the two indicators.

Finally, we control for relationship duration. Studies indicate that relationship duration is associated with relationship learning (Kotabe, Martin, & Domoto, 2003; Schildt, Keil, & Maula, 2012), and it may take time for partners to develop trust and make relation-specific investments. Relationship duration was measured as the number of years the partners had cooperated.

All items and measures are presented in Table 1. All Cronbach's alpha values for the multi-item scales are above 0.70. Table 2 presents descriptive statistics and correlations.

4. Results

4.1. Testing H1–H3

H1–H3 were first tested by OLS regressions (Table 3). We find that triadic embeddedness has a non-significant effect on relation-specific investments and significant effects on relationship learning and benevolence-based trust. The results reject H1 and support H2 and H3.

Concerning the control variables, relationship duration is positively related to relationship learning. It indicates that relationship learning increases over time. Structural equivalence is negatively related to trust. Structural equivalence reflects similar network positions and may indicate that the partners are competitors, which may hamper the development of trust. The two indicators of power asymmetry are not related to the dependent variables.

We also tested H1–H3 with instrumental variables, and these results confirm support for H2 and H3 and reject of H1 (see Appendix 2 for more information about these tests).

4.2. Testing H4–H6

H4–H6 were also first tested by OLS regressions. Since relationship learning and trust as independent variables correlate strongly (correlation coefficient of 0.745), simultaneously including both is likely to cause multicollinearity problems. We, therefore, include relation-specific investments and relationship learning, and relation-specific investments and trust in separate regression models. We observe in Table 4 that relation-specific investments have non-significant effects, while relationship learning and trust have significant effects on both cost reductions and end-product enhancements. The results imply that H4 is rejected, while H5 and H6 receive empirical support. The findings supporting H5 and H6 are confirmed by testing them with instrumental variables (see Appendix 2).

Table 1
Measures.

Variable	Measures	Cronbach's α
Triadic embeddedness	• Total number of ties to actors in the network shared by both partners in the dyad.	
Relation-specific investments	• We have made extensive internal adjustments in order to deal effectively with this partner. • Training of people to deal with this partner has involved substantial commitments of time and money. • We have made significant investments in equipment and/or machinery dedicated to our relationship with this partner. • Our administrative routines and procedures have been tailored to this partner. • We have adapted our own organization to this partner.	0.872
Relationship learning	• Our firm has learned to jointly execute marketing, product development, and production operations with this partner. • Our firm has learned to exchange skills, know-how, and technologies with the partner. • Our firm has gained new techniques, competencies, or technologies from this partner. • Our firm has developed new ideas or skills because of our cooperation with this partner. • We regularly visit each other's facilities and observe onsite how operations are conducted. • Both we and the partner have learned much from the direct contact between our firms.	0.938
Benevolence-based trust	• While making important decisions, the partner firm is concerned about our company's welfare. • The partner firm would not knowingly do anything to hurt our company. • Our firm's needs are important to the partner firm. • The partner firm looks out for what is important to our firm in the cooperation.	0.909
Cost reductions	• This cooperation has enabled us to reduce our costs. • Our routines and procedures have over time become more efficient due to this cooperation. • In this cooperation, we have been able to realize cost reductions through the implementation of efficient systems and methods.	0.855
End-product enhancements	• This cooperation has positively contributed to boosting our sales. • Cooperation with this firm has contributed positively to customers' perception of our products and services. • This cooperation has contributed to new products and services.	0.742
Structural equivalence	• The correlation of the two dyadic partners' networking pattern.	
Power asymmetry (1)	• Difference in degree centrality between ego and alter.	
Power asymmetry (2)	• Absolute value of the difference in degree centrality between ego and alter.	
Relationship duration	• The number of years the partners had cooperated.	

Table 2
Descriptive statistics and correlations.

Min.	Max.	Average	St. dev.	Skew.	Kurt.		1	2	3	4	5	6	7	8	9
1	6.4	2.74	1.41	0.942	0.336	Relation-specific investments (1)									
1	7	3.53	1.57	0.530	−0.069	Relationship learning (2)	0.643***								
1	7	4.37	1.54	−0.291	−0.383	Trust (3)	0.529***	0.745***							
1	6	3.17	1.49	0.279	−0.937	Cost reductions (4)	0.476***	0.639***	0.583***						
1	7	4.67	1.26	−0.409	−0.202	End-product enhancements (5)	0.395**	0.491***	0.513***	0.529***					
0	23	7.94	5.78	0.902	0.238	Triadic embeddedness (6)	0.139	0.316*	0.336*	0.207	0.132				
−0.024	0.630	0.376	0.140	−0.636	1.18	Structural equivalence (7)	−0.044	0.022	−0.022	0.004	−0.076	0.555***			
−2.13	2.01	−0.033	1.17	0.059	−1.15	Difference in degree centrality (8)	0.070	0.121	0.093	0.091	0.021	−0.171	−0.051		
0.054	2.13	1.02	0.554	0.223	−0.668	Abs. value of diff. in degr. Centr. (9)	−0.073	0.009	0.028	0.070	−0.039	−0.150	−0.349*	0.008	
2	48	13.9	10.8	1.23	1.05	Relationship duration	0.190	0.281†	0.179	0.045	0.171	−0.063	0.027	0.082	−0.157

Means and standard deviations for, relationship learning, trust, cost reductions, end-product enhancement are calculated based on average composites of the constructs. $N = 48$. Conservative two-tailed tests of significance. † $p < .10$, * $p < .05$, ** $p < .01$., *** $p < .001$.

Table 3
Ordinary least square (OLS) regressions.

Model	1	2	3
Dependent variables	Relation-specific investments	Relationship learning	Trust
Independent variable			
Triadic embeddedness	0.282	0.507**	0.557**
	(1.57)	(3.12)	(3.40)
Control variables			
Structural equivalence	−0.230	−0.242	−0.317†
	(−1.23)	(−1.44)	(−1.86)
Power asymmetry – difference in degree centrality	0.092	0.169	0.155
	(0.615)	(1.24)	(1.13)
Power asymmetry – absolute value of difference in degree centrality	−0.081	0.049	0.034
	(−0.509)	(0.342)	(0.233)
Relationship duration	0.194	0.313*	0.215
	(1.30)	(2.32)	(1.58)
R-square	0.098	0.264	0.248
Adj. R-square	−0.009	0.176	0.158
F-ratio	0.917 n.s.	3.01*	2.77*

$N = 48$. Conservative two-tailed tests of significance concerning the hypothesized effects. † $p < .10$, * $p < .05$, ** $p < .01$.
Standardized coefficients with T-values in parentheses.
Variance inflation factor (VIF) concerning triadic embeddedness as independent variable is 1.50 (in all models).

Table 4
Ordinary least square (OLS) regressions.

Model	1	2	3	4
Dependent variables	Cost reductions	End-product enhancements	Cost reductions	End-product enhancements
Independent variables				
Relation-specific investments	0.121	0.135	0.232	0.172
	(0.804)	(0.804)	(1.68)	(1.16)
Relationship learning	0.552***	0.404*		
	(3.67)	(2.40)		
Trust			0.460**	0.422**
			(3.33)	(2.84)
R-square	0.405	0.252	0.379	0.284
Adj. R-square	0.378	0.219	0.352	0.253
F-ratio	15.3***	7.58**	13.7***	8.94***
VIF for both concepts	1.71	1.71	1.39	1.39

$N = 48$. Conservative two-tailed tests of significance concerning the hypothesized effects.
†$p < .10$, * $p < .05$, ** $p < .01$.
Standardized coefficients with T-values in parentheses.

5. Discussion and implications

5.1. Discussion of the results

The results show that two sources of relational rents – interfirm learning and trust-based governance – are a function of triadic embeddedness. The findings confirm Coleman (1988), Krackhardt (1998), and Simmel's (1950) views that a dyad anchored in triads impacts the relationship between the partners. Creating benefits from cooperation is thus not only a question of the partners' ability to cooperate, but the dyad's triadic embeddedness in the wider network also plays an important role. We did not find that triadic embeddedness has a significant effect on relation-specific investments. A plausible explanation is that the sample size is not sufficiently large to generate a significant effect.

We also find that interfirm learning and trust-based governance increase interfirm performance measured as cost reductions and end-product enhancements. The study shows that triadic embeddedness has direct positive effects on the sources of relational rents and indirect positive effects on interfirm performance. We did not find any significant effect of relation-specific investments on cost reductions and end-product enhancements. Again, the sample size may not be sufficiently large to uncover significant results.

We find the strong association between triadic embeddedness and trust-based governance worth noting, as it suggests that trust within a dyad is stronger if the partners share ties to one or more actors in the broader network. It implies that triadic embeddedness restricts partners from pursuing behavior that may negatively affect the other actor (e.g., Coleman, 1988). Our study supports the idea that dyadic actors sharing ties with other actors will downplay individual interests and focus on common interests (Krackhardt, 1999; Simmel, 1950). Moreover, since trust usually develops gradually over time, mutual ties to third parties may make the trust development process less time-consuming. Triadic embeddedness can serve as a facilitator for the implementation of self-enforcing contracts.

We believe the findings can be relevant to other coproducing contexts sharing similarities with tourism destinations (e.g., Gomes-Casseres, 2003; Hannah & Eisenhardt, 2018). Travel-related coproducing contexts include airlines and airports (Chiambaretto & Fernandez, 2016; Forsyth, Niemeier, & Wolf, 2011; Min & Joo, 2016), and ports (Inoue, 2018). Other potential contexts sharing similar co-producing characteristics and the structural linking of dyadic relationships to other dyads in activity-chains in the network can be the biotechnology industry (Lin, Wu, Chang, Wang, & Lee, 2012), the information and communication technology industry (Lee, Park, & Lee, 2018), and the automobile manufacturing industry (Dubois & Fredriksson, 2008; Wilhelm, 2011). If dyads are not properly anchored within a broader coproducing network structure, they may be less efficient in exploiting the sources of relational rents. However, further research should be conducted in other contexts, and generalizations should be made with care.

The combination of dyadic survey data and network data enables an in-depth study of dyadic relationships, and it also gives information about the dyadic partners' relationships with actors in the wider network. This methodological approach gives pathways to extending our knowledge of the interplay of dyadic- and network relationships. We have, in this way, responded to Choi and Wu's (2009a, p. 265) request of studying "how in a network, a dyad is affected by another dyad". Since interfirm dyads and networks have traditionally been studied separately due to the use of different theories and methods, our contribution has extended both approaches by illustrating how different levels of analysis interact in the value creation processes.

5.2. Theoretical implications

The fact that triadic embeddedness is related to relationship learning and trust-based governance provides support for the main purpose of this study; to assess whether triadic embeddedness has direct effects on the sources of relational rents. From a theoretical point of view, exploring and realizing the sources of relational rents in dyadic cooperation is thus not only a question of developing a relationship, but the partners need to be aware of how they individually and mutually are linked to other actors in the network. The study is in line with the emerging body of research arguing that the relationship (or actor bonds) between two dyadic partners is influenced by other relationships in the network (Choi & Wu, 2009a; Dubois, 2009; Swierczek, 2019; Hartmann & Herb, 2015). Choi and Wu (2009a, 2009b) argue for the importance of moving from a dyadic level of analysis to a triadic level to further develop our knowledge of complex and adaptive supply networks. Dubois (2009) further adds that triads are arbitrary subsets of larger networks and that these larger structures should also be considered. This study serves both ends as we address triadic embeddedness and its effect on dyadic-level characteristics. We do not investigate arbitrary triads but the whole set of triads embedding a dyad in the wider network. Thus, the study accounts for both open (tertius gaudens) and closed (tertius

iungen) triadic structures. In sum, we do not replace dyadic views with triadic ones, but we go further and show how they are linked while accounting for the impact of the larger network structure.

In revisiting the relational view, Dyer et al. (2018) offer a dynamic perspective on the drivers of value creation and value capture in strategic alliances. Higher levels of interdependence result in more long-lasting relational rents, while lower levels result in short-lived relational rents. Although Dyer et al. (2018) extend the perspective of how the sources of relational rents contribute to value creation by incorporating a dynamic and coevolving perspective, they still have a dyadic focus and do not consider the broader network in which the dyad is embedded. Our study extends the relational view in a complementary direction by showing that a dyad's network embeddedness affects the sources of relational rents. Dyadic relations do not only evolve as a function of the two actors involved, but they also coevolve as a function of the broader network structure in which they are embedded.

Social capital, described as the value of network relationships (Nahapiet & Ghoshal, 1998), is usually related to individual firms. We have studied a dyad's common relationships with other actors in the network. This can be described as the dyad's social capital or the two dyadic actors' social capital. The joint social capital shared by the two dyadic actors may be distinctly different from each actor's social capital. This study indicates that this common social capital is important for understanding value creation in dyads. Thus, it contributes to a broader understanding of social capital.

5.3. Managerial implications

From a managerial perspective, this study shows that the partners' extended network impacts dyadic relationships. Thus, managers should bear in mind that their extended network behavior may influence their ability to manage one specific relationship, for example, reliance on trust as a governance mechanism. Creating trust within a dyadic relationship is not only a question of working within the relationship; having common relationships with third parties may spur the development of dyadic trust.

Managers can also benefit from knowledge about their extended network in selecting alliance partners. By selecting a partner in the extended network and thereby forming triads, the partners may be better positioned to realize benefits in terms of relationship learning and trust-based governance. Since triadic embeddedness is associated with common goals, shared interests, and cognitive agreement, ties to common third parties may make it easier for the partners to learn from each other. However, extensive triadic embeddedness can also lead to information redundancy (Burt, 1992) and over-embeddedness (Uzzi, 1997), which limits access to new and novel information necessary for innovation and growth. Managers need to be aware of the pros and cons when selecting partners as the selection will alter the structure of the interfirm network.

5.4. Limitations and future research

A limitation of the study is that we have only forty-eight observations with matching network and survey data. However, one must bear in mind that combining the two datasets is a unique, complex, and challenging procedure, making it difficult to obtain large sample sizes. Therefore, we must expect missing observations from both datasets, and similar challenges are noted by Wu et al. (2010). Including non-responding firms' ties in the network data based on information from the responding firms is also a limitation due to different judgments of what they may consider as a relationship. This may lead to biases in the data, but when checking if being a respondent or a non-respondent referred to by a respondent affected the results of H1–H3, the results were not altered (see the first part of Appendix 2).

We rely on data from the context of tourism destinations. A key characteristic of tourism destinations is the need for firms to enter into coproduction to deliver a total destination product (e.g., Murphy et al., 2000). This requires both dyadic cooperation and a need for all firms to find their positions within the larger destination network. We argue that this type of context is particularly suitable for studying the role of triadic embeddedness. Since few reported studies have focused on triadic embeddedness, selecting one homogeneous setting may at this stage be preferred compared to a multi-context study, as our approach reduces unnecessary and uncontrollable noise in the data. However, we should be cautious in generalizing the results to other contexts.

We have analyzed the sources of relational rents as a linear function of triadic embeddedness. Due to potential information redundancy in over-embedded network structures (Burt, 1992; Uzzi, 1997), we cannot rule out that the positive effects at a certain point may dampen and even turn negative. We find in unreported analyses negative marginal effects, which imply that increasing triadic embeddedness increases the sources of relational rents at a decreasing rate. However, the non-linear negative, marginal effects are non-significant, possibly due to low sample size. Future studies should, therefore, address if the non-linear effect is significant in larger samples.

We have studied triadic embeddedness only in terms of the number of common actors the two dyadic partners share. Future research should include other dimensions of triadic embeddedness. Two relevant dimensions are the variety and strength of triadic relationships. Mapping actors as suppliers, buyers, competitors, complementary companies, etc. will give an overview of the variety of triadic partners and illuminate the importance of different types of triadic relationships. Duration of relationship and frequency of contact can serve as indicators of the strength of triadic relationships. It is reasonable to believe that some triadic relationships will be more important and influential than others. Triadic relationships based on different strength levels can give valuable information on how strong versus weak triadic relationships affect a dyadic relationship.

We control for power asymmetry by including two indicators of difference in degree centrality between the two dyadic partners. However, these indicators do not capture the actual use of power strategies since they only reflect the difference in the dyadic actors' network activity. Bastl, Johnson, and Choi (2013) argue that power in supply chains cannot be related only to the relationship between two dyadic actors, as links these actors have to parties outside the dyadic relationship may influence the actors' decisions. Triads can open for coalition behavior where a less powerful actor can form a coalition with a third party in response to being in an unbalanced dyadic relationship. Studying power strategies and coalition behavior within triads can be a fruitful avenue for advancing our knowledge of how dyads and triads are interrelated.

In a similar vein, coopetition – balancing both competitive and cooperative strategies – can further increase our understanding of dyads and networks. Wilhelm and Sydow (2018) study coopetition from a paradox perspective by highlighting the tensions between competition and cooperation and firm responses. Another approach to studying coopetition can be to apply a network or industry cluster approach and explore if some network or cluster characteristics facilitate a healthy balance between competition and cooperation. Similarly, as we find that triadic embeddedness affects the sources of relational rents at the dyadic level, some network characteristics may also influence coopetition at the dyadic level.

5.5. Conclusion

This study, in its novelty, addresses an important and under-researched topic; dyadic embeddedness in triadic relationships. This study extends the relational view by showing how triadic embeddedness directly affects the sources of relational rents and indirectly affects interfirm performance. Triadic embeddedness affects in this way the dyadic partners' ability to realize benefits from their cooperation. The use of two different and separate methods to measure respectively

triadic embeddedness and the sources of relational rents and interfirm performance reduces problems with common method variance. The time asymmetry of 1 year in measurement between independent and dependent variables further strengthens the study's internal validity. We acknowledge that the study has limitations, primarily the external validity of the findings can be questioned due to a low number of observations. We outline suggestions for future studies that can mitigate some of the limitations of this study and encourage researchers to explore further how dyads and networks interact.

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Appendix 1. Further details about the data collection procedure and the sampled firms

To measure a dyad's embeddedness in triads, both the respondent firm and the partner firm in each dyad need to be present in the network data. We first checked if we had network data for the 72 respondent firms (ego) in the survey. 9 of the 72 respondent firms were not included in the network data, and these were excluded reducing the sample to 63 firms. Second, we checked if the partner firms (alter) that had been named as dyadic partners by these 63 respondent firms were included in the network data. We did not have network data for 15 partner firms, and these fifteen survey responses were also excluded. In total, we either lacked respondent (ego) or partner (alter) network data for 24 firms reducing the original 72 survey responses to 48 responses. Thus, we have matching network and survey data for these 48 reporting firms. For two observations, ego reported on alter, and vice versa. We controlled for any effect of this on the results by (1) excluding these two observations and (2) including a dummy variable, but it did not alter any statistical conclusion. Table A1 provides an overview of the data collection.

Of the 48 firms, about 70% (34) have 10 or fewer employees with revenues ranging from 2-3 million NOK and up to 10 million NOK, while the largest firm has 150 employees and a revenue of about 150 million NOK. Table A2 provides an overview of the roles of the firms in the dyads and the primary focus of the relationship. It shows that most relations are between complementary firms, non-competing horizontal firms, and buyer-supplier relations. The cooperative activities taking place in these relationships are buying and selling, joint marketing and product development, and strategy and business development.

Appendix 2. Robustness checks and hypotheses testing with instrumental variables

Robustness checks in unreported analyses

For a firm to be included in the network data, it has been a respondent when gathering the network data, and/or it has been referred to by other responding firms. To check whether being a respondent, or a non-respondent firm being referred to by other respondents, affected the results of testing H1–H3, we included two dummy variables in unreported analyses: (1) ego is a network respondent (coded as 1 and 0 otherwise), and (2) alter is a network respondent (coded as 1 and 0 otherwise). No statistical conclusions concerning H1–H3 were altered when including the dummy variables. We also performed analyses only including observations in which both ego and alter were responding firms in the network data ($N = 21$), and the statistical conclusions remain robust.

Testing H1–H3 with instrumental variables

Despite the time asymmetry between measuring independent and dependent variables, as triadic embeddedness was measured about 1 year before measuring the sources of relational rents, we cannot rule out potential reverse causal orders. Moreover, despite the inclusion of relevant control variables, we cannot rule out potential omitted variable bias in the estimates. To take account of these issues, we carried out two-stage least square estimations with instrumental variables (for detailed explanations, see Cameron & Triverdi, 2010; Wooldridge, 2010). Ego and alter's degree centralities correlate strongly with triadic embeddedness and are relevant candidates as instrumental variables (correlations were 0.480 and 0.535, respectively, $p < .001$, conservative two-tailed tests).

Table A3 reports replicated hypotheses testing with triadic embeddedness as an instrumented independent variable. No statistical conclusion is altered, but H2 and H3 receive stronger and statistically more robust empirical support than by OLS regressions. The results are fairly similar for the control variables, but we note that structural equivalence is negatively related to both relationship learning and benevolence-based trust, and relationship duration is positively related to both relationship learning and benevolence-based trust.

The Durbin (1954) and Wu-Hausman tests of endogeneity (Hausman, 1978; Wu, 1974) show non-significant p-values and reject the assumption of triadic embeddedness as an endogenous variable. That is, if OLS estimations and estimations with instrumental variables diverge (which they do not), the former will give the least unbiased estimates. Sargan (1958) and Basmann's (1960) tests of over-identifying restrictions, returning non-significant p-values, show that the instrumental variables are uncorrelated with the error term and that the models are not misspecified (for details, see Davidson & MacKinnon, 1993; Judge, Griffiths, Hill, Lütkepohl, & Lee, 1991). The partial effect of the instrumental variables on triadic embeddedness (in the three models) gives a significant F-ratio of 105.7 ($p < .001$), which is higher than the critical value of 10 as suggested by Stock, Wright, and Yogo (2002). It implies that the instrumental variables are robust. In sum, we conclude that triadic embeddedness has positive effects on relationship learning and benevolence-based trust.

Testing H5 and H6 with instrumental variables

In addition to a strong correlation between relationship learning and benevolence-based trust, using OLS regressions for testing H4–H6 is problematic due to lack of time asymmetry between the measurement of the independent and dependent variables. Since the independent and dependent variables were measured in the same survey, there is also a potential problem with common method bias.

To counter these challenges, we estimated H5 and H6 in separate two-stage least square regression models by including one instrumented independent variable at a time. (We were unable to identify appropriate instrumental variables for relation-specific investments, and since H4 is rejected by OLS regression, we did not conduct further analyses of H4.) As instrumental variables on relationship learning and benevolence-based trust, we

used respectively triadic embeddedness, structural equivalence, and relationship duration. Our motive for including the instrumental variables is that they are significantly or borderline significantly associated with relationship learning and benevolence-based trust. Table A4 reports the two-stage least square regressions results, and we observe that H5 and H6 receive empirical support.

The Durbin (1954) and Wu-Hausman tests of endogeneity (Hausman, 1978; Wu, 1974) show non-significant *p*-values and reject the assumption of relationship learning and benevolence-based trust as endogenous variables. Sargan (1958) and Basmann's (1960) tests of overidentifying restrictions, returning non-significant *p*-values, show that the instrumental variables are uncorrelated with the error term and that the models are not misspecified. However, the partial effect of the instrumental variables on the independent variables shows that the instruments are weak, that is, below 10 in all models (Stock et al., 2002). Due to the rejection of relationship learning and benevolence-based trust as endogenous variables and weak instruments, Table 2 probably presents less unbiased estimates than Table A4, but both Tables show consistently that H5 and H6 receive empirical support.

Table A1
Overview of the data collection.

Stage 1	Stage 2	Stage 3	Stage 4
Identification of firms	Collection of network data	Collection of dyadic survey data	Matching network and dyadic survey data
• 568 firms were identified at the nine tourism destinations.	• The 568 firms were contacted by telephone and asked to identify firms they were cooperating with or had cooperated with. • Cooperating firms could be located at the respondent's destination, another destination, or outside any destination. • 202 responses were received. • 434 of the 568 firms at the nine destinations were identified, and in addition, 116 other firms were identified. • The total network consists of 550 firms connected with 2686 ties.	• The 568 firms were again contacted about a year later and asked to participate in a survey. • 325 firms agreed to participate and received an electronic questionnaire. • The respondents were asked to describe their relationship to a firm at their destination that they were currently cooperating closely with. • 72 usable responses were received.	• The 72 responding firms in the survey and the partner they had chosen in the survey were checked for being present or missing in the network data. • Network data were missing for nine responding firms and fifteen partner firms. • These 24 firms identified in the survey, but not being present in the network data, were excluded. • 48 responses with complete network and survey data.

Table A2
Description of the 48 coproducing dyads.

Type of cooperation		Buyer-supplier relation-ship	Relationship with competing firm	Similar products, but not directly competitor	Complementary products and services	
		$N = 14$	$N = 3$	$N = 15$	$N = 16$	$N = 48$
Content of cooperation?	Buying/selling products and services from each other	8	2	6	13	$N = 29$
	Strategy and business development	5	1	6	1	$N = 13$
	Marketing and product development	9	2	9	6	$N = 26$
	Ongoing operations	4	2	3	–	$N = 9$

Table A3
Two-stage least square regressions with instrumental variables.

Model	1	2	3
Dependent variables	Relation-specific investments	Relationship learning	Trust
Instrumented independent variable			
Triadic embeddedness	0.279	0.560***	0.652***
	(1.52)	(3.37)	(3.87)
Control variables			
Structural equivalence	−0.228	−0.272†	−0.370*
	(−1.27)	(−1.68)	(−2.25)
Power asymmetry – difference in degree centrality	0.091	0.176	0.168
	(0.652)	(1.39)	(1.31)
Power asymmetry – absolute value of difference in degree centrality	−0.081	0.047	0.030
	(−0.543)	(0.350)	(0.222)
Relationship duration	0.194	0.316*	0.221†
	(1.39)	(2.50)	(1.73)
Wald χ^2	4.73 n.s.	17.4**	17.6**
R-square	0.098	0.262	0.242
Tests of endogeneity			
Durbin χ^2	0.002	0.629	1.96
Durbin (*p*-value)	(0.968)	(0.428)	(0.162)
Wu-Hausman F-ratio	0.001	0.544	1.74

(*continued on next page*)

Table A3 (*continued*)

Model	1	2	3
Dependent variables	Relation-specific investments	Relationship learning	Trust
Wu-Hausman (*p*-value)	(0.970)	(0.465)	(0.194)
Tests of overidentifying restrictions			
Sargan χ^2	0.153	0.0001	0.002
Sargan (*p*-value)	(0.696)	(0.991)	(0.965)
Basman χ^2	0.131	0.0001	0.002
Basman (*p*-value)	(0.718)	(0.992)	(0.968)

$N = 48$. Conservative two-tailed tests of significance concerning the hypothesized effects. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.
Standardized coefficients with *Z*-values in parentheses. Instruments/instrumental variables: Ego's degree centrality and alter's degree centrality.
Test of instrument robustness (in all models): First stage regression partial R-square is 0.838. F-ratio for the instruments is 105.7 ($p < .001$).

Table A4
Two-stage least square regressions with instrumental variables.

Model/hypothesis	1	2	3	4
Dependent variables	Cost reductions	End-product enhancements	Cost reductions	End-product enhancements
Instrumented independent variables				
Relationship learning	0.477*	0.580*		
	(2.02)	(2.22)		
Trust			0.527*	0.588*
			(2.12)	(2.24)
Wald χ^2	4.08*	4.94*	4.49*	5.00*
R-square	0.373	0.233	0.337	0.257
Tests of endogeneity				
Durbin χ^2	0.562	0.154	0.067	0.107
Durbin (*p*-value)	(0.453)	(0.695)	(0.796)	(0.744)
Wu-Hausman F-ratio	0.533	0.145	0.063	0.100
Wu-Hausman (*p*-value)	(0.469)	(0.705)	(0.803)	(0.753)
Tests of overidentifying restrictions				
Sargan χ^2	0.910	0.504	0.225	0.615
Sargan (*p*-value)	(0.634)	(0.777)	(0.894)	(0.744)
Basman χ^2	0.850	0.466	0.207	0.571
Basman (*p*-value)	(0.634)	(0.792)	(902)	(0.752)
Tests of instrument robustness				
First stage regression partial R-square	0.234	0.234	0.224	0.224
F-ratio for the instruments	4.48**	4.48**	4.23*	4.23*

$N = 48$. Conservative two-tailed tests of significance concerning the hypothesized effects.
† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.
Standardized coefficients with Z-values in parentheses. Instruments/instrumental variables:
Triadic embeddedness, structural equivalence, and relationship duration.

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