Impact of Co-Opetition on Firm Competitive Behavior: An Empirical Examination[†]

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The authors examine how co-opetition—simultaneous cooperation and competition—affects firms' competitive behavior, proposing that differential structural positions among firms in a co-opetitive network reflect resource asymmetries among them and that such asymmetries lead to differences in the volume and diversity of competitive actions undertaken by those firms. Data on cooperative network structure and competitive actions from the steel industry suggest that the firm's centrality is positively related to its volume of competitive actions and that its structural autonomy is positively related to the diversity of such actions. Moreover, market diversity moderates the impact of centrality and structural autonomy on competitive behavior.

Keywords: *co-opetition; competitive behavior; network structure*

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Co-opetition, the phenomenon in which firms engage in simultaneous cooperation and competition with each other (Brandenburger & Nalebuff, 1996; Lado, Boyd, & Hanlon, 1997), is intriguing in theoretical as well as practical terms. Examples of co-opetition abound. The New United Motor Manufacturing, Inc. (NUMMI) alliance between GM and Toyota was an early example of co-opetition in the auto industry, involving collaborative auto production at a California site simultaneous with vigorous competition worldwide. Kodak and Fuji, although fighting each other tooth and nail in the photo paper business, were partners in a large R&D joint venture. More than 50% of new cooperative alliances formed are between competitors (Harbison & Pekar, 1998), and "the phenomenon in practice is on the rise" (Ketchen, Snow, & Hoover, 2004: 795). Scholars have argued that "firms can generate economic rents and achieve superior, long-run performance through simultaneous competition and cooperation" (Lado et al., 1997: 11) and that co-opetition is "the most advantageous relationship between competitors" (Bengtsson & Kock, 2000: 411). Although some scholars suggest that collaboration among rivals may inhibit competition by facilitating collusion or by shaping industry structure in anticompetitive ways (e.g., Porter & Fuller, 1986), others suggest that firms derive valuable resources from their collaborative-competitive relationships and strengthen their competitive capabilities (e.g., Gnyawali & Madhavan, 2001). Because of limited empirical research, it is unclear whether, and to what extent, co-opetition influences the competitive aggressiveness of firms. Motivated by this phenomenon of high academic and managerial significance, we take a network view of co-opetition and ask, "How does the firm's position in a cooperative network among competitors influence its competitive behavior?"

Systematic study of co-opetition may follow several (complementary) paths. At its simplest, it may be helpful to investigate how increases in cooperative activity (e.g., number of cooperative ties) affect *levels* of competitive activity (e.g., number of competitive actions) (Young, Smith, & Grimm, 1996). Another option is to focus on how increases in cooperative activity affect *patterns* of competition—for example, are increasing levels of cooperative activity demonstrably associated with patterns of group-versus-group competition? Yet another option is to ask how patterns of cooperative-competitive ties affect competition—for example, are the structural aspects of co-opetitive networks associated with levels and patterns of competition? Each of these alternatives, and their variations, may be pursued at three primary levels of analysis: industry level (e.g., levels and patterns of cooperative and competitive activity across industries), group level (e.g., structure and behavior of competitive groups), and firm level (e.g., levels and patterns of firm cooperative and competitive activity). Although all these options can shed light on the nature of co-opetition and its effects, individual researchers face theoretical and practical trade-offs in choosing one option or the other. In this article, we adopt the third option noted above with a firm-level focus and examine how the firm's position in a co-opetition network influences its competitive behavior. Firms that engage in co-opetition ties find themselves gradually enmeshed in a network of crosscutting ties. Consistent with well-established network arguments (e.g., Nohria, 1992), such firms derive several benefits from their co-opetitive network, such as easier and earlier access to a large volume of network resources, earlier knowledge of important developments in the industry, and ability to control information and resource flows in the network. We argue that firms that have advantageous network positions—that is, those with a large number of connections and are therefore highly central, and those having nonredundant ties and are therefore highly

structurally autonomous—gain several such benefits from their co-opetitive network and become more competitively aggressive. Simply put, differential access to network resources leads to resource asymmetries between the firms and therefore to differences in competitive behavior.

Analyzing data on the coopetitive network structure (i.e., patterns of collaborative linkages among competing firms in the global steel industry) and competitive behavior of the firms, we find that firms that occupy more central positions in the network undertake more competitive actions. Similarly, firms with higher levels of structural autonomy undertake more diverse competitive actions. The results also suggest that firms with high market diversity seem to reap more benefits from their central and structurally autonomous positions in the co-opetitive network. Overall, our research demonstrates the utility of the network perspective in studying co-opetition and generates intriguing possibilities for future research. Three implications are especially noteworthy: First, firms vary in systematic ways in their ability to extract competitive benefits from their co-opetitive networks. Second, firms that achieve superior network positions in a co-opetitive network are better able to develop their competitive capabilities through a network of ties and increase competitive advantage. Third, co-opetitive relationships possess unique structural and competitive characteristics and therefore deserve serious scholarly attention.

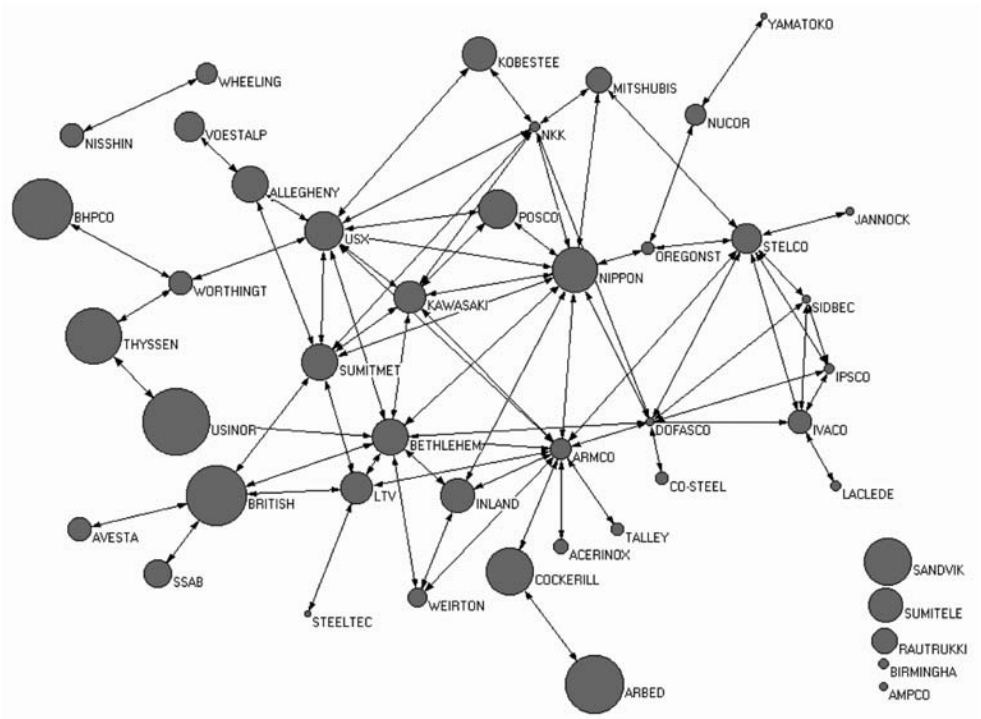
Theory and Hypotheses

When multiple players of an industry collaborate with each other via bilateral and multilateral agreements, a network of co-opetitive relationships begins to emerge (refer to Figure 1 for an example of such a network in the global steel industry). Within the same network, different firms possess differential structural characteristics. In Figure 1, companies such as Nippon, Armco, and USX have several ties and occupy more central positions in the network, whereas Wheeling and Nisshin have only one tie with each other. Thus, Nippon and USX demonstrate very different structural positions from Wheeling and Nisshin. As Porter and Fuller (1986) suggested, when a firm collaborates with competitors, it assumes certain risks and reaps benefits. Because of differences in structural position, firms are likely to experience the benefits and costs of co-opetition differentially. Accordingly, our interest is in how a firm's structural position in a network of collaborative relationships among competitors (such as USX's position in the global steel industry network depicted in Figure 1) affects the firm's likelihood of undertaking many and varied competitive actions.

Uniqueness of Co-Opetitive Networks

The existence of simultaneous cooperative and competitive relations possesses a unique dynamic that is just beginning to be understood (Ketchen et al., 2004). Firms in such co-opetitive networks need to manage the paradox of simultaneous competition and collaboration, walking a fine line between cooperating with partners in good faith and maintaining a posture of vigorous competition with rivals, often including those very same partners (Bengtsson & Kock, 2000; Hamel, 1991; Khanna, Gulati, & Nohria, 1998). Motives behind

Figure 1
Global Steel Industry Network (1995)



Note: Bubbles represent firms, with the size of the bubble indicating firm size (number of employees). Arrows represent strategic alliances.

firms' moves in such networks may simultaneously involve a countering motive (i.e., to reduce the benefits enjoyed by a competitor) or a clustering motive (i.e., to syndicate the unique resources and competencies of each other for common purposes) (Madhavan, Gnyawali, & He, 2004). Competitive actions within a co-opetitive network may take various forms: between partners in nonpartnership areas (e.g., two firms may collaborate on R&D while competing aggressively in product markets) or between nonpartners (e.g., a firm may undertake competitive actions by challenging or attacking those rivals with whom it has no cooperative ties). Thus, firm competitive behavior in a co-opetitive network takes place in a complex and nuanced manner.

Cooperative ties with competitors provide a firm with opportunities to learn about its partners (as well as indirectly about the partners' partners) and afford access to resources residing in the network. Scholars have suggested that firm resources play an important role in determining a firm's competitive actions (Chen, 1996; Smith, Ferrier, & Ndofor, 2001). Extending the notion of resources further, Gnyawali and Madhavan (2001) suggested that network

resources are critical in shaping a firm's competitive behavior. In a typical network, three types of resource flows take place between partners—information flows, asset flows, and status flows—and firms' ability to access and use network resources varies depending on their structural position in the network (Gnyawali & Madhavan, 2001). Thus, the firm's structural position in such networks becomes important. A firm with a superior position in its network (i.e, a firm with high centrality and structural autonomy) is likely to learn about competitive opportunities sooner and use that knowledge in planning and executing competitive actions (e.g., Burt, 1992). Similarly, enhanced status emanating from a superior position might provide the firm with greater freedom to pursue beneficial competitive opportunities while limiting the flexibility of lower status counterparts. Although rivals are expected to be cautious in entering into cooperative ties and sharing resources, thus possibly dampening asset flow, partnerships will mean *some* access to each other's resources, which enables better positioned firms to more swiftly access network-based resources and use them to aggressively pursue competitive opportunities (Gnyawali & Madhavan, 2001). In sum, structurally advantaged firms have more opportunities to learn about the plans and capabilities of other firms of the network, have greater flexibility to take action based on such knowledge, and can draw key assets from the network with less difficulty. Thus, such firms have both opportunity-based advantages (i.e., they know more about the competitors and fruitful competitive opportunities) and resource-based advantages (i.e., they have access to much unique and valuable information as well as other resources), whereas others lack those benefits.

Dependent Constructs: Competitive Activity and Competitive Variety

As an initial attempt to empirically examine co-opetition and its effects on firm competitive behavior, we focus our analysis on firm competitive *actions*. Competitive actions are important because they are the essence of competitive conduct (Caves, 1984; Porter, 1980) and "the principal vehicle by which firms position themselves in the competitive environment" (Smith et al., 2001: 321). We define competitive actions as purposeful and observable moves undertaken by firms in order to improve their competitive position vis-à-vis their competitors in the industry. We focus on two key aspects: competitive activity and competitive variety.

Competitive activity refers to the total number of competitive actions undertaken by a firm (Ferrier, Smith, & Grimm, 1999; Smith, Grimm, Wally, & Young, 1997; Young et al., 1996) and reflects the *scale* of competitive behavior. Research suggests that the more competitive actions a firm undertakes or the more competitively aggressive the firm is, the more likely that it will disrupt the status quo of the industry, increase market share and profitability, and improve its competitive advantage (D'Aveni, 1994; Ferrier et al., 1999; Smith et al., 2001; Young et al., 1996). *Competitive variety* refers to the range or diversity of competitive actions (Ferrier et al., 1999; Nayyar & Bantel, 1994) and reflects the *scope* of competitive behavior. The competitive variety of a firm is high if it undertakes a wide range of actions across many domains such as research and development, marketing, manufacturing, and distribution (Nayyar & Bantel, 1994). Competitive variety is important because firms that undertake a broader scope of competitive actions can affect competitors in multiple ways, thereby making it difficult for competitors to understand the complex set of actions and respond to them

(Jacobson, 1992; Young et al., 1996). Also, firms that implement a variety of competitive actions are often perceived as less predictable and their actions as more difficult to interpret (cf. Padgett & Ansell, 1993), thus reducing the likelihood of competitor response and increasing the first-mover advantage.

Independent Constructs: Network Centrality and Structural Autonomy

We restrict the scope of this research to the *firm-level* structural properties of centrality, an index of a firm's strategic position in the network (Wasserman & Faust, 1994), and structural autonomy, an index of how many "structural holes" are in the firm's network (Burt, 1992), for three reasons. First, as we argue below, both centrality and structural autonomy are theoretically interesting in our context as they in an important way influence a firm's ability to access and acquire network resources as well as to control the potential flow of resources to rivals, thereby creating network-based resource asymmetries among firms. Second, among various firm-level network properties, centrality and structural autonomy are by far the most commonly studied and have sufficient theoretical and empirical support in the literature (e.g., Brass & Burkhardt, 1992; Burt, 1992; Wasserman & Faust, 1994). Finally, firm-level structural properties represent a natural starting point in a program of research into co-opetition networks; we hope that subsequent research will build on this research to examine co-opetition at other levels.

We expand on the above arguments and develop our hypotheses below by relating the network and competitive behavior constructs. In this initial study of co-opetition, we assume factors such as internal resources of a firm (Chen, 1996; Grimm & Smith, 1997) and multimarket relationships among competitors (e.g., Gimeno, 1999) to be constant in developing our hypotheses. By building on this work, future research could examine more complex models by incorporating firm-level, market-level, and network-level factors.

Centrality Enhances Firm Competitive Activity

Centrality in a co-opetitive network refers to the *extent to which a firm occupies a strategic position in the network by virtue of being involved in many significant cooperative ties with its competitors* (cf. Wasserman & Faust, 1994). Because network ties are conduits for resource flows (Galaskiewicz, 1979), a highly central actor benefits from higher volume of information, status, and asset flows. Being at the confluence of a larger number of information sources, a central actor tends to receive a large amount of information (Rogers, 1995) and has easier access to important new developments in the environment (Valente, 1995). A central actor is often a sought-after partner and enjoys greater prestige and power (Brass & Burkhardt, 1992; Powell, Koput, & Smith-Doerr, 1996; Wasserman & Faust, 1994). With respect to assets, a central actor has easier access to a larger volume of external assets—such as technology, money, and management skills—from its network partners. Thus, a central actor has, in general, easier access to a large volume of network resources and opportunities, benefiting thereby from a positive resource asymmetry.

Given these benefits of centrality, the central firm is likely to be more aggressive, that is, will undertake a large number of competitive actions. Being at the "hub" of the co-opetitive network, such a firm will have access to a large amount of information about its competitors' motives, capabilities, and actions. Increased knowledge about competitors and the competitive landscape of the industry will make the central firm more aware of competitive opportunities, thus increasing the likelihood that the firm will be tempted to take advantage of them.

Because of its potential access to a large volume of physical assets from its partners, the central firm may be able to access the kinds of resources needed to turn the competitive opportunities into competitive actions. However, under conditions of co-opetition, it is not easy to acquire resources from partners who are also competitors. That is where status plays a key role. The higher status enjoyed by the central firm (Galaskiewicz, 1979) and its bargaining power over competitors are likely to make it easier to actually acquire network resources (Lin, 1982). Thus, the central firm enjoys positive resource asymmetry created through its increased knowledge of the competitive environment, increased and easier access to a large pool of network resources, and increased ability to acquire network resources. As a result, the central firms will be able to better marshal such resources for competitive purposes. It is important to note that a central firm, because of its large number of contacts, may experience some leakage of competitive information through the direct ties. On the whole, however, we believe that the benefits of centrality will outweigh its costs, for two key reasons: One, unless the highly central firm's partners are able to syndicate their information, each one will only have a narrow slice of it, whereas the former has a comprehensive view. Two, the higher status and access to assets associated with higher centrality will act as a counterweight to any unavoidable information loss. Overall, because a greater amount of resources increases the likelihood of competitive moves (Chen, 1996; Chen, Smith, & Grimm, 1992), the central firms are likely to undertake a greater number of competitive actions.

A corollary to the above arguments is that the resources and prestige advantage of central firms will not only encourage greater competitive activity on their part but also dampen the likelihood of direct competitive responses from less central firms. Given the resource superiority and prestige of the central firm, competitors will expect it to undertake more actions by itself as well as to respond strongly to competitors' actions. Once the central firm has undertaken competitive actions, its high status and resource superiority make it difficult for others to respond to those actions. Even if they respond, the central firm's resource superiority increases its likelihood of further actions. Although it is possible that a central firm, because of its large number of contacts, may be susceptible to leakage of its competitive information, the logic of higher status and superior access to assets serves to weaken such a counterargument. Although increased centrality may lead to increased information loss and increased actions by the competitors, we would expect to see, all else being equal, increased activity on the part of the central firm, as it will respond to the actions of its competitors. Therefore, we hypothesize the following:

Hypothesis 1: In co-opetitive networks, the greater the centrality of a firm in its network, the greater will be its competitive activity.

Structural Autonomy Enhances Firm Competitive Variety

Structural autonomy in a co-opetitive network refers to *the extent to which a firm enjoys structural holes in its network of cooperative relationships with its competitors* (cf. Burt, 1992). For example, if Actor A has ties to both B and C but B and C are not tied directly to each other—that is, B and C can reach each other only through A—a structural hole exists between B and C, which A can exploit. A's advantage is built on three factors. First, A has timely access to information and other resources separately from both B and C, and the resources it receives are less likely to be redundant. Second, A has the opportunity to control B and C by "playing them off against each other" through selective transfer of information and other resources. Finally, A can simply arbitrage resources between B and C—for example, buying from B and selling to C at a premium. Thus, a structurally autonomous firm has several resource advantages: Network-based information and assets accessible to it are more unique, and it gets timely information about important new developments.

The positive resource asymmetry associated with structural autonomy will tend to increase competitive variety in several ways. First, higher access to diverse and nonredundant resources would mean that structurally autonomous firms are more likely to be aware of unique competitive opportunities and to take advantage of their resource superiority to undertake a wider range of activities (Burt, 1992). Each aspect of the diverse information flows alerts the firm of unique competitive opportunities, which can be relatively easily exploited because of superior access to diverse assets in the network. Second, the timing of access to resources and capability matters. The early access to information and resource would endow the firm with the opportunity to be a first mover. Once an opportunity for competitive action is spotted, faster access to diverse assets will make it possible for the firm to quickly use network resources in its favor. As a first mover, it has a broader menu of actions to choose from, whereas late movers are inherently limited in their choices (cf. Lieberman & Montgomery, 1998). Third, because of the control benefits, the structurally autonomous firm can hide information from other network members and has greater flexibility in undertaking necessary actions while constraining other firms' ability to do so. Fourth, the structurally autonomous firm's network will also include a diverse set of competitors, so it can learn about a wide range of competitive approaches from various firms and use its diverse knowledge to undertake many different types of actions. Finally, because innovation and new knowledge arise at the interfaces of existing knowledge domains (Granovetter, 1973; Simon, 1985), it may be argued that networks rich in structural holes will spur innovation. Recent evidence suggests that actors with high structural autonomy are more likely to have good ideas, are more likely to express their ideas, are less likely to have their ideas dismissed, and are more likely to have their ideas evaluated as valuable (Burt, 2004). Consequently, the autonomous firm can experiment with many unique ideas and can undertake actions of wide variety as it has both resource-based advantages and flexibility-based advantages.

Hypothesis 2: In co-opetitive networks, the greater the structural autonomy of a firm in its network, the greater will be its competitive variety.

The above hypotheses dealt with the direct effects of firms' structural position in a co-opetitive network on firm competitive behavior. However, it is very likely that the benefits of an advantageous structural position will not be uniform for all types of firms in the network. With the same level of centrality and structural autonomy, some firms may be better prepared to extract network benefits than others. We propose that the extent of a firm's participation in diverse markets influences the firm's capacity to extract competitive benefits from the network.

The Moderating Role of Market Diversity

Market diversity refers to the breadth of a firm's customers and markets (cf. Miller & Chen, 1994) and is similar to the notion of strategic variety, that is, the "mix of businesses the firm is engaged in" (Prahalad & Bettis, 1986: 494). Firms with high market diversity participate in markets other than their primary ones. In their discussion of dominant logic, Prahalad and Bettis (1986) implied that diversified firms need to understand and manage multiple environments. Furthermore, because "the repertoire of tools that top managers use . . . is determined by their experiences" (Prahalad & Bettis, 1986: 490), operating in multiple businesses forces the high-market-diversity firm to be adept at decoding and responding to a wide variety of environmental signals. Similarly, Miller and Chen (1994) submitted that firms with high market diversity have broader learning opportunities as they are exposed to a large amount of information from multiple environments. Such firms may be more externally oriented and can take advantage of external resources more efficiently (Koka & Prescott, 2003). Accordingly, firms with high market diversity are likely to possess the internal capabilities needed to acquire and use network resources more efficiently and effectively and therefore benefit more from centrality and structural autonomy than do firms with low market diversity.

Research on competitive behavior underscores the importance of firms' information processing capability (Smith & Grimm, 1991; Smith, Grimm, & Gannon, 1992; Smith, Grimm, Gannon, & Chen, 1991). The theory of organizational information processing (e.g., Tushman & Nadler, 1978) suggests that as the volume and complexity of information in the environment increase, the organization needs to have correspondingly high levels of information processing capacity. Because centrality provides greater volume of information from various sources, an increase in centrality would mean the need for a corresponding increase in information processing capacity. As noted above, firms with high market diversity are likely to have better information processing capabilities. In a related manner, Smith et al. (1991) suggested that firms with an external orientation can process a greater volume of rich information. Access to more information (provided by centrality), when coupled with the higher information processing capabilities associated with market diversity, translates into the ability to take advantage of the information and to become competitively more aggressive. Conversely, firms with low market diversity might be unable to handle the volume of information created with increased centrality. Because of potential information overload, they may have trouble interpreting the environment and thus cannot easily plan and execute large numbers of competitive actions. Therefore, firms with low market diversity but highly central would be less likely to undertake large volume of actions.

Similarly, whereas firms with low market diversity are likely to have a resource profile that mirrors the industry (i.e., possess the amount of resources needed to compete within the industry), firms with high market diversity are more likely to have their internal resources thinly spread across multiple products and markets. As a result, firms with low market diversity will be less dependent on external resources available in the network or are less likely to need such network resources. On the other hand, diversified firms need external resources and could take better advantage of such resources. Thus, firms with high market diversity would be more aggressive in the search for and use of external resources. Also, it is important to note that the negative effects of centrality (such as being dependent on partners, leakage of competitive secrets, overembeddedness) (Uzzi, 1997) may hurt a firm with low market diversity more than they do a similar firm with high market diversity. Increased dependency on the partners may limit the "wiggle room" of a firm that is highly central and has less market diversity at the same time. Overall, market diversity provides the opportunity to learn from the network and to take advantage of network resources and therefore enhance firm competitive activity.

Hypothesis 3: In co-opetitive networks, market diversity will moderate the relationship between centrality and competitive activity. Specifically, the positive effect of centrality on competitive activity will be greater for firms with higher market diversity.

Firms need to have the ability to access and process diverse amounts of information and other resources in order to undertake varied competitive actions. Therefore, the above arguments about information processing and resources are also applicable in the context of structural autonomy and firm competitive variety. Furthermore, firms with high structural autonomy are exposed to diverse network partners and the breadth of information and resources such partners provide (Burt, 1992). Typically, actors with structural holes intersect many different social worlds (Burt, 2004), which is further reinforced in the case of firms that compete in several product markets. Therefore, compared with others, firms with high market diversity are more likely to benefit from structural autonomy by acquiring, processing, and using diverse information and resources and in turn undertaking a wide range of competitive activities. Thus,

Hypothesis 4: In co-opetitive networks, market diversity will moderate the relationship between structural autonomy and competitive variety. Specifically, the positive effect of structural autonomy on competitive variety will be greater for firms with higher market diversity.

Method

We tested the above hypotheses using data on the strategic alliance network and competitive behavior in the global steel industry, which is an appropriate context to examine the effects of co-opetitive network structure on firm competitive behavior for both theoretical and practical reasons. The matured industry context of the steel industry (SIC 3312) is especially relevant for the study of co-opetition as Lado and colleagues (1997) suggested that firms in industries at the latter stages of the industry life cycle (such as maturity and decline) are more likely to pursue simultaneous cooperation and competition than those in the earlier stages of the life

cycle. In practical terms, the industry has a relatively well-defined set of players, which makes it possible to define the network boundary and to systematically capture the competitive actions undertaken by the firms. Actions of such established players are more likely to be reported in major publications, which allows us to use published sources for data collection (Chen et al., 1992).

Data Collection

We collected data from three primary sources: the Business and Industry database for competitive actions data, Dow Jones Interactive for interfirm cooperative network data, and Research Insight (Compustat) and Worldscope (for non-U.S. firms) for control variables and other supplemental information. The sample consisted of 45 major steel-producing firms from the United States, Europe, Asia, and Australia, which were reported as engaging in strategic alliance activity up to and including the year 1995. Basing the sample on those firms that have engaged in strategic alliances is consistent with the relationship criterion approach to network boundary specification (Laumann, Marsden, & Pensky, 1983). A review of the sample firms confirmed that these firms reasonably represent the industry as a whole. For example, 30 of the world's top 50 steel producers were in the sample, accounting for about 75% of the top 50 firms' steel production.

To capture all the published/reported competitive actions of the firms, we downloaded all news items reported in the Business and Industry database during the calendar years 1995 and 1996 on the sampled firms. The Business and Industry database includes full-text articles from major business publications (e.g., *The Wall Street Journal*), specific industry publications (e.g., *American Metal Market*), and many overseas sources. Overall, 3,781 news reports (1,320 for year 1995 and 2,461 for 1996) about the sample firms were downloaded and coded using the process described below. Because steel is a rather cyclical industry, it was important to choose the study period carefully. The years 1995 and 1996 were chosen because the early 1990s saw a significant downturn in the world steel industry, with the situation beginning to improve in 1993. For example, according to International Iron & Steel Institute figures, world steel production shrank 0.5% per year during 1990-1995 and grew 2.4% per year in 1995-2000. The choice of years 1995 and 1996 had the advantage that the industry recovery was under way, although there was no evidence yet of an unusually long expansion period—thus ensuring that the data were drawn from a "normal" time period of the industry. Use of more than 1 year of data helps us build confidence in the results.

Coding of competitive actions. To make sure that firm competitive actions were thoroughly captured and appropriately coded, we undertook several steps to develop a theoretically comprehensive and practical coding scheme appropriate to the industry. First, we prepared a comprehensive list of actions relevant for the global steel industry based on the characteristics of the industry. Each action was carefully defined in very specific terms to ensure an appropriate level of "shared understanding" among multiple coders. Second, four experts, consisting of one steel industry manager, two academics thoroughly familiar with the steel industry, and a third academic knowledgeable about competitive action research, reviewed the list and defini-

tions. This step was undertaken to ensure comprehensiveness, clarity, relevance, and discriminant validity (i.e., ensuring that each action is different from others) of the list of actions. The action list and definitions were revised based on the expert feedback. Third, using the revised list and definitions of actions, the authors performed trial coding and further refined the list of actions and their definitions. Finally, one of the authors and three Ph.D. students performed pilot coding of more than 100 news reports of one company. Feedback from this pilot coding was used to further refine and finalize the coding scheme. This pilot coding also served as training to the coders for final coding of the data. The final coding scheme consisted of 49 types of actions. On the basis of the above steps, we prepared a detailed coding manual consisting of a list of competitive actions and their definitions and clearly specified coding decision rules.

Using the coding manual, one of the authors and one Ph.D. student trained in the coding process content-analyzed all the "enhanced titles" of the news reports, which contain summary information of the news (going into the details of the report whenever necessary), published during 1995 and 1996 in the Business and Industry database and coded the relevant news reports into the 49 types of actions. For instance, *The Wall Street Journal* reported on September 19, 1995, the news about Nucor with the enhanced title that "Nucor cuts its prices for hot rolled sheet steel by about 6%." On the basis of our coding scheme, this action was coded as a price decrease. The final coding task was divided in such a way that each company's news reports were coded independently by two individual coders. After both coders finished coding, they discussed their coding choices and attempted to resolve any differences. This process led to an intercoder agreement of 96.38%. The final data set consisted of a total of 1,140 competitive actions (582 for the year 1996 and 558 for 1995) undertaken by the sample firms. Our use of the structured content analysis of news reports to identify competitive actions is consistent with prior research in the area (Chen et al., 1992; Ferrier et al., 1999).

Network data. Data about strategic alliances formed in the global steel industry up to and including 1995 were culled from the Dow Jones Interactive. When reports indicating a strategic alliance in the steel industry were found, the partners' names and alliance details were noted. To reflect the strength of the relationship, each alliance was coded using an adapted form of the scale proposed by Contractor and Lorange (1988: 6). This approach has been used in prior research (e.g., Nohria & Garcia-Pont, 1991). Using this approach, we assigned a score of 9 for a greenfield joint venture, 8 for a joint venture in an existing unit, and so on. The score for each alliance proxies the strength, or "intensity," of the relationship, thereby indicating the potential for resource flow. Where a given pair of partners had more than one alliance, the scores for all alliances were added up. This method of coding appeared to be the most efficient, albeit rather rough, way to capture the overall strength of the relationship between any two firms and potential resource flows between them. This process resulted in a 45×45 adjacency matrix that summarized the pattern of relationships between each pair of firms and was the basis for calculating the network properties.

Operationalization

Competitive behavior measures. A firm-level database was prepared containing the coded competitive actions of all the firms for the years 1995 and 1996. This database was used to operationalize firm-level competitive activity and competitive variety. Consistent with prior research (Ferrier et al., 1999; Young et al., 1996), competitive activity was operationalized as the total number of competitive actions undertaken by a firm during the time period in all 49 types of actions.

$$\text{Competitive activity for firm } i\text{: } CA_i = \sum_{k=1}^{49} N_{ik},$$

where N_{ik} refers to the number of actions of the kth type that firm i undertook in a given year.

To control for the stimulant effect of other firms' competitive activity on a focal firm, we converted each firm's activity count to a z-score value using mean and standard deviation scores for integrated and nonintegrated firms as appropriate (e.g., an integrated focal firm's competitive activity is measured as that firm's number of actions minus the average number of actions for all integrated firms, divided by the standard deviation for integrated firms). Integrated steelmakers are the established players in the industry, and there are significant historical, technological, cultural, and performance differences between them and the nonintegrated mills (e.g., Ahlbrandt, Fruehan, & Giarratani, 1996).

Competitive variety was operationalized as the range of competitive actions undertaken by a firm across the various aspects of the value chain (inbound logistics, production, outbound logistics, marketing, after-sales service, technology, human resources, infrastructure, procurement) plus corporate and other actions. The three authors first independently classified the 49 types of actions into the various aspects of the value chain. Then they discussed and resolved the differences, leading to the final agreement of 100%. Competitive variety was computed as follows (Blau's heterogeneity index), which is similar to prior operationalization of action repertoire simplicity (Ferrier et al., 1999).

$$\text{Competitive variety for firm } i\text{: } CV_i = 1 - \sum_j (N_{i,j} / N_i)^2,$$

where $N_{i,j}$ is the number of actions in the jth aspect of the value chain for firm i; thus, $(N_{i,j} / N_i)$ is the proportion of competitive actions in the jth aspect of the value chain for firm i. As with competitive activity, this measure was also converted to its z-score value relative to technology group (integrated versus nonintegrated), along the lines described above.

Network structure measures. As noted earlier, both centrality and structural autonomy are commonly used constructs to examine *firm-level* structural properties. Following prior literature, we operationalized centrality as the normalized information centrality (Stephenson & Zelen, 1989) score for each firm. This measure of centrality focuses on the resources contained in all network paths originating with a specific actor (thus indicating its appropriateness for our study) and differs from most other measures of centrality in two important respects

(Wasserman & Faust, 1994). First, it takes into account all paths between actors, rather than only geodesics, that is, the shortest paths between two nodes. Flows of information and other resources in networks take place via indirect pathways in stepwise fashion rather than only through directly linked nodes (Stephenson & Zelen, 1989), and firms in a co-opetitive network are especially likely to use all possible paths for gathering competitive intelligence and resources from the network. Second, this measure does not make the simplifying assumption (made in other measures of centrality) that all geodesics are equally likely when estimating the probability that an actor falls on a particular geodesic. Thus, it takes into account the fact that an actor with more ties who is on a given geodesic is also more likely to be on other geodesics than actors with less number of ties. These two factors suggest that information centrality is the most appropriate measure of centrality for our purposes. The computation followed Stephenson and Zelen (1989) and Wasserman and Faust (1994: 194), as implemented in UCINET V network analysis software (Borgatti, Everett, & Freeman, 1999).

We operationalized structural autonomy by reversing the sign of the constraint measure described by Burt (1992: 55), and as implemented in UCINET V. This operationalization represents standard practice among network analysts and is in essence a measure of "the extent to which ego is invested in alters who are invested in other ego's alters" (Borgatti et al., 1999).

Moderator variable of market diversity. Market diversity was operationalized as the inverse of each firm's proportion of sales from the steel industry. The greater the percentage of a firm's sales outside the steel industry, the greater is the firm's market diversity. This measure is in line with Koka and Prescott (2003), who suggested that such a measure of market diversity reflects the firm's extent of diversification into nonsteel markets.

Control variables. We controlled for three substantive factors. First, we used a dummy variable, integrated, to control for whether the firm was an integrated or nonintegrated (i.e., a minimill or specialty) steelmaker because, as noted earlier, integrated and nonintegrated mills are very different from each other. Second, we controlled for total assets (log) as a measure of firm size because firm size is widely accepted as a predictor of competitive behavior (e.g., Miller & Chen, 1996). Third, we controlled for prior period return on assets (ROA) as previous performance is likely to influence competitive behavior (Smith et al., 2001; Young et al., 1996). Finally, because the network variables are based on the same network structure, we controlled for the effects of one network variable while examining the effects of the other network variable. Accordingly, we controlled for structural autonomy effects while testing the centrality effects, and vice versa.

Analytic Techniques

We employed ordinary least squares regression models to investigate the extent to which the data supported our hypotheses. Because the dependent variable data covered 2 years (1995 and 1996), we included a year dummy variable to keep track of any temporal difference. All hypothesis-testing analyses were conducted using hierarchical regression equations, with the year dummy and the other substantive control variables entering in the first step, followed by

the network variable of interest (second step), the moderator (third step), and the interaction term (final step). Prior to the regression analysis, we squared centrality, structural autonomy, and market diversity to improve their adherence to normality assumptions. In line with standard practice in testing for interactions (Aiken & West, 1991), we then centered these variables prior to computing the product terms.

Results

Table 1 shows the summary statistics and correlations, Tables 2 and 3 present the results of the hypothesis tests, and Figure 2 graphically depicts the interaction effects.

Table 1 suggests that intercorrelations between the dependent variables are, in general, not high enough to warrant undue concern about multicollinearity (across all models, the highest variance inflation factor (VIF) was 1.75, whereas the highest VIF for any one variable was 2.63). Tables 2 and 3 present the results of the hierarchical regression analysis. With respect to the standard control variables, only integrated and total assets are consistently and highly significant as predictors of competitive activity. Because activity is a volume measure, it is not surprising that there are differences between the larger integrated firms and the smaller nonintegrated firms. In contrast, none of the control variables are consistently significant as predictors of competitive variety.

With respect to the control effect of each network variable when assessing the main effect of the other, we find significant results. As is to be expected, structural autonomy is significantly related to activity (Model 1); hence controlling for structural autonomy in Model 2 allows us to isolate the effect of centrality. Similarly, centrality is significantly related to variety (Model 5); hence controlling for centrality allows us to isolate the effect of structural autonomy in Model 6.

The results presented in Tables 2 and 3 provide support for Hypotheses 1 through 4. As depicted in Table 2, the regression model testing centrality's effect on competitive activity (Model 2) is significant at the .01 level, and the independent variable of interest, centrality, is significant at the .05 level, with the addition centrality leading to an R^2 change of .053. Thus, Hypothesis 1 is supported. Similarly, as depicted in Table 3, the regression model testing structural autonomy's effect on competitive variety (Model 6) is significant at the .01 level, and the independent variable of interest, structural autonomy, is significant at the .01 level (R^2 change of .11). Thus, the results indicate that structural autonomy has a positive effect on competitive variety, supporting Hypothesis 2. On the basis of these results, we may conclude that in co-opetitive networks, firms occupying central and structurally autonomous positions seem to benefit from the network structure and become competitively more aggressive.

Models 4 and 8 provide support for both moderator Hypotheses 3 and 4, although the support is weak for the former. In Model 4, the interaction term is significant at the .1 level (with an R^2 change of .027), suggesting some support for the hypothesis that market diversity moderates centrality's effect on competitive activity. In Model 8, the interaction term is significant at the .05 level (with an R^2 change of .05), suggesting that market diversity moderates structural autonomy's effect on competitive variety. To understand the exact nature of the moderating effects of market diversity on the relationship between the network variables and competi-

Table 1
Means, Standard Deviations, and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Year (dummy)	0.500	0.503								
2. Integrated (dummy)	0.600	0.493	.000							
3. Total assets	8.097	1.484	.011	.596**						
4. Return on assets	3.928	5.267	.368**	–.169†	–.071					
5. Centrality	0.000	0.182	.417**	.177†	.186†	–.002				
6. Structural autonomy	0.000	0.409	.007	.194†	.323**	–.175	–.168			
7. Market diversity	0.000	0.312	.000	.077	.391**	–.105	–.273*	–.086		
8. Competitive activity	0.000	0.983	.000	.000	.415**	.119	.157	.254*	.076	
9. Competitive variety	0.000	0.981	.000	.000	.050	.080	.204†	.233*	–.272*	.469**

Note: $N = 90$ firm-years. Pairwise correlations are presented.
$^{\dagger}p \leq .10$
$^{*}p \leq .05$
$^{**}p \leq .01$

Table 2
Network Effects on Competitive Activity

	Dependent Variable: Competitive Activity			
Variable	Model 1	Model 2 (Hypothesis 1)	Model 3	Model 4 (Hypothesis 3)
Year (dummy)	–0.099	–0.362	–0.176	–0.134
	–0.49	–1.64	–0.75	–0.58
Integrated (dummy)	–0.777	–0.836	–0.960	–1.073
	–3.20**	–3.54**	–3.89**	–4.28**
Total assets	0.400	0.361	0.487	0.522
	4.90**	4.50**	4.99**	5.32**
Return on assets	0.029	0.040	0.026	0.030
	1.46	2.01*	1.28	1.49
Structural autonomy	0.466	0.655	0.460	0.516
	1.81†	–2.60*	1.74†	1.96†
Centrality		1.51	0.647	0.306
		2.54*	0.95	0.44
Market diversity			–0.930	–0.847
			–2.42*	–2.22*
Market Diversity × Centrality				2.755
				1.82†
Constant	–2.820	–2.381	–3.376	–3.582
	–4.68**	–3.92**	–4.52**	–4.82**
N	84	84	80	80
R^2	.31	.37	.39	.42
R^2 change		.053*	–.021	.027†
$F(d, f)$ change		6.468(1, 77)*	0.27(1, 72)	3.322(1, 71)†

Note: Coefficients and *t* statistics listed.
†$p \leq .1$
*$p \leq .05$
**$p \leq .01$

tive behavior variables, we followed the graphing procedure suggested by Aiken and West (1991). In Figure 2, high market diversity equals one standard deviation above the mean, and low market diversity equals one standard deviation below the mean. The results clearly indicate that firms with high market diversity tend to benefit more from their centrality. Combining this with the regression results in Table 2 (Model 4), we conclude that increased centrality leads to increased competitive activity for firms with high market diversity. Similarly, the graphic analysis in conjunction with Model 8 results suggests that firms with high market diversity tend to benefit more from structural autonomy. Overall, the moderator results show that the benefits of a firm's network structural positions vary depending on the extent of market diversity of the firm.

Table 3
Network Effects on Competitive Variety

Variable	Dependent Variable: Competitive Variety			
	Model 5	Model 6 (Hypothesis 2)	Model 7	Model 8 (Hypothesis 4)
Year (dummy)	–0.412	–0.591	–0.466	–0.51
	–1.47	2.19*	–1.65	–1.84†
Integrated (dummy)	–0.101	–0.12	–0.093	0.036
	–0.35	–0.44	–0.33	0.13
Total assets	0.048	–0.035	0.063	0.019
	0.50	–0.37	0.53	0.16
Return on assets	0.029	0.049	0.037	0.032
	1.23	2.13*	1.57	1.38
Centrality	1.785	2.275	1.634	2.09
	–2.28*	3.02**	1.88†	2.38*
Structural autonomy		0.943	0.733	0.901
		-3.14**	2.36*	2.86**
Market diversity			–0.841	–0.866
			–1.67†	–1.76†
Market Diversity × Structural Autonomy				2.125
				2.02*
Constant	–0.248	0.433	–0.381	–0.114
	–0.34	0.60	–0.41	–0.12
N	76	76	72	72
R^2	.09	.20	.22	.27
R^2 change		.11**	.02	.05*
$F(d, f)$ change		9.868(1, 69)**	0.128(1, 64)	4.071(1, 63)*

Note: Coefficients and *t* statistics are listed.
†$p \leq .1$
*$p \leq .05$
**$p \leq .01$

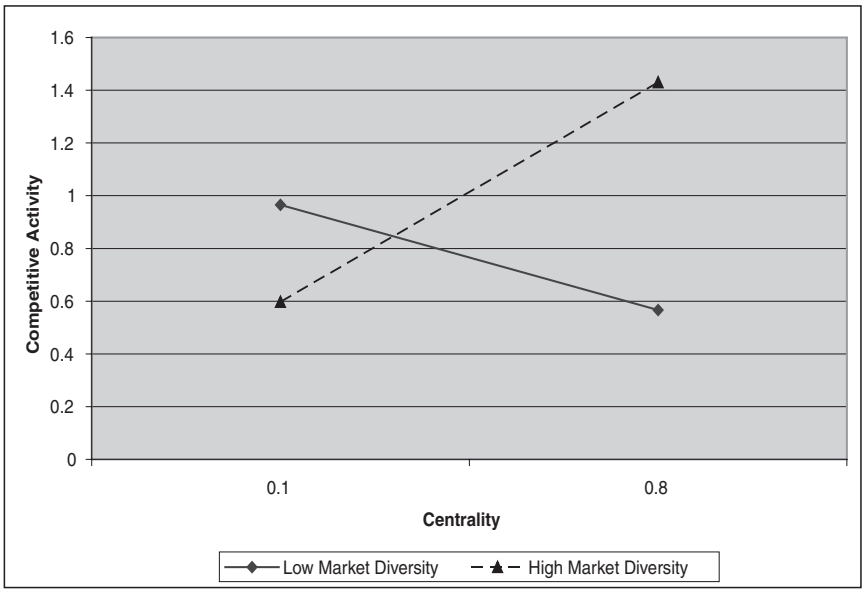
Discussion and Implications

Scholars suggest that co-opetition is an intriguing phenomenon and deserves scholarly attention (Bengtsson & Kock, 2000; Ketchen et al., 2004; Lado et al., 1997), and the managerial trend shows increased tendency to form cooperative ties with competitors (Harbison & Pekar, 1998) and network-based competition among firms (Gomes-Casseres, 1996). Yet, little empirical research has addressed the phenomenon of co-opetition and its implications (Ketchen et al., 2004). By empirically examining how cooperative networks among competitors affect firm competitive behavior, we believe that this study advances our understanding of co-opetition and suggests several possibilities for future research and management practice.

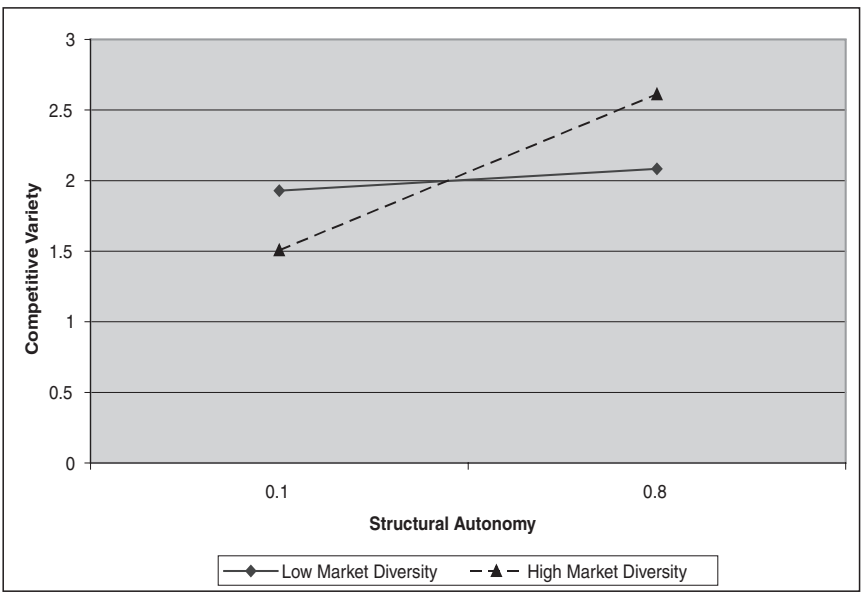
Three points are noteworthy based on our theory and data: First, firms' structural positions in a co-opetitive network have clear implications on their competitive behavior—firms that are highly central and structurally autonomous tend to be more competitively active and versatile. Second, firms seem to vary in systematic ways in their ability to extract competitive benefits

Figure 2
Interaction Effects

A



B



Panel A. Moderating Effect of Market Diversity on Centrality–Competitive Activity Relationship
Panel B. Moderating Effect of Market Diversity on Structural Autonomy–Competitive Variety Relationship

from their network. In particular, the data suggest that firms with higher market diversity benefit more from their structural position in the network. One direct implication is that firms need to invest in internal resources and capabilities to take advantage of the network structure. Third, co-opetitive networks possess unique structural and competitive characteristics and deserve scholarly attention. Although cooperative networks among competitors are only one among various kinds of networks, such a network is expected to have some unique patterns of resource flows, suggesting that differential structural positions in such networks may endow firms with competitive advantage in a distinctive manner. As co-opetitive networks set up a continuous and dynamic tension, firms that can effectively manage such a tension may reap greater network benefits.

Limitations and Directions for Future Research

In interpreting our study, three important limitations have to be kept in mind. First, our focus was on a single industry, which has the benefit of controlling for industry effects but also the downside of limiting the generalizability of results. Second, consistent with current practice in network studies (e.g., Ahuja, 2000), we have not directly measured resource flows among firms, instead employing the structural properties of a firm in its network as indicators of such flows. Finally, our network boundary excluded firms that did not have formalized cooperative relationships with other firms in the industry (or "isolates" in network terms), so the application of the findings should be restricted to firms engaged in cooperative strategies.

Notwithstanding these limitations, our results are an important step toward understanding the fundamental changes in competitive behavior wrought by the increasing prevalence of strategic alliances between competitors. Although the current study is only a beginning, it underscores the notion that such co-opetition influences key elements of competitive behavior in subtle ways that are yet to be fully explored. Although we focused on firm-level issues of co-opetition, future research could examine co-opetition at other levels by building on the conceptual arguments and methods developed in this article. For illustration purposes, we point out one macro or industry level and one micro-level area of co-opetition. At the industry or macro level, it would be interesting to examine whether the overall level of competitive aggressiveness in the industry goes up or down as cooperation among the industry players increases. Examination of this issue will require a multi-industry sample and collection of collaboration and competition data of all players in the sampled industries. At a rather micro or pair level, researchers could examine if firms that collaborate with each other are more or less likely to attack each other through competitive actions. This issue could be examined by specifically collecting data on multiple pairs of firms and evaluating the degree of mutual collaboration and the extent to which they attack (or do not attack) each other. In what ways would two firms collaborating with each other also compete with each other? This issue is germane not only for the manager whose interest may be in a given firm's competitiveness but also for the antitrust regulator who needs to understand how patterns of competition change in subtle ways as cooperative activity increases among competitors. As more and more types of cooperative activity are legitimized, policy makers need to closely monitor the resultant network structures and how they influence subsequent competitive behavior.

Several avenues exist for the future use of the network perspective method in understanding co-opetition. Whereas our study focused on firm-specific structural factors in a network, future research can investigate the effects of pair-level network factors such as structural equivalence (Wasserman & Faust, 1994) and tie-level factors such as direct and indirect ties and strength of ties on competitive actions and responses between firm pairs. An even more sophisticated approach would be to examine multilevel models by studying the simultaneous effects of firm, pair, and network-level variables on competitive actions and responses of firms. As such multilevel investigations become available, they will have important implications for our understanding of co-opetition (e.g., Moldoveanu, Baum, & Rowley, 2003). Future research could also take a more dynamic perspective on the network and competitive behavior and examine the extent to which a firm's current structural position and changes in the position over time lead to changes in bargaining power and competitive benefits the firm can derive from the network. Porter and Fuller (1986) suggested that one major implication of collaboration among competitors is change in bargaining power of firms. It is possible that competitive secrets get leaked through the ties and new competitors are formed over time. Also, a partner may be able to capture a disproportionate share of the value created by the coalition and therefore change the relative bargaining power of each other. Future researchers could use longitudinal data and research designs to investigate such nuanced issues of co-opetition.

Our findings have important managerial implications as well. As managers face the task of nurturing collaborative relationships with the same set of firms they compete with, a key challenge is to manage the simultaneity of trust and distrust (Lewicki, McAllister, & Bies, 1998) in a co-opetitive relationship. Similarly, partner selection issues get complicated in co-opetitive situations. For instance, some competitors may be better partners (such as those with different, complementary assets and expertise) than others (such as those with similar assets and competitive profile), depending on the strategic intent. More broadly, the idea of asymmetry in network resources suggests that firms need to think of network structure as a key strategic lever. The differential effects of network structural positions and the moderating role of market diversity suggest that managers need to think in nuanced ways about how to manage co-opetitive networks. When the firm participates in such networks, each contact is *simultaneously* a source of network resources and a potential competitive interaction. Such attributes of co-opetitive networks set up intriguing managerial dynamics that need to be addressed carefully. Thus, managerial considerations in the design and management of co-opetitive networks need to be fairly nuanced and responsive to the firm's strategic context.

In conclusion, our empirical study shows that firms' structural positions in co-opetitive networks do indeed have a systematic influence on competitive activity and competitive variety. Also, the moderating role of market diversity observed in our data hints at the likelihood that firms vary in their ability to unlock value from structural advantages. In examining the effects of co-opetition on firm competitive behavior, this study integrated two major streams of strategy research: competitive behavior and strategic networks. We hope that this article will stimulate further research on the increasingly important phenomenon of co-opetition and provide new insights for managers and policy makers.

References

Ahlbrandt, R. S., Fruehan, R. J., & Giarratani, F. 1996. *The renaissance of American steel: Lessons for managers in competitive industries*. New York: Oxford University Press.

Ahuja, G. 2000. Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, 45: 425-455.

Aiken, L. S., & West, S. G. 1991. *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Bengtsson, M., & Kock, S. 2000. "Co-opetition" in business networks—To cooperate and compete simultaneously. *Industrial Marketing Management*, 29: 411-426.

Borgatti, S. P., Everett, M. G., & Freeman, L. C. 1999. *Ucinet 5 for Windows: Software for social network analysis*. Natick, MA: Analytic Technologies.

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

Brass, D. J., & Burkhardt, M. E. 1992. Centrality and power in organizations. In N. Nohria & R. Eccles (Eds.), *Networks and organizations: Structure, form and action:* 191-215. Boston: Harvard Business School Press.

Burt, R. S. 1992. *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

Burt, R. S. 2004. Structural holes and good ideas. *American Journal of Sociology*, 110: 349-399.

Caves, R. E. 1984. Economic analysis and the quest for competitive advantage. *The American Economic Review*, 74(2): 127-132.

Chen, M.-J. 1996. Competitor analysis and interfirm rivalry: Toward a theoretical integration. *Academy of Management Review*, 21: 100-134.

Chen, M.-J., Smith, K. G., & Grimm, C. M. 1992. Action characteristics as predictors of competitive responses. *Management Science*, 38: 439-455.

Contractor, F., & Lorange, P. 1988. Why should firms cooperate? The strategy and economics basis for cooperative ventures. In F. Contractor & P. Lorange (Eds.), *Cooperative strategies in international business:* 3-30. Lexington, MA: Lexington Books.

D'Aveni, R. A. 1994. *Hypercompetition: Managing the dynamics of strategic maneuvering*. New York: Free Press.

Ferrier, W. J., Smith, K. G., & Grimm, C. M. 1999. The role of competitive action in market share erosion and industry dethronement: A study of industry leaders and challengers. *Academy of Management Journal*, 42: 372-388.

Galaskiewicz, J. 1979. *Exchange networks and community politics*. Beverly Hills, CA: Sage.

Gimeno, J. 1999. Reciprocal threats in multimarket rivalry: Staking out "spheres of influence" in the U.S. airline industry. *Strategic Management Journal*, 20: 101-128.

Gnyawali, D. R., & Madhavan, R. 2001. Cooperative networks and competitive dynamics: A structural embeddedness perspective. *Academy of Management Review*, 26: 431-445.

Gomes-Casseres, B. 1996. *The alliance revolution*. Cambridge, MA: Harvard University Press.

Granovetter, M. S. 1973. The strength of weak ties. *American Journal of Sociology*, 78: 1360-1380.

Grimm, C. M., & Smith, K. G. 1997. *Strategy as action: Industry rivalry and coordination*. St. Paul, MN: West.

Hamel, G. 1991. Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, 12(Summer Special Issue): 83-103.

Harbison, J. R., & Pekar, P., Jr. 1998. *Smart alliances*. San Francisco: Jossey-Bass.

Jacobson, R. 1992. The "Austrian" school of strategy. *Academy of Management Review*, 17: 782-807.

Ketchen, D. J., Snow, C. C., & Hoover, V. L. 2004. Research on competitive dynamics: Recent accomplishments and future challenges. *Journal of Management*, 30: 779-804.

Khanna, T., Gulati, R., & Nohria, N. 1998. The dynamics of learning alliances: Competition, cooperation, and relative scope. *Strategic Management Journal*, 19: 193-210.

Koka, B. R., & Prescott, J. E. 2003. *Designing alliance networks: The interacting effects of environmental change and firm strategy on firm performance*. Working paper, Arizona State University, Tempe.

Lado, A. A., Boyd, N. G., & Hanlon, S. C. 1997. Competition, cooperation, and the search for economic rents: A syncretic model. *Academy of Management Review*, 22: 110-141.

Laumann, E. O., Marsden, P., & Pensky, D. 1983. The boundary specification problem in network analysis. In R. Burt & M. Minor (Eds.), *Applied network analysis: A methodological introduction:* 18-87. Beverly Hills, CA: Sage.

Lewicki, R. J., McAllister, D. J., & Bies, R. J. 1998. Trust and distrust: New relationships and realities. *Academy of Management Review*, 23: 438-458.

Lieberman, M. B., & Montgomery, D. B. 1998. First-mover (dis)advantages: Retrospective and link with the resource-based view. *Strategic Management Journal*, 19: 1111-1125.

Lin, N. 1982. Social resources and instrumental action. In P. Marsden & N. Lin (Eds.), *Social structure and network analysis:* 131-145. Beverly Hills, CA: Sage.

Madhavan, R., Gnyawali, D. R., & He, J. 2004. Two's a company, three's is a crowd? Triads in cooperative-competitive networks. *Academy of Management Journal*, 47: 918-927.

Miller, D., & Chen, M.-J. 1994. Sources and consequences of competitive inertia: A study of the U.S. airline industry. *Administrative Science Quarterly*, 39(1): 1-23.

Miller, D., & Chen, M.-J. 1996. The simplicity of competitive repertoires: An empirical analysis. *Strategic Management Journal*, 17: 419-439.

Moldoveanu, M. C., Baum, J. A., & Rowley, T. 2003. Information regimes, information strategies and the evolution of interfirm network topologies. In F. Yammarino & F. Dansereau (Eds.), *Research in multi-level issues*, vol. 2: 221-264. Amsterdam: JAI.

Nayyar, P. R., & Bantel, K. A. 1994. Competitive agility: A source of competitive advantage based on speed and variety. *Advances in Strategic Management*, 19: 193-222.

Nohria, N. 1992. Is a network perspective a useful way of studying organizations? In N. Nohria & R. G. Eccles (Eds.), *Networks and organizations: Structure, form, and action:* 1-22. Boston: Harvard Business School Press.

Nohria, N., & Garcia-Pont, C. 1991. Global strategic linkages and industry structure. *Strategic Management Journal*, 12(Summer Special Issue): 105-124.

Padgett, J. F., & Ansell, C. K. 1993. Robust action and the rise of the Medici, 1400-1434. *American Journal of Sociology*, 98: 1259-1319.

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

Porter, M. E., & Fuller, M. B. 1986. Coalitions and global strategy. In M. E. Porter (Ed.), *Competition in global industries*, chap. 10: 315-343. Boston: Harvard Business School Press.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. 1996. Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, 41(1): 116-145.

Prahalad, C. K., & Bettis, R. A. 1986. The dominant logic: A new linkage between diversity and performance. *Strategic Management Journal*, 7: 485-501.

Rogers, E. M. 1995. *Diffusion of innovations*. New York: Free Press.

Simon, H. A. 1985. What we know about the creative process. In R. L. Kuhn (Ed.), *Frontiers in creative and innovative management*, vol. 4: 3-20. Cambridge, MA: Ballinger.

Smith, K. G., Ferrier, W. J., & Ndofor, H. 2001. Competitive dynamics research: Critique and future directions. In J. S. Harrison (Ed.), *The Blackwell handbook of strategic management:* 315-361. Malden, MA: Blackwell.

Smith, K. G., & Grimm, C. M. 1991. A communication-information model of competitive response timing. *Journal of Management*, 17(1): 5-23.

Smith, K. G., Grimm, C. M., & Gannon, M. J. 1992. *Dynamics of competitive strategy.* Newbury Park, CA: Sage.

Smith, K. G., Grimm, C. M., Gannon, M. J., & Chen, M.-J. 1991. Organizational information processing, competitive responses, and performance in the U.S. domestic airline industry. *Academy of Management Journal*, 34: 60-85.

Smith, K. G., Grimm, C. M., Wally, S., & Young, G. 1997. Strategic groups and rivalrous firm behavior: Towards a reconciliation. *Strategic Management Journal*, 18(2): 149-157.

Stephenson, K., & Zelen, M. 1989. Rethinking centrality: Methods and applications. *Social Networks*, 11: 1-37.

Tushman, M. L., & Nadler, D. A. 1978. Information processing as an integrating concept in organizational design. *Academy of Management Review*, 3: 613-624.

Uzzi, B. 1997. Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42(1): 35-67.

Valente, T. W. 1995. *Network models of the diffusion of innovations.* Cresskill, NJ: Hampton.

Wasserman, S., & Faust, K. 1994. *Social network analysis: Methods and applications*. Cambridge, MA: Cambridge University Press.

Young, G., Smith, K. G., & Grimm, C. M. 1996. "Austrian" and industrial organization perspectives on firm-level competitive activity and performance. *Organization Science*, 7: 243-254.

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