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Does It Pay to Compete Aggressively? Contingent Roles of Internal and External Resources

Goce Andrevski
Queen's University
Walter J. Ferrier
University of Kentucky

We examine, in hypercompetitive environments, why some firms fail to benefit from competitive aggressiveness while others experience superior profits. We explore the relationship between competitive aggressiveness and performance in a sample of 141 firms from three hypercompetitive industries—personal computers, computer-aided software engineering, and semiconductors—from 1995 to 2006. Contrary to the predominant view within competitive dynamics research, we find that competitive aggressiveness is not a universally effective strategy. For some firms, excessive competitive aggressiveness can escalate costs and diminish performance. Using polynomial regression analysis and response surface methodology, we identify the conditions under which competitive aggressiveness enhances firm performance. Our findings reveal that firms benefit from competitive aggressiveness when they have specialized technological resources and support from a dense network of alliance partners.

Keywords: *alliance networks; competitive actions; competitive aggressiveness; competitive dynamics; hypercompetition*

Competitive aggressiveness is a strategic competitive behavior that reflects a firm's propensity to challenge rivals by rapidly carrying out numerous competitive actions, such as new products, marketing campaigns, market entries, and price cuts (M. J. Chen, Lin, & Michel, 2010; M. J. Chen & Miller, 2012). Incorporating time and speed as essential attributes,

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Corresponding author: Goce Andrevski, Smith School of Business, Queen's University, 143 Union Street, Kingston, ON K7L 3N6, Canada.

E-mail: andrevs@queensu.ca

competitive aggressiveness is a central construct in competitive dynamics research for explaining differences in firm performance in hypercompetitive environments (M. J. Chen et al., 2010; Nadkarni, Chen, & Chen, 2016; Young, Smith, & Grimm, 1996). Aggressive firms are able to more frequently recognize and exploit opportunities for carrying out competitive actions, thereby creating a series of temporary competitive advantages that yield superior profits (D'Aveni, Dagnino, & Smith, 2010; Young et al., 1996). Empirical research shows that competitive aggressiveness is most advantageous in dynamic competitive environments, such as newly developed markets (Katila, Chen, & Piezunka, 2012), and hypercompetitive (M. J. Chen et al., 2010), high-velocity (Nadkarni et al., 2016), and high-growth industries (Andrevski, Richard, Shaw, & Ferrier, 2014).

Despite the commonly held view that aggressiveness begets superior performance, empirical findings and the reasons for them are equivocal and confusing. Some studies find a positive relationship between competitive aggressiveness and firm performance (e.g., Andrevski et al., 2014; M. J. Chen et al., 2010; Derfus, Maggitti, Grimm, & Smith, 2008; Ferrier, 2001; Katila et al., 2012; Nadkarni et al., 2016; Young et al., 1996), whereas others report a negative relationship (e.g., E. L. Chen, Katila, McDonald, & Eisenhardt, 2010). Still others fail to find a statistically significant relationship at all (e.g., M. J. Chen & Hambrick, 1995; Gnyawali, He, & Madhavan, 2006; Hambrick, Cho, & Chen, 1996). These inconsistent empirical findings suggest that not all firms benefit from competitive aggressiveness. For example, research suggests that market leaders possess superior resources that allow them to benefit more from competitive aggressiveness (Derfus et al., 2008) and that the benefits vary between small firms with limited resources and large, resource-rich firms (Katila et al., 2012). Yet, beyond firm size, we know little about why the effects of competitive aggressiveness vary across firms. While research shows that internal and external resources can enable firms to compete aggressively (e.g., Gnyawali et al., 2006; Ndofor, Sirmon, & He, 2011), we still lack knowledge on why some aggressive firms incur losses while others gain superior profits.

We argue that for some firms, competitive aggressiveness is a suboptimal strategy because they lack the capability to cope with the acceleration-cost tradeoff. Specifically, as firms strive to carry out a series of new competitive actions, the time required for their development and execution accelerates, which in turn generates time compression diseconomies (Pacheco-de-Almeida, 2010). Owing to the shortened time between successive actions, costs escalate sharply. These rising costs are associated with, for example, diminished returns on invested resources, increased coordination costs, limited learning potential, and frequent mistakes and errors (Dierickx & Cool, 1989; Pacheco-de-Almeida & Zemsky, 2007; Scherer, 1967). Thus, as competitive aggressiveness accelerates, costs for developing new actions increase rapidly, diminishing firm profitability.

Given the acceleration-cost tradeoff, a key question for competitive dynamics research is, how can aggressive firms earn superior profits despite escalating costs? We propose a resource-based explanation (Barney & Arikan, 2001; Lavie, 2006) as to why some aggressive firms can overcome the acceleration-cost tradeoff and gain superior profits while others incur losses. The resource-based view (RBV) suggests that knowledge-based resources can enable firms to outperform rivals in dynamic environments (Miller & Shamsie, 1996). In particular, technological resources—"the firm's repository of technological knowledge and competences"—are critical for developing and executing competitive actions (Ndofor et al., 2011: 644). We argue that the depth of a firm's technological resources can enable it to carry out a rapid succession of competitive actions while preventing escalating costs. In addition, RBV suggests that firms' access to external resources embedded in their alliance networks can enable them to gain competitive advantages (Lavie, 2006, 2007) by affecting their abilities to develop and undertake competitive actions (Gnyawali & Madhavan, 2001). Specifically, a network of densely connected alliance partners can provide opportunities for efficient learning from alliance partners, as well as for the mobilization of unique resources (Dyer & Nobeoka, 2000). Thus, we argue that alliance network density and technological resource depth can allow firms to cope with the acceleration-cost tradeoff by simultaneously reducing the costs and increasing the benefits of competitive aggressiveness. Applying quadratic polynomial regression analysis with response surface methodology (Edwards, 2007; Edwards & Parry, 1993), we examine the contingent effect of technological resource depth and alliance network density on the relationship between competitive aggressiveness and profitability on a sample of 141 firms from the personal computer, computer-aided software engineering, and semiconductor industries from 1995 to 2006.

We make two primary contributions to competitive dynamics research. First, we show that not all firms can benefit from competitive aggressiveness. For some firms, excessive competitive aggressiveness can escalate costs and hurt performance. While previous research focused solely on benefits, we examine costs and benefits simultaneously and find that highly aggressive, competitive behavior exhibits an inverted U-shaped effect on firm performance. Second, our study shows how aggressive firms can overcome the acceleration-cost tradeoff. Here, we find that competitive aggressiveness is advantageous for firms that possess specialized technological resources and are embedded in a dense network of alliance partners. Overall, our study suggests that firms need to develop resource advantages prior to the decision to pursue a competitively aggressive strategy. Adopting competitive aggressiveness without a strong internal or external resource base diminishes firm performance. Thus, competitive aggressiveness is an advantageous strategy but only for those firms with superior resources and capabilities.

Theoretical Background

Inspired by the key tenets of the Austrian school of economics (e.g., Hayek, 1937; Kirzner, 1973; Mises, 1949), competitive dynamics research conceptualizes product-market rivalry as a dynamic and competitive process (Smith, Ferrier, & Ndofor, 2001). Firms gain market share and superior profits by continuously discovering new profit opportunities, and they carry out competitive actions to exploit those opportunities more frequently than their rivals are able to (Grimm & Smith, 1997). Early competitive dynamics research focused on the drivers and outcomes of individual competitive actions and responses (e.g., M. J. Chen & MacMillan, 1992; Smith, Grimm, Chen, & Gannon, 1989). Subsequent research focused on competitive action repertoires—defined as the firm's entire set of competitive actions carried out in a given period—to explore how repertoire attributes such as simplicity, complexity, nonconformity, and volume ultimately influence firm performance (e.g., Ferrier, Smith, & Grimm, 1999; Miller & Chen, 1994, 1996). Competitive aggressiveness—the number of competitive actions, and the frequency with which a firm carries out these actions—has long been a principal focus of competitive dynamics research for three reasons. First, competitive aggressiveness most closely captures the idea of strategy as a series of temporary advantages (D'Aveni, 1994; Young et al., 1996). Firms create temporary competitive advantages through competitive actions, so the frequency of actions initiated by a firm reflects its propensity to create a string of small transient advantages that cumulatively lead to superior profits (D'Aveni et al., 2010). Second, competitive aggressiveness captures the essence of the firm's competitive strategy in a dynamic market process. The Austrian school of thought explains that the firm's ability to develop and execute numerous competitive actions is "the surest path, in most industries, to competitive advantage" (Jacobson, 1992: 798). Third, competitive aggressiveness accentuates time and speed as key characteristics of a firm's strategic behavior, which are critical for successfully competing in hypercompetitive environments (Nadkarni et al., 2016). Compared with passive firms, aggressive firms are able to develop and execute competitive actions faster than their rivals.

However, competitive aggressiveness is not universally beneficial. Instead, it is primarily beneficial in highly dynamic environments characterized by intense competition, frequent changes, high industry growth, and high industry concentration (Andrevski et al., 2014; M.-J. Chen et al., 2010; Derfus et al., 2008; Katila et al., 2012; Nadkarni et al., 2016). Even for competition within the same market or industry environment, high levels of competitive aggressiveness do not uniformly benefit all firms. Derfus et al. (2008: 67) found that the positive effect of competitive aggressiveness on firm performance is stronger for firms with higher market share because "market leaders have the resources to engage in more effective search and action, which facilitates greater learning." In addition, other research finds that small, resource-poor and large, resource-rich firms can benefit from competitive aggressiveness, but it depends on whether they compete in new or established markets (Katila et al., 2012).

However, beyond firm size, we know little about why firms vary in their ability to profit from excessive competitive aggressiveness. Previous research suggests that firms with superior internal and external resources can compete more aggressively (e.g., Gnyawali et al., 2006; Ndofor et al., 2011). We extend this research by showing why some aggressive firms incur losses and fail to make profits while others gain superior profits as a function of their superior internal or external resources. We first discuss the drivers of the benefits and costs of competitive aggressiveness and explain how they jointly explain the effects on profitability. We then explore the contingent role of internal and external resources in explaining the relationship between competitive aggressiveness and firm profitability.

Theory and Hypotheses

Benefits of Competitive Aggressiveness

Competitive aggressiveness confers three principal benefits. First, it continuously generates superior value for customers through the rapid execution of new actions, such as new versions of products, sales incentives, innovative advertising campaigns, and new market entries. Although each competitive action can indeed increase consumer value, it provides only short-term competitive advantages for the firm. Rivals can quickly neutralize the effect of each action, regardless of its type and degree of innovativeness (D'Aveni, 1994; Lee, Smith, Grimm, & Schomburg, 2000). It takes an aggressive series of competitive actions to outcompete rivals. By the time that rivals respond and neutralize the effect of one competitive action, an aggressive firm quickly launches a new action and thus stays ahead of its rivals. By continuously offering superior value, competitive aggressiveness also accelerates the obsolescence of existing products and technologies. Innovative features in newer product versions attract both new and previous customers who find their older versions incompatible with the new offerings (Waldman, 1993). As a result, competitive aggressiveness increases market share and generates superior profits (Ferrier, 2001; Jacobson, 1988; Young et al., 1996).

Second, competitive aggressiveness delays rivals' reactions. When firms carry out an aggressive series of actions, rivals have ever-decreasing time to evaluate, develop, and execute an effective competitive response. A simultaneous and sequential thrust—characterized as an aggressive series of competitive actions—can stun and confuse rivals into a state of inaction and nonresponse (D'Aveni, 1994; Ferrier et al., 1999). Each additional action in the sequence disrupts the status quo in the market, generates discourse in the market, and delays counteractions (Smith & Cao, 2007). Rivals need time to make sense of the implications of each action on their performance before they choose a response (Smith & Di Gregorio, 2002). Thus, aggressive firms create a series of temporary monopolistic positions that enable them to charge premium prices, increase revenues, and earn high profit margins (Boyd & Bresser, 2008; Jacobson, 1988; Makadok, 1998; Young et al., 2006).

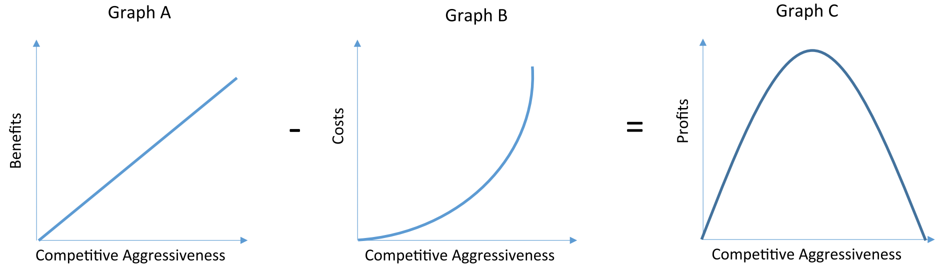
Third, aggressive firms engage in an intensive action-based learning process. Competitive actions allow for two types of learning: experimental/improvisational and trial and error (Bingham & Davis, 2012). In hypercompetitive environments, firms act under conditions of uncertainty because knowledge is unevenly distributed across market participants and it rapidly changes over time, so firms act with incomplete knowledge (Hayek, 1937). Each competitive action reveals a glimpse of the future by learning from competitive outcomes in real time. In this sense, competitive actions serve as a means through which the firm can improvise, "probe" the future, and gain hands-on experience (Brown & Eisenhardt, 1997). Therefore, aggressive firms constantly generate new knowledge and develop superior foresight about future trends. Additionally, they learn, through trial and error, which combinations of actions were effective or ineffective in particular situations or against specific rivals in the past (Ferrier, 2001; Rindova, Ferrier, & Wiltbank, 2010). They learn from the outcomes of previous actions and make inferences about their new ones (Bingham & Davis, 2012). Thus, repetitive and cumulative learning processes build internal capabilities, routines, and practices (Levinthal & March, 1993). Hence, competitive aggressiveness enables firms to gain intensive learning and real-time information, reduce market uncertainty, and launch successful new competitive actions.

In summary, previous research suggests that competitive aggressiveness can increase firm performance. By continuously offering superior value for customers, firms generate new demand through accelerated obsolescence. An aggressive series of actions also delays rival responses and creates temporary monopolistic positions, allowing firms to charge premium prices and earn higher profit margins. In addition, competitive aggressiveness enables firms to learn in real time and successfully launch actions ahead of rivals.

Costs of Competitive Aggressiveness

As competitive aggressiveness intensifies and reaches very high levels, time compression diseconomies give rise to escalating costs. Specifically, firms must develop new actions within shorter periods, which exponentially increases total development costs. For example, a 1% decrease in project development time increases total development costs by 1.75% (Pacheco-de-Almeida & Zemsky, 2007). Shorter project development times require the use of additional resources with diminishing returns. In addition, compressed learning reduces the potential for

Figure 1
Theoretical Logic for the U-Shaped Relationship Between Competitive Aggressiveness and Firm Profitability



accumulating new knowledge; it takes time to understand complex issues, and prior knowledge limits future comprehension (Cohen & Levinthal, 1990; Dierickx & Cool, 1989).

Furthermore, excessive competitive aggressiveness generates operational inefficiencies. Firms have less time to evaluate and execute effective attacks and responses against rivals, thereby increasing the risk of making expensive mistakes, misjudging customer preferences, and executing actions prematurely (Brown & Eisenhardt, 1997). In addition, competitive aggressiveness creates organizational discoordination. Too frequent changes in organizational processes can diminish learning, create interdepartmental tensions among units (engineering, manufacturing, and marketing), and inhibit the development of organizational routines (Brown & Eisenhardt, 1997). Developing many actions within short periods also requires close and frequent collaboration with various new suppliers, manufacturers, and designers, further increasing the costs of coordinating a complex and dynamic network of partners.

In sum, excessive competitive aggressiveness generates time compression diseconomies. Invested resources yield diminishing returns; intra- and interfirm coordination costs increase; and numerous mistakes and errors become more likely. Thus, as increasing aggressiveness reaches high levels, the costs rise rapidly, ultimately diminishing profitability.

Competitive Aggressiveness and Profitability

By considering the costs and benefits of competitive aggressiveness simultaneously, we argue that competitive aggressiveness and profitability have a nonlinear relationship. To increase the clarity of our argument, we adopt Haans, Pieters, and He's (2015) recommendations for visualizing the theoretical logic of U-shaped relationships. As Figure 1 illustrates, two countervailing mechanisms drive the relationship between competitive aggressiveness and profitability.

As firms initially increase competitive aggressiveness, the benefits increase proportionally (Young et al., 1996). Competitive aggressiveness enhances the customer-perceived value of products and services, delays rival response, and intensifies action-based learning, enabling firms to outpace rivals, charge premium prices, and generate more revenue (Derfus et al., 2008; Ferrier, 2001; Ferrier et al., 1999; Young et al., 1996). Thus, the benefits of competitive aggressiveness linearly increase with competitive aggressiveness (Graph A, Figure 1). However, as competitive aggressiveness increases and reaches very high levels, the costs escalate rapidly (Graph B, Figure 1). With decreased time for developing and carrying out new actions, time compression diseconomies increase total investment costs disproportionally (Pacheco-de-Almeida, 2010). As noted above, the accelerated development of new actions requires more investments with diminished returns. Furthermore, firms are prone to making expensive mistakes and facing high coordination costs. Thus, excessive competitive aggressiveness will increase costs exponentially while benefits will keep rising linearly. The difference between the benefit line (Graph A) and the cost curve (Graph B) results in an inverted U-shaped relationship between competitive aggressiveness and firm profitability (Graph C, Figure 1). Initially, as competitive aggressiveness increases and reaches moderate levels, benefits exceed costs, and profitability increases. Thus, moderate levels of competitive aggressiveness (the peak of the curve) generates the largest difference between benefits and costs. As competitive aggressiveness further increases, there is a shorter amount of time remaining to develop new actions, which increases costs exponentially, exceeding benefits and negatively affecting profitability. Thus, all else being equal, we expect the following:

> *Hypothesis 1:* The relationship between competitive aggressiveness and firm profitability will exhibit an inverted U-shaped pattern.

Contingent Roles of Internal and External Resources

While costs will inevitably escalate as competitive aggressiveness reaches high levels, the rate of increase and the point at which costs will exceed benefits vary across firms. Firms possess idiosyncratic resources (Barney & Arikan, 2001) and have uneven access to resources controlled by other firms (Lavie, 2006), so they have differential potential for developing and executing new competitive actions. First, the RBV suggests that firms can create competitive advantages over their rivals based on their internally developed property- and knowledge-based resources. Knowledge-based resources are particularly relevant for successfully competing in dynamic environments (Miller & Shamsie, 1996). In this study, we focus on knowledge-based resources and, in particular, on technological resources—technological knowledge and competences that are critical for successfully competing in rapidly changing environments (e.g., Ndofor et al., 2011; Stuart & Podolny, 1996). We argue that technological resource depth—specialized knowledge and competences within a narrow technological domain (Moorthy & Polley, 2010)—can enable firms to more frequently develop and execute new actions while limiting costs.

Second, other firms can gain preferential access to network resources that might also restrain escalating costs. Lavie (2006) extended the RBV to suggest that external network resources can also enable firms to gain competitive advantages. *Network resources* refers to "external resources embedded in the firm's alliance network that provide strategic opportunities and affect firm behavior and value" (Lavie, 2006: 638). Alliance partners develop network resources through sharing, combining, and codeveloping idiosyncratic resources (Dyer & Singh, 1988). However, firms have unequal access to network resources, which explains the differences in their abilities and motivations to develop and undertake competitive actions (Gnyawali & Madhavan, 2001). In particular, previous research suggests that firms can gain a competitive advantage by developing a dense alliance network—a network of highly interconnected alliance partners (Dyer & Nobeoka, 2000). Alliance network density can provide preferential access to unique resources that enable firms to increase the speed and decrease the costs of competitive aggressiveness. Thus, we argue that technological resource depth and alliance network density are two types of resource-based advantages that can enhance the benefits of competitive aggressiveness, delay the point at which costs will escalate, and thus generate above-average profits.

The moderating role of technological resource depth. Firms vary significantly in their technological knowledge and competencies for developing and carrying out competitive actions (Ndofor et al., 2011). Having limited resources, they make choices between developing deep knowledge within a single technological domain and cultivating broad knowledge across multiple technological disciplines (Moorthy & Polley, 2010). A deep technological resource base (Katila & Ahuja, 2002)—as developed through exploitative search and experiential learning within a narrow technological space (March, 1991)—can be particularly relevant for restraining escalating costs. Exploitative learning processes are typically associated with refinements, efficiency, and execution (March, 1991). Over time, focused learning helps firms develop deep expertise, reliable routines, and competences within familiar knowledge domains, which makes the additional search for new competitive actions more efficient (Levitt & March, 1988).

A deep knowledge base can reduce time compression diseconomies and enable the more rapid and cheaper development of new actions through three mechanisms: repeated usage, focused search, and predictable processes. First, technological resource depth indicates that specialized knowledge and competences are developed through the repeated use of familiar technologies. By combining knowledge elements within the same technological space, firms develop a deeper understanding and unique competences (Katila & Ahuja, 2002). As experience and competence accumulate in technological areas, firms can more efficiently develop and execute new competitive moves (Cohen & Levinthal, 1990). Second, resource depth requires a focused search for new solutions that leads to the development of reliable routines and procedures, which helps firms to avoid the pitfalls associated with errors and misjudgments (Levitt & March, 1988). Third, firms with specialized knowledge can develop predictable, well-understood processes to develop new competitive actions (Katila & Ahuja, 2002). Firms that have predictable processes can squeeze project development time by sequencing activities and eliminating unnecessary steps (Eisenhardt & Tabrizi, 1995), thus simultaneously increasing the frequency and efficiency with which they develop new competitive actions. In addition, a more predictable action development/execution process allows for the greater synchronization of activities internally across organizational units and externally with collaborators, thus reducing costs from intra- and interorganizational discoordination.

Besides reducing costs, technological resource depth could enhance the benefits from competitive aggressiveness. As firms develop a deeper understanding of a certain technological domain, they will increase their capacity to find new ways to offer superior value to customers. At the same time, resource depth leads to more effective action-based learning, as firms can develop a deep knowledge base that increases their ability to make sense of new information, assimilate it, and use it for developing and executing new actions (Cohen & Levinthal, 1990).

In summary, technological resource depth prevents the cost escalation associated with high levels of competitive aggressiveness. A focused search for new competitive actions increases reliability and reduces mistakes and reworks, whereas the repeated use of technologies increases the efficiency with which new competitive actions are developed and executed. In addition, greater synchronization of organizational processes reduces coordination costs.

Thus, at high technological resource depth, the cost curve should flatten. Simultaneously, the benefits line should steepen because knowledge depth can increase the capacity to continuously offer superior value while learning from action outcomes (Graphs A and B, Figure 1). Hence, a steeper benefit line and a flatter cost curve will strengthen the positive effect on firm profitability, which will weaken the inverted U-shaped pattern.

> *Hypothesis 2*: Technological resource depth will strengthen the positive effect of competitive aggressiveness on firm profitability, weakening the inverted U-shaped effect.

The moderating role of alliance network density. Network resources can also enable firms to increase the speed and reduce the costs with which new actions are developed. First, firms can share knowledge and learn intensively from alliance partners for a greater return on research and development (R&D) investments. Second, firms can gain preferential treatment from network partners and thus effectively mobilize marketing, distribution, manufacturing, or engineering capabilities, which are also critical for the speedy execution of a series of competitive actions. Third, firms can improve operational efficiency and interfirm coordination by increasing information exchange with various collaborators, thus encountering fewer delays and product malfunctions.

A firm can realize these cost advantages when it develops a dense alliance network—a network of highly interconnected alliance partners (Ahuja, 2000; Coleman, 1988). Network density encourages trust among network members by developing social norms of "acceptable" behavior, ensuring reciprocal knowledge exchange (Coleman, 1988; Rowley, 1997). The norms for cooperative behavior discourage opportunism and promote network member solidarity in working toward collective goals. As a result, firms are committed and willing to respond quickly to a given partner's needs, to invest in transaction-specific assets without fearing opportunistic behavior, to give partners favorable terms, and to exert extra effort in developing and executing actions (Dyer, 1996; Dyer & Nobeoka, 2000). Firms in dense networks can also earn higher returns on R&D investments because trustful network partners are willing to share R&D discoveries (Ahuja, 2000). In addition, highly interconnected partners can reduce coordination costs. Firms can effectively collaborate with various suppliers, distributors, and manufacturers by exchanging reliable and confidential information, which ensures compatibility and reduces errors and omissions (Dyer & Nobeoka, 2000). Thus, firms in dense networks can speed up the action development/execution process while reducing costs.

In summary, a dense network of trustworthy partners can increase competitive aggressiveness while reducing costs by gaining R&D economies of scale, effectively mobilizing proprietary resources from various partners, increasing operational efficiencies, and decreasing coordination costs. Hence, dense networks will affect the relationship between competitive aggressiveness and firm profitability primarily by preventing costs from escalating. At the same time, dense networks will slightly enhance the benefits of competitive aggressiveness. Previous research suggests that a support network of densely connected partners can enhance the firm's innovativeness (Ahuja, 2000), in turn facilitating the discovery of new competitive actions. The net effect of the steeper benefit line and the flatter cost curve would strengthen the positive effect of competitive aggressiveness on firm profitability and weaken the inverted U-shaped relationship.

Hypothesis 3: Dense networks will strengthen the positive effect of competitive aggressiveness on firm profitability, weakening the inverted U-shaped pattern.

Methods

Sample and Data

As noted above, previous research suggests that the effect of competitive aggressiveness on firm performance is strongest in rapidly changing competitive environments. To examine whether even within the most favorable context, some firms fail to benefit from competitive aggressiveness, we tested the hypotheses on a sample of firms competing in hypercompetitive industries. To identify hypercompetitive industries, we drew ideas from the industry clockspeed literature, in which the empirical findings show that the fastest clockspeeds occur in the following industries: personal computer (standard industry classification [SIC] 3571) computer-aided software engineering (SIC 7373), and semiconductor (SIC 3674; Mendelson & Pillai, 1999; Nadkarni & Narayanan, 2007: 250). Among the 225 industries examined, those three industries had the highest rate of new product introductions, rapid technological process innovations, and the highest frequency of launching new strategic actions. Thus, we examine the effect of competitive aggressiveness on firm performance in industries with highly intensive innovative and competitive activity. Researchers regularly use these industries to study firms' strategic and competitive behaviors (e.g., Lee et al., 2000; Stuart, 2000; Young et al., 1996).

We merged three databases to obtain data for our measures: Compustat for financial data, the NBER Patent Citations Database for patent data, and the Thomson Financial SDC database for strategic alliances data. In addition, we used the Factiva database and content analysis methods to generate data for competitive actions. Our sample includes 141 companies over the course of 12 years (1995-2006). Our panel is unbalanced because the data were unavailable for some firms/years. The main reason for the missing data was the limited media coverage of smaller companies. As noted above, we content analyzed published news articles to identify competitive actions, so we were unable to identify any actions that the media had not yet reported. In cases that have a truncated independent variable (i.e., competitive aggressiveness) and a dependent variable (relative return on assets [ROA]) available for all observations, sample selection bias is not an issue (Certo, Busenbark, Woo, & Semadeni, 2016). However, we tested whether the media coverage bias limited the generalizability of our findings. We created a binary variable with values of 1 (action data available) and 0 (action data missing). We regressed this variable on several independent variables. The results suggest that the missing data occurred primarily in the early years (1995-2001 vs. the base year, 2006). Besides network size ($b = 0.78$, $p < .00$) and firm size ($b = 0.66$, $p < .00$), firms did not vary in terms of relative ROA ($b = -0.06$, $p < .67$), absolute ROA ($b = -0.14$, $p < .48$), number of patents ($b = 0.36$, $p < .31$), R&D intensity ($b = -0.18$, $p < .44$), market share ($b = -0.10$, $p < .73$), financial leverage ($b = 0.19$, $p < .66$), and technological resource depth ($b = -0.07$, $p < .64$). Thus, media reporting bias primarily affected the generalizability of our findings to small firms.

Measures

Dependent variable: Relative profitability. Following previous research (Derfus et al., 2008; Nadkarni et al., 2016; Thomas & D'Aveni, 2009), we measured firm profitability as ROA (net income / total assets). We industry-centered this variable to compute relative performance, as suggested in strategic management research (e.g., Sirmon, Hitt, Arregle, & Campbell, 2010). Positive values indicate above-average profitability; negative values indicate below-average profitability.

Independent variable: Competitive aggressiveness. We measured competitive aggressiveness as the total number of market-based competitive actions carried out in a given year. We followed previous research and focused on externally directed, product-market actions rather than internally directed, factor-market organizational actions to avoid possible common variance with our moderators (e.g., Andrevski, Brass, & Ferrier, 2013). To identify competitive actions, we followed the coding procedure developed in previous competitive dynamics research (e.g., Boyd & Bresser, 2008; Ferrier et al., 1999; Gnyawali et al., 2006). We first randomly selected five firms from each of the three industries and downloaded news articles for each using the general keyword search criteria in Factiva: company name (e.g., *Dell/f30/*—the company name in the first 30 words of the article) and year = 1999. We then inductively identified four categories of product-market actions that indicated attempts to enhance a firm's market position: marketing (advertising and promotions), new products (new products and versions), price cuts (lowered prices and sales incentives), and market expansions (new production capacities and new market entries). One expert and two academics with a thorough understanding of the personal computer and semiconductor industries validated the four action categories. Then, we developed a detailed keyword search query in the Factiva database for each action type. Our search produced 14,225 articles (after deleting repetitive and irrelevant articles). We read each article and coded competitive moves into one of the four action types. Table 1 provides examples from our data for each action type along with the earliest dates of news announcements. To test the reliability of the coding process, we randomly selected 1% of the articles, which two graduate students independently recoded. The estimated Perreault and Leigh's (1989) interrater coding reliability was 0.91. In our sample, firms averaged 13.91 competitive actions (SD = 23.42). We log transformed this variable to reduce positive skewness (M = 1.78, SD = 1.27).

Moderating Variables

Technological resource depth. We used patent data to measure technological resource depth, following the previous competitive dynamics research (Ndofor et al., 2011). A firm's patent portfolio indicates its level of technological knowledge (Hall, Jaffe, & Trajtenberg, 2001). We obtained patent data from the NBER Patent Citations Database. We measured technological resource depth$_i$ using the Herfindahl index: $H = \sum p_{ij}^2$, where p_{ij} is the proportion of patents received by firm i in technological category j (j = 1-37). High values indicate high resource depth; low values indicate high resource breadth. In our sample, this variable ranges from 0 to 0.90 (M = 0.66, SD = 0.34).

Network density. We collected alliance data from Thomson Financial SDC, which is the most comprehensive database (e.g., Schilling, 2009). Previous research has used 3- or 5-year

Table 1
News Examples of Competitive Action Types

Competitive Action Type	News Examples
New products and versions	May 12, 2003 "NVidia launches new performance graphics chip." December 7, 1999 "Sun Microsystems announces availability of Java(TM) 2 platform on Linux."
Advertising and promotions	March 19, 2004 "Texas Instruments to showcase 15 years of wireless influence at CTIA TI's mobile entertainment summit keynote." August 8, 2005 "Quick Logic to present at the summer tech fest 2005 investor conference."
Capacity and market expansion	October 24, 2005 "Intel Corporation today announced plans to invest $650 million in the company's existing manufacturing site in New Mexico. The investment will be used to increase the capacity." February 14, 2004 "Micron Technology Inc. is expanding its operations in China."
Price cuts and sales incentives	July 10, 1996 "Dell Computer Corp. (DELL) cut prices across its PowerEdge network server line in the U.S." March 20, 2000 "Lucent Technologies reduces prices of select Cajun campus stackable and workgroup Ethernet switches."

moving windows to create firm-by-firm network matrixes (e.g., Lavie, 2007; Stuart, 2000). Given that our study examines firms in hypercompetitive industries featuring frequent corporate changes (Nadkarni & Narayanan, 2007), we followed recent competitive dynamics research and chose the more conservative 3-year window (Andrevski et al., 2013). The 3-year moving window provides some stability for the network structure while still capturing changes to the structure over time. Thus, our network matrices for each year include all alliances formed among our sample firms in the past 3 years. We measured network density using Burt's (1992) network constraint index: $c = \sum_j (p_{ij} + \sum_q p_{iq} p_{qj})^2$, $q \neq i, j$, where p_{ij} is the proportion of firm i's alliances with partner j in firm i's alliance network, thus capturing the strength of the relationship with partner j; the term $\sum_q p_{iq} p_{qj}$ indicates the extent to which firm i's alliance partners collaborate with one another. We computed network constraint using UCINET 6.594 (Borgatti, Everett, & Freeman, 2002). This index ranges from 0 (a sparse network in which all partners are disconnected) to 1 (a dense network in which all partners are interconnected; $M = 0.32$, $SD = 0.37$).

Control Variables

We controlled for several firm- and industry-level control variables. Industry concentration was the proportion of total revenues generated by the top four firms to total industry revenues. Firms with oligopolistic market positions can tacitly collude and limit competition to increase profitability. The industry growth rate was as follows: (industry revenues$_{i,t}$ – industry revenues$_{i,t\text{-}1}$) / industry revenues$_{i,t\text{-}1}$. Firms in high-growth industries, compared with firms in low-growth industries, have greater potential for increasing profits; that is, rather than trying to steal market share from rivals, they just need to keep up with the industry growth rate. Number of rivals controlled for differences in competitive aggressiveness and firm performance caused by the number of firms in an industry. This measure was log transformed to reduce positive skewness. In addition, all models include industry dummies to control for other possible industry-level factors.

We controlled for several firm-level characteristics. Firms adjust their strategic behavior according to previous performance, which can affect competitive aggressiveness and future performance (Cyert & March, 1963; Ferrier, 2001). Past performance was measured as the ROA (net income / total assets). Firm size was the accounting value of total assets, log transformed to reduce positive skewness. Resource endowments can affect competitive aggressiveness and profitability. Market share was a firm's total revenues divided by the total industry revenues. We included this control variable to account for a firm's monopolistic position, which can affect its profitability. Financial slack was measured with the quick ratio, computed as current assets minus inventories divided by current liabilities. Higher values of this variable represent the greater availability of slack resources, which can affect competitive aggressiveness and firm performance. Financial leverage was the debt-to-equity ratio (total long-term debt / total shareholder equity). This measure controls for the firm's propensity to use debt to finance its major capital investments, which can affect competitive aggressiveness and profits. We controlled for alliance network size, measured as a log-transformed count of alliance partners in a firm's ego network. More central (i.e., prominent) firms have easier access to financial and social capital, which in turn affects its competitive behavior and profits (Gnyawali & Madhavan, 2001). We also controlled for number of patents in a given year (log transformed to reduce skewness), which can affect competitive aggressiveness and performance. We controlled for action complexity to account for a possible alternative explanation that the range of action types, rather than action frequency (i.e., competitive aggressiveness), explains profitability. We computed action complexity using the Herfindahl index: $H = 1 - \Sigma_j p_j^2$, where p represented the proportion of competitive actions in the j category (j = 1-4). Finally, we controlled for R&D intensity, computed as R&D expenditures divided by total sales, which can also affect the frequency of developing new actions and profitability.

Statistical Model

To address the unobserved heterogeneity that arises from unobservable but stable factors over time, we applied the fixed effects and random effects panel data model (Green, 1951). Both models generated consistent results. However, Hausman's (1978) specification test was significant ($p < .001$), suggesting that the random effects estimator was inefficient, so we report the results from the fixed effects panel data model, formulated as follows: $Y_{it} = \alpha_i + \beta' X_{it} - 1 + \varepsilon_{it}$, where subscripts i and t represent firms (i = 1-141) and years (t = 1-12), respectively. $\beta' X_{it}$ is the coefficient (slope) of the independent variables assumed to be constant across firms, and ε_{it} is the error term. All models include a set of dummy variables for each year to control for time-specific factors such as government interventions or economic downturns.

To test the moderating hypotheses, we used quadratic polynomial regression analysis with response surface methodology (Edwards, 2007). This methodology provides “a nuanced view” of interactions among variables and has greater explanatory potential than traditional moderated regression analysis (Shanock, Baran, Gentry, Pattison, & Heggestad, 2010: 543). The general form of the polynomial regression model is as follows: $Z = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2 + e$, where XY is the interaction between variables X and Y in predicting Z. The response surface plot illustrates the direction and form of the interaction effects (Edwards & Parry, 1993).

Results

Table 2 reports the descriptive statistics and correlations among variables. Table 3 presents the regression results for all hypotheses. Model 1 includes only the control variables lagged 1 year. The results suggest that slack resources help firms outperform rivals, which is consistent with what was reported by prior research, suggesting that slack resources provide capabilities to respond quickly to rivals and rapidly execute actions (Smith et al., 2001). In addition, as expected, firms with a larger market share exhibit below-average profitability, suggesting that profit margins shrink as firms attempt to build market share by competing aggressively. Finally, the number of rivals negatively affects profitability, which is also consistent with the findings of the previous literature (e.g., Young et al., 1996). Furthermore, the joint test of the year dummies was statistically significant, $F(10, 140) = 13.79$, $p < .001$, suggesting that time-specific factors influenced relative profitability.

Model 3 shows the results for Hypothesis 1. The coefficient for the linear term of competitive aggressiveness is positive and statistically significant ($b = 0.17$, $p < .01$), and the squared term is negative and significant ($b = -0.07$, $p < .05$). Figure 2 shows the form of the relationship. Competitive aggressiveness affects firm profitability in an inverted U-shaped fashion, with an inflection point at +1.06 standard deviations from the mean ($M = 1.78$, $SD = 1.27$), supporting Hypothesis 1.

Models 4, 5, and 6 show the results of the quadratic polynomial regression models that test the moderating role of technological resource depth, network density, and rival aggressiveness (Edwards, 2007). All variables were standardized before the interaction terms were computed, to reduce multicollinearity and facilitate interpretation. Model 4 shows the results for Hypothesis 2. The interaction between competitive aggressiveness and technological resource depth is significant ($b = 0.07$, $p < .05$). Figure 3 shows the response surface pattern for the moderating effect of technological resource depth. At high resource depth (+2 standard deviations), competitive aggressiveness increases almost linearly with profitability (from −0.04 to 1.28), weakening the U-shaped effect and supporting Hypothesis 2. As resource depth decreases, costs rapidly escalate, so the profitability of highly aggressive firms sharply declines.

Model 5 tests the moderating effect of network density. As predicted, competitive aggressiveness has a positive and statistically significant interaction with network density ($b = 0.09$, $p < .01$). The surface plot in Figure 4 shows that when alliance network density is high (+2 standard deviations), the effect of competitive aggressiveness on firm profitability sharply increases in a linear fashion, thus weakening the inverted U-shaped effect and supporting

Table 2
Descriptive Statistics and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Firm profitability (relative ROA)	0.27	1.29															
2. Past profitability (ROA)	−0.16	0.55	.27														
3. Industry concentration	0.57	0.22	−.03	−.16													
4. Industry growth	0.08	0.17	.07	.05	−.26												
5. No. of rivals (log)	4.98	0.58	.05	.05	−.58	.07											
6. Market share	0.03	0.09	.04	.11	.31	−.02	−.39										
7. Firm size (log total assets)	6.01	2.14	.16	.33	−.08	.04	−.11	.57									
8. Financial slack	3.85	4.23	.07	.11	−.14	.01	.17	−.18	−.14								
9. Financial leverage	0.26	1.76	−.01	−.21	.02	−.04	.01	.03	.06	−.06							
10. R&D intensity	0.44	2.67	−.10	−.07	−.02	−.04	.03	−.04	−.10	.08	−.01						
11. Alliance network size	0.27	1.55	.01	.04	.17	.02	−.09	.57	.46	−.15	.03	−.03					
12. No. of patents (log)	2.25	2.30	−.01	.12	−.04	.10	−.09	.48	.70	−.14	.04	−.04	.50				
13. Action complexity	0.29	0.24	.08	.01	.00	.00	−.10	.19	.24	−.12	.09	−.06	.11	.13			
14. Competitive aggressiveness (log)	1.78	1.27	.14	.17	−.02	.01	−.18	.49	.59	−.19	.05	−.07	.34	.32	.49		
15. Technological resources depth	0.66	0.34	.01	−.10	.08	−.08	.15	−.40	−.57	.11	−.02	.00	−.33	−.44	−.07	−.33	
16. Network density	0.32	0.37	.05	.04	−.08	.01	.09	−.19	−.16	.09	−.02	−.02	−.19	−.18	.01	−.10	.17

Note: Coefficients >.065 are significant at 5%. R&D = research and development; ROA = return on assets.

Hypothesis 3; therefore, network density strengthens the positive effect of competitive aggressiveness on firm profitability. As network density decreases, aggressive firms' profitability rapidly declines, suggesting that support from densely connected alliance partners is critical for aggressive firms' ability to contain escalating costs.

Model 6 incorporates all interaction effects. The results are stable except for the moderating effect of technological depth, which decreased the significance level to 10%. However, given that we used the more conservative two-tailed test (for a one-tailed test, the interaction coefficient is still significant at the 5% level) and since polynomial regression analysis includes many terms and demands larger statistical power, our results provide good support for Hypothesis 2.

Robustness Checks

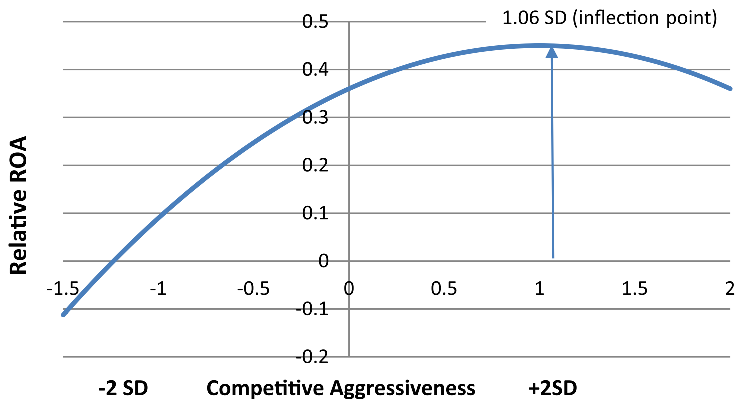
We conducted several robustness checks to probe the validity of our results. To increase confidence in the causality of the hypothesized relationships, we controlled for past performance in all models (Makadok, 1998). We also tested the reversed effect by regressing competitive aggressiveness on relative past performance (relative ROA). The coefficient of past relative ROA was not statistically significant ($b = 0.028$, $p < .227$) in

Table 3
Fixed Effects Panel Data Model for Firm Profitability (Relative ROA)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Past profitability (ROA)	0.08	0.06	0.06	0.05	0.06	0.04
	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Industry concentration	2.81*	2.88*	3.01*	2.94*	2.99*	2.91*
	(1.19)	(1.22)	(1.19)	(1.20)	(1.17)	(1.19)
Industry growth	0.63†	0.56	0.56	0.57	0.49	0.50
	(0.37)	(0.37)	(0.37)	(0.38)	(0.37)	(0.37)
Number of rivals	−0.82*	−0.96*	−0.86*	−0.78*	−0.84*	−0.76*
	(0.36)	(0.37)	(0.36)	(0.34)	(0.36)	(0.35)
Market share	−2.49**	−2.66**	−2.31**	−2.33**	−2.67**	−2.72**
	(0.57)	(0.58)	(0.57)	(0.57)	(0.62)	(0.62)
Firm size (log total assets)	0.03	0.01	0.01	−0.02	−0.01	−0.03
	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)
Financial slack	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Financial leverage	−0.01	−0.01	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
R&D intensity	0.00	0.00	0.00	−0.00†	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
Alliance network size	0.00	−0.01	0.00	0.00	0.00	0.00
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
No. of patents	0.02	0.03	0.02	0.00	0.01	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Action complexity	0.07*	0.04	0.02	0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
CA		0.16*	0.17**	0.19**	0.17**	0.20**
		(0.06)	(0.06)	(0.07)	(0.06)	(0.07)
CA squared			−0.07*	−0.06†	−0.06†	−0.05
			(0.03)	(0.03)	(0.03)	(0.03)
TRD				0.01		0.02
				(0.06)		(0.06)
TRD squared				0.14*		0.15*
				(0.07)		(0.07)
Interaction: CA × TRD				0.07*		0.06†
				(0.03)		(0.03)
ND					0.10	0.11
					(0.07)	(0.07)
ND squared					−0.06	−0.06
					(0.07)	(0.07)
Interaction: CA × ND					0.09**	0.09**
					(0.03)	(0.03)
_cons	0.40	0.41	0.35	0.34	0.45	0.46
	(1.95)	(2.01)	(1.94)	(1.90)	(1.98)	(1.95)
R^2	0.27	0.27	0.28	0.29	0.29	0.29

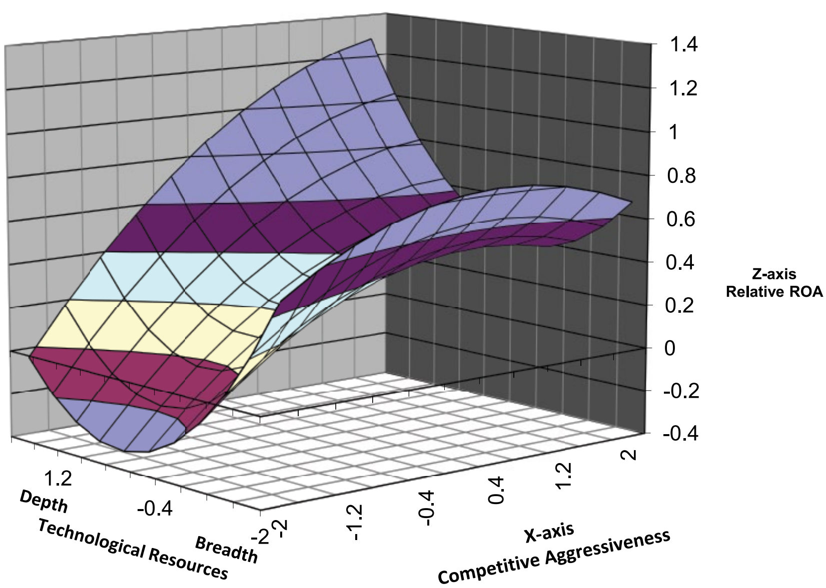
Note: N = 867 for each model. Year dummies included but not shown; robust standard errors in parentheses. CA = competitive aggressiveness; ND = network density; R&D = research and development; ROA = return on assets; TRD = technological resources depth.
†$p < .10$.
*$p < .05$.
**$p < .01$.

Figure 2
Inverted U-Shaped Relationship between Competitive Aggressiveness and Firm Profitability



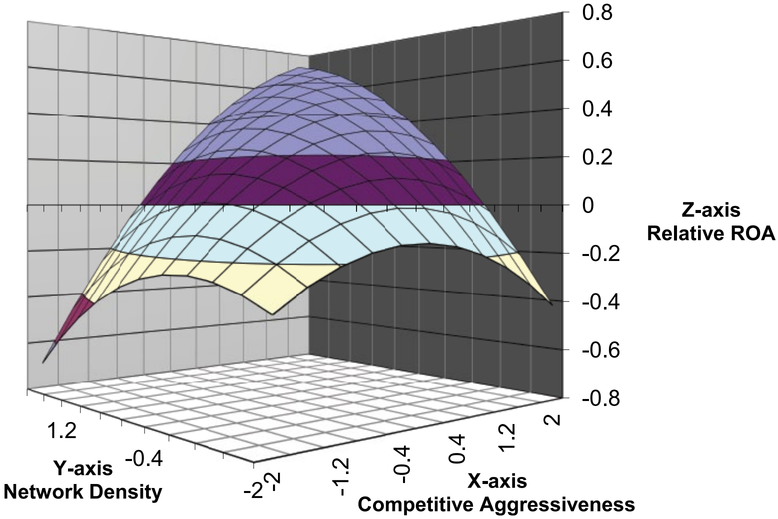
Note: ROA = return on assets.

Figure 3
Interaction Between Competitive Aggressiveness and Technological Resource Depth on Firm Profitability



Note: X- and *y*-axis values are in standard deviations (−2 to +2). ROA = return on assets.

Figure 4
Interaction Between Competitive Aggressiveness and Alliance Network Density on Firm Profitability



Note: X- and *y*-axis values are in standard deviations (–2 to +2). ROA = return on assets.

predicting competitive aggressiveness, suggesting that reverse causality was not affecting our results. Furthermore, the costs for developing competitive actions vary across action types (M. J. Chen, Smith, & Grimm, 1992), so we tested all models with weighted measures of competitive aggressiveness. We assigned (a) higher weights to new products and market/capacity expansions and (b) lower weights to price cuts and marketing actions, as suggested by previous research (Ferrier, 2001: 876). The regression results for all models were consistent with those shown in the paper. In addition, because of perfect collinearity with the fixed effects, some invariant control variables were dropped from the models. To examine their impact on our findings, we ran a random effects model with additional controls: industry dummies, product diversification (the number of product markets in which the firm competes), and multimarket contact (a firm's average market overlap with rivals). The random effects model results were consistent with those of the fixed effects model. We also tested for possible multicollinearity issues. We identified control variables with variance inflation factors >4 in all models. To check whether multicollinearity affects our estimates, we estimated models that excluded variables with variance inflation factors >4 (firm size, industry concentration, and industry growth); the results remained unchanged.

Discussion

The received wisdom regarding the relationship between competitive aggressiveness and performance in hypercompetitive environments suggests that aggressiveness begets superior performance. We find, however, that for some firms, highly aggressive competitive behavior can escalate costs and diminish profitability primarily due to the acceleration-cost tradeoff. Our study suggests that competitive aggressiveness can enable firms to gain above-average profits but only when they possess internal and external resource advantages that can increase the speed with which they develop competitive actions while lowering costs.

Specifically, we find that technological research depth increases both the speed and the efficiency of developing and executing new competitive actions. Figure 3 shows that firms earn their highest profits when they have highly specialized technological resources (high technological resource depth) and use those resources to carry out a high volume of competitive actions (high competitive aggressiveness). Thus, we find support for the argument that aggressive firms with specialized technological resources learn intensively through improvisation and trial and error (Bingham & Davis, 2012), which enables them to develop actions faster and at lower costs than rivals and thus earn superior profits. In contrast, as aggressive firms become less specialized (i.e., competitive aggressiveness is high while resource depth declines), firm profitability decreases.

Additionally, firms with high technological resource breadth—those that possess a broad knowledge of and competences across multiple technological disciplines (Moorthy & Polley, 2009)—can outperform rivals but not through competitive aggressiveness. Figure 3 shows that firm performance is above average at high technological resource breadth, regardless of the level of competitive aggressiveness. This finding further suggests that competitive aggressiveness is not effective for all firms. While it works for firms with specialized resources, it is not critical for firms with broad technological resources. First, technological resource breadth is associated with exploratory searches that may lead to a few radically innovative actions that substantially delay rival responses (Ahuja & Lampert, 2001). Therefore, firms with low aggressiveness might launch a few highly innovative actions that can enable them to charge premium prices and gain superior profits. Second, as previous research suggests, technological resource breadth primarily drives the range of competitive actions in the firm's action repertoire (Ndofor et al., 2011). Thus, it is possible that technological resource breadth, combined with action complexity, is another way that firms are able to gain superior profits in dynamic environments characterized by disruptive, discontinuous technological change.

We used the industry clockspeed literature to identify dynamic industries based on the rate of technological process innovations, new product introductions, and other corporate changes (Mendelson & Pillai, 1999; Nadkarni & Narayanan, 2007). These industry characteristics do not distinguish incremental from disruptive technological changes (Pisano, 2015). Future research should explore whether (a) competitive aggressiveness and technological resource depth are appropriate for dynamic environments with incremental change, whereas (b) competitive action complexity and technological resource breadth might work better for dynamic environments with disruptive change. Nevertheless, we controlled for action innovativeness and action complexity in our models. Consistent with previous research (e.g., Ndofor et al., 2011), action complexity was statistically significant in predicting firm profitability (Table 3, Model 1). However, Model 2 includes both competitive aggressiveness and action complexity; here, the coefficient of action complexity becomes insignificant, suggesting that competitive aggressiveness more strongly predicts firm profitability in our empirical setting.

Additionally, we did not examine how the interplay between resource breadth and depth influences the effects of competitive aggressiveness on firm performance. Firms face tradeoffs when allocating limited resources; these tradeoffs are between exploratory searches that expand resource breadth and exploitative searches that extend resource depth (March, 1991). Exploitative and exploratory activities can both create new knowledge and competences that enable firms to carry out actions frequently and efficiently. Exploitative activities combine "existing solutions to generating new combinations," whereas exploratory activities provide "completely new solutions" (Katila & Ahuja, 2002: 1191), so firms can carry out actions with varying degrees of innovativeness that, in turn, can differentially affect short- and long-term performance. Thus, future research should explore how firms can combine different levels of resource depth and breadth to compete aggressively across different competitive environments and over time.

Furthermore, we show that network resources, as provided by a dense network of trustworthy alliance partners, are an alternative strategy that can be used to overcome the acceleration-cost tradeoff. Similar to Dyer and Nobeoka (2000), who found that a highly interconnected network is a competitive advantage in the automobile manufacturing industry, we find that network density can curb escalating costs and generate above-average profits in the personal computer, computer-aided software engineering, and semiconductor industries. Our study extends the alliance networks research by showing that the effect of network density on firm performance depends on the firm's strategy. We find that network density enhances performance only when a firm pursues a highly aggressive competitive activity. Figure 4 shows that as competitive aggressiveness and network density increase proportionally, firm profitability increases linearly (from the front corner to the back corner, along the $X = Y$ line). The equation of this curve is as follows: $b_0 + 0.27X - 0.03X^2$, where the coefficient of the linear term is statistically significant ($b_1 = 0.27$, $SE = 0.09$, $p < .002$) and the squared term is not significant ($b_2 = -0.03$, $SE = 0.08$, $p < .732$; Edwards & Parry, 1993). The results suggest that firms can maximize profits by simultaneously building a network of interconnected alliance partners with increasing competitive aggressiveness. In contrast, when firms are highly aggressive but lack trusted partner support, they earn below-average profits. Similarly, their profits are below average when they build dense networks but fail to use these network-based resources to launch competitive actions. These results are consistent with the reports of Ahuja (2000), who found that dense networks are better than sparse networks (with many structural holes) for generating innovative actions. In our empirical setting, sparse networks are less critical for maximizing benefits from competitive aggressiveness. Future research should explore whether sparse networks are advantageous for other competitive behaviors, such as competitive action complexity and heterogeneity.

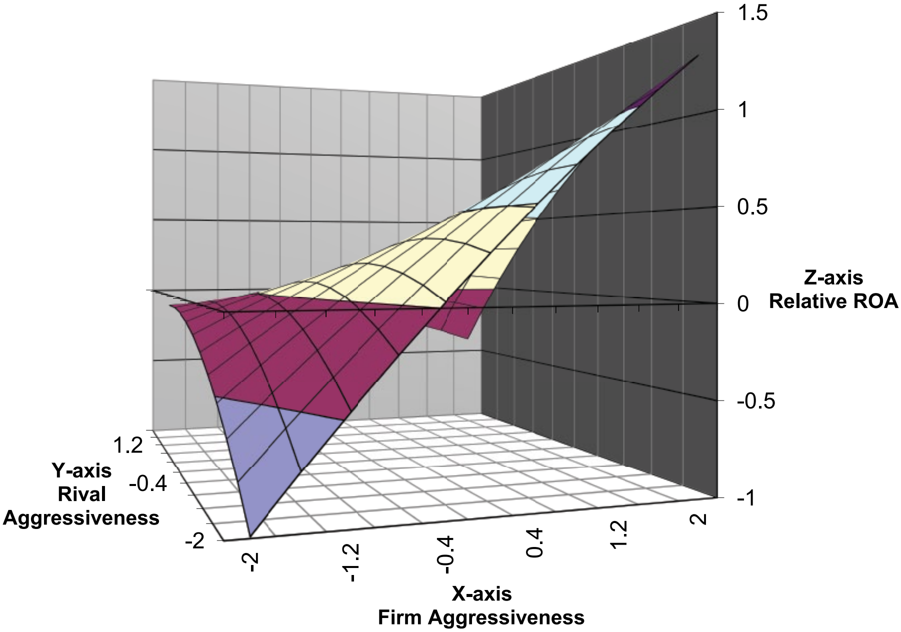
Furthermore, rivals' inability or their lack of motivation to match the focal firm's level of aggressiveness is suggestive that these rivals' resource base may be inferior to that of the focal firm, thereby diminishing rivals' capability to compete on an equal footing (M. J. Chen, Su, & Tsai, 2007; Derfus et al., 2008). In contrast, when a firm lacks resource advantages, rivals will quickly match the firm's aggressiveness level, generating "red queen" competition—a progressive cycle of rivalry that diminishes performance (Barnett & Hansen, 1996). We conducted an additional analysis to examine the moderating effect of the average rival aggressiveness (results available on request). The interaction between competitive aggressiveness and firm aggressiveness was statistically significant ($b = -0.16$, $p < .05$). Figure A1 illustrates that profitability linearly increases with firm aggressiveness when rival aggressiveness is low (–2 standard deviations). However, as firm aggressiveness and rival aggressiveness increase proportionally (from the front corner [–2, –2] to the back corner [2, 2], along the $X = Y$ line), firm profitability increases and then decreases, exhibiting a strong U-shaped pattern. This curve is formulated as follows: $b_0 + 0.15X - 0.23X^2$ (Edwards & Parry, 1993). The coefficient of the linear term is positive and not significant ($b_1 = 0.15$, $p < .32$), whereas the coefficient of the squared term is negative and statistically significant ($b_2 = -0.23$, $p < .01$). This additional analysis suggests that aggressive firms can gain above-average profits when rivals lack the capability to match the firm's aggressiveness levels. In contrast, when rivals match competitive aggressiveness, costs escalate and benefits decrease, diminishing profitability.

Overall, our study has important managerial implications. Top managers should adopt competitive aggressiveness only after careful assessment of their capabilities. Even if they can quickly develop competitive actions, they will face rapidly increasing costs that may exceed the benefits. Therefore, aggressive competitive behavior is advisable only for those firms that have superior resources and capabilities that can overcome acceleration-cost tradeoffs, such as specialized technological resources and a network of trustworthy partners. Future research should explore other firm-specific resources and capabilities, such as human, reputational, or financial resources (Barney, 1991; Grant, 1991), for their ability to reduce the costs of competitive aggressiveness. Our findings suggest that firms can proportionally develop their resources and competitive aggressiveness and thus incrementally increase their performance. In this sense, integrating the dynamic capabilities literature with competitive dynamics research can advance our knowledge of how firms can integrate, build, and reconfigure internal and external resources to outperform their rivals through competitive aggressiveness (Eisenhardt & Martin, 2000). A recent review of this literature suggests that dynamic capabilities can be valuable even in stable and moderately dynamic environments (Barreto, 2010), so future research should examine whether superior internal and external resources can enable aggressive firms to earn above-average profits in less dynamic competitive environments.

In conclusion, our study shows that competitive aggressiveness can be an advantageous strategy in hypercompetitive environments. However, for some firms, competitive aggressiveness can escalate costs and diminish profitability. Our findings suggest that firms can be successfully aggressive if they have the necessary resources and capabilities to cope with the acceleration-cost tradeoff. We find that specialized technological resources and a network of trustworthy partners provide superior capabilities for competing aggressively and gaining superior profits.

Appendix

Figure A1
Interaction Between Firm Aggressiveness and Rival Aggressiveness on Firm Profitability



Note: X- and *y*-axis values are in standard deviations (–2 to +2). ROA = return on assets.

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