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Alliance Portfolio Configurations and Competitive Action Frequency

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We advance competitive dynamics research by introducing alliance portfolio configuration as an important antecedent of competitive action frequency. We propose and test a model for developing effective alliance portfolio configurations that enhance a firm's ability to discover, conceptualize, and carry out new competitive actions. Our model consists of three overlapping components: (a) opportunity recognition capacity as evidenced by the portfolio attribute of structural holes, (b) opportunity development capacity as indicated by R&D alliance scope, and (c) action execution capacity as exhibited by equity alliances with trusted partners. We hypothesize and find a multiplicative effect of the configuration of all three alliance portfolio attributes on the frequency of competitive actions carried out by 12 large global automobile manufacturing firms with 1,471 unique partners and 37,520 alliances formed over a 16-year period (1988 to 2003). The three-way configuration of portfolio attributes was stronger for more complex competitive actions requiring more time, expertise, and resources to develop and execute.

Keywords: *alliance portfolio configuration; competitive dynamics; competitive actions; competitive action frequency; social networks; strategic alliances*

Competitive dynamics research has consistently found that firms that compete aggressively by frequently "attacking" rivals with competitive actions (new products, product

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improvements, price cuts, market expansions, advertising campaigns) significantly outperform more passive firms (D'Aveni, 1994; Ferrier, 2001; Ferrier, Smith, & Grimm, 1999; Miller & Chen, 1996; Young, Smith, & Grimm, 1996). Each competitive action is a firm's attempt to improve the value of its products and services, and consequently, its market position. The more frequently firms introduce new competitive actions, the more challenged are rivals to respond and negate the effect of the initiating firm's action. Thus, competitive action frequency (also called action volume, competitive aggressiveness, and competitive intensity) enables firms to create a series of temporary competitive advantages and gain superior profits (D'Aveni, Dagnino, & Smith, 2010).

Why are some firms able to develop and carry out competitive actions more frequently than their rivals? Previous research has examined several firm-specific attributes—such as firm size, organizational slack, past performance, top management team characteristics, and technological resources—that drive competitive action (e.g., Chen & Hambrick, 1995; Chen, Su, & Tsai, 2007; Hambrick, Cho, & Chen, 1996; Ndofor, Sirmon, & He, 2011; Young et al., 1996). Those research efforts notwithstanding, some competitive dynamics scholars have called for more research on how the firm's access to network resources affects competitive behavior (Chen & Miller, 2012; Smith, Ferrier, & Ndofor, 2001). Responding to this call, Gnyawali and Madhavan (2001) argued that firms are embedded in networks of collaborative relationships that facilitate or constrain their competitive behavior. For example, firms centrally positioned in a cooperative network of global steel producers had preferential access to network resources, such as status, assets, and information, allowing them to carry out more competitive actions than peripheral firms (Gnyawali, He, & Madhavan, 2006).

Very little is known, however, about how various types of alliance portfolio configurations affect competitive action frequency. Alliance *portfolio* refers to a firm's collection of strategic alliances (Lavie, 2007), and alliance *portfolio configuration* refers to the arrangement of relational and structural portfolio attributes that shape the potential for reaching network resources (Hoffmann, 2007). The configuration of alliance portfolios determines the quality, quantity, and diversity of resources available to firms (Hoffmann, 2007; Wassmer, 2010), which in turn influences the firm's ability to develop and introduce new competitive actions. We adopt a configurational approach to extend previous studies of the effects of *structural* network properties on competitive behavior (Gnyawali et al., 2006; Gnyawali & Madhavan, 2001) by simultaneously and interactively considering important *relational* properties—strength and breadth of network ties.

We ask, What is the optimal configuration of various alliance portfolio attributes that maximizes the firm's ability to frequently carry out competitive actions? Alliance portfolios can simultaneously incorporate various attributes that jointly determine the firm's access to network resources. Not all combinations of portfolio attributes confer advantages, however. Some attributes are complementary and mutually reinforcing; others are redundant (Rowley, Behrens, & Krackhardt, 2000) or mutually exclusive (e.g., a single portfolio cannot have high levels of both structural holes and ego network density). We believe our study is the first to propose a model for effectively combining alliance portfolio attributes that collectively increase action frequency and enable firms to create a series of temporary advantages.

Table 1 provides a summary of our theoretical model. We propose that effective alliance portfolio configurations incorporate portfolio attributes that simultaneously enhance opportunity recognition capacity (e.g., structural holes), opportunity development capacity (e.g.,

Table 1
Summary of the Theoretical Model

Portfolio Attributes	Primary Relational Resources	Outcomes for the Action Development Process	
Structural holes	Access to diverse information	Opportunity recognition capacity (ideas for new actions)	Action Frequency
R&D alliance scope	Broad knowledge base	Opportunity development capacity (evaluation of ideas and design of action concepts)	
Equity alliances	Reliable and trustful network of partners	Action execution capacity (market introduction)	

R&D alliance scope), and action execution capacity (e.g., equity alliances), which in turn accelerate competitive action frequency. We empirically test one optimal alliance portfolio configuration derived from our theoretical model—a mix of structural holes, R&D alliance scope, and equity alliances—using multiplicative three-way interaction method (Baker & Cullen, 1993; Dess, Lumpkin, & Covin, 1997).

The effect of alliance portfolio configurations, however, can vary across different action types, depending on complexity, time, and resources. Previous competitive dynamics research has shown that competitive action type is a critical variable that has important theoretical and managerial implications (Chen & MacMillan, 1992; Chen, Smith, & Grimm, 1992; Smith et al., 2001; Smith, Grimm, Gannon, & Chen, 1991). Strategic actions, such as new products, are more complex to develop and require more time and resources to execute than tactical actions, such as price cuts. We argue that the effect of alliance portfolio configurations on competitive action frequency will be stronger for strategic actions than for tactical actions.

Our study also contributes to alliance portfolio configuration research. This research explores the content and the arrangement of alliance portfolios (Wassmer, 2010). Previous research examined how certain properties of alliance portfolios influence performance-related outcomes. However, we still lack theoretical explanation about how several portfolio attributes coexist in a single portfolio and which combinations of portfolio attributes can maximize firms' competitiveness. We address Wassmer's (2010) recent call for more research on the configuration of alliance portfolios by showing how various portfolio attributes complement and reinforce one another and thus create synergistic effects on competitive action frequency.

Theoretical Background

Competitive dynamics research examines the antecedents and consequences of interfirm rivalry by analyzing specific competitive actions. Generally, competitive dynamics researchers have taken two approaches to studying competitive behavior: competitive interaction and competitive repertoire (Chen & Miller, 2012). The competitive interaction approach focuses on predicting competitive actions and responses at a dyadic level (Chen et al., 1992). Competitive repertoire research, our primary focus, explicitly examines the "Austrian" view of the market as a process through which firms incessantly try to outdo rivals by offering superior ways for serving customers (Ferrier et al., 1999; Kirzner, 1973; Smith et al., 2001; Young et al., 1996). In most industries, it has become increasingly difficult for firms to sustain their competitive advantages (Thomas & D'Aveni, 2009); rivals can quickly imitate or overcome any competitive advantage, so firms must constantly create temporary advantages (D'Aveni, 1994). Firms create temporary advantages by frequently launching competitive actions. The cumulative effect of increased competitive action frequency is superior performance (Young et al., 1996).

Recent research suggests that firms can achieve high competitive action frequency by actively managing their resource portfolios (Ndofor et al., 2011; Sirmon, Gove, & Hitt, 2008). However, to compete successfully, firms cannot develop all the necessary resources internally; they must rely on external, network-born resources (Powell, Koput, & Smith-Doerr, 1996). Facing resource constraints, firms increasingly form multiple strategic alliances to access resources controlled by other firms (Hagedoorn, 1995). Although each alliance aims for a particular strategic objective, alliance portfolios provide benefits beyond those provided by each alliance independently. Therefore, managing alliance portfolios is strategically important and challenging (Wassmer, 2010).

Alliance Portfolio Configuration

We focus on the management of alliance portfolio configurations. The concept of organizational configuration refers to "any multidimensional constellation of conceptually distinct characteristics that commonly occur together" (Meyer, Tsui, & Hinings, 1993: 1175). A fundamental premise of configurational theories and methods is that the arrangement of several organizational attributes has a stronger effect on organizational performance than the individual effects of the same attributes studied in isolation (Fiss, 2007). Thus, individual portfolio attributes might exhibit different effects on organizational performance depending on how those attributes are arranged in an alliance portfolio. We adopt a configurational approach to study how the arrangement of relational and structural alliance portfolio attributes (i.e., alliance portfolio configuration) shape firms' potential to reach network resources and thus affect competitive action frequency.

Researchers have used several methods to empirically investigate organizational configurations: interaction effects, cluster analysis, deviation scores, and set-theoretic method (e.g., Delery & Doti, 1996; Dess et al., 1997; Fiss, 2007; Ketchen & Shook, 1996). Multiplicative three-way interactions, in particular, have been used in testing organizational configurations that comprise three theory-based attributes (Baker & Cullen, 1993; Dess et al., 1997). We use three-way interactions to test the effect of alliance portfolio configuration on competitive action frequency. Our theoretical model is based on three types of portfolio attributes that interactively affect competitive action frequency through distinct but complementary theoretical mechanisms.

Theory and Hypotheses

Our theoretical model draws from entrepreneurial opportunity research (Ardichvili, Cardozo, & Ray, 2003; Haynie, Shepherd, & McMullen, 2009; McMullen & Shepherd, 2006) to suggest that alliance portfolio configurations affect competitive action frequency by influencing three parts of the action development process: (a) opportunity recognition, (b) opportunity development, and (c) action execution. Accordingly, we classify portfolio attributes in three categories: attributes that increase opportunity recognition capacity, attributes that increase opportunity development capacity, and attributes that increase action execution capacity.

Opportunity recognition capacity refers to the ability to generate ideas for new competitive actions, which can include sensing market needs and/or identifying underemployed resource combinations (Ardichvili et al., 2003). Portfolio attributes providing access to diverse information, such as structural holes, increase the ability to generate good ideas (Burt, 2004) and thus enhance opportunity recognition.

Opportunity development capacity refers to the ability to refine new ideas, evaluate their feasibility, and develop new action concepts. Opportunity evaluation and opportunity development processes are intertwined, so we use the term *opportunity development* to refer to both (Ardichvili et al., 2003).[1] Portfolio attributes that expand the knowledge base, such as R&D alliance scope, can increase opportunity development capacity by allowing firms to appreciate the commercial value of a wide range of ideas and conceptualize new competitive actions.

Finally, *action execution capacity* refers to the ability to produce and launch actions rapidly. Portfolio attributes that ensure reliable and trustworthy partners, such as equity-based alliances, increase the market introduction speed by providing effective coordination and cooperation among multiple partners responsible for assembling, distributing, marketing, financing, manufacturing, and other services.

Table 1 summarizes the links between portfolio attributes and the action development process, including the primary underlying mechanisms (relational resources) that drive each relationship. Opportunity recognition, opportunity development, and action execution are distinct but interdependent mechanisms. Thus, alliance portfolio configurations that maximize competitive action frequency must include all three types of attributes. Lacking one or more, the action development process decelerates. Specifically, access to diverse information increases the potential for recognizing ideas for possible competitive actions. However, firms must also make sense of diverse information and use iterative processes to select and further develop ideas with the highest competitive potential (Ardichvili et al., 2003). At the same time, firms must also execute viable opportunities. Without action execution capacity, they cannot rapidly undertake competitive action. Thus, alliance portfolios with attributes that simultaneously maximize opportunity recognition, opportunity development, and action execution will generate more frequent actions.

Indeed, a given portfolio attribute may provide more than one relational resource, and there may be more than one effective portfolio configuration. Consistent with the equifinality assumption of configurational approaches, we do not exclude the possibility that more than one optimal alliance portfolio configuration can maximize competitive action frequency (we discuss configurations of other portfolio attributes in the Discussion section). In Table 1, however, we summarize the portfolio attributes that we examine in this study. We focus on structural holes, R&D alliance scope, and equity alliances because (a) they have been highly prominent and frequently examined portfolio attributes in previous research and (b) they distinctively relate to each theoretical mechanism and to each part of the action development process. We next discuss how structural holes, R&D alliance scope, and equity alliances individually relate to opportunity recognition capacity, opportunity development, and action execution capacity, respectively. Then we explain how they interact and collectively increase competitive action frequency.

Structural Holes and Opportunity Recognition Capacity

Actors (firms or individuals) "are not simultaneously aware of opportunities. . . . Even if information is of high quality, and eventually reaches everyone, the fact that diffusion occurs over an interval of time means that individuals informed early or more broadly have an advantage" (Burt, 2000: 351). Actors embedded in networks rich in structural holes are more often exposed to such informational advantages than are actors in networks lacking structural holes (Burt, 1992). *Structural hole* refers to the absence of ties between an actor's partners (alters). Actors spanning many structural holes can access nonredundant information from various disconnected network clusters. Members of clusters monitor and communicate more frequently with one another and tend to be less aware of activities of firms in other clusters. Thus, information becomes homogenous within clusters and heterogeneous across clusters. Consequently, actors linked with partners from disconnected clusters have access to diverse information, which in turn enables them to recognize new possibilities for entrepreneurial action (Burt, 2004).

Exposure to diverse information enables firms to expand their "productive opportunity"—possibilities for discovering new productive resource combinations (Penrose, 1959). As access to information about the availability of new resources increases, so does the pool of unused combinations of productive resources. As a result, possibilities for discovering new resource bundles increase at a combinatorial rate (Moran & Ghoshal, 1999), enhancing the potential to recognize new opportunities because there is a dynamic interaction between a firm's available resources and market opportunities (Penrose, 1959). Hence, exposure to diverse information predisposes firms to "connect the dots"—to recognize connections between seemingly unrelated trends, events, technologies, and other complementary resources (Baron, 2006: 106). In sum, structural holes increase exposure to diverse information, which increases the capacity to recognize new opportunities for developing competitive actions, such as new vehicle models, new versions of existing vehicle models, and entry into new market segments.

R&D Alliance Scope and Opportunity Development Capacity

The ability to recognize opportunities for actions differs from the ability to evaluate the feasibility of opportunities and to conceptualize new competitive actions. Firms recognizing opportunities will have information or ideas for initiating possible competitive actions, but to convert ideas into actions, they need technical knowledge to assess opportunity viability and to design new competitive actions (Ardichvili et al., 2003; McMullen & Shepherd, 2006). Accumulated knowledge, however, facilitates or constrains the opportunity assessment and development processes (Haynie et al., 2009). Exposed to the same information about an emerging technology, some will pursue new opportunities and some will not, depending on their distinct learning experiences. For example, firms with accumulated knowledge in ceramics were more likely to realize how three-dimensional printing technology could be applied to produce efficient ceramic filters for the power generation industry (Shane, 2000). Accordingly, firms with broader knowledge bases will evaluate and judge more opportunities to be feasible. In contrast, firms that underinvest in developing new knowledge limit their ability to discern the commercial potential of emerging technologies (W. Cohen & Levinthal, 1990).

Knowledge bases can be expanded through portfolios containing collaborative R&D alliances encompassing many industries and technological fields. Firms increasingly form R&D partnerships to explore new knowledge and compete more successfully in many industrial sectors, including the automobile manufacturing industry—a research setting relevant for this study (Hagedoorn, 1995). R&D alliances are a more efficient and flexible mode of learning than acquisitions, and compared to other types of alliances, they are the most knowledge-intensive type of alliance, involving close interactions and exchange of tacit knowledge between partners (Kumar & Nti, 1998; Lavie & Rosenkopf, 2006). Because firms have limited resources to explore multiple technological areas, joint R&D investments leverage their resource potential. As a result, R&D alliances expand knowledge, which then enables firms to be more receptive to emerging opportunities and more proactive in evaluating their prospects (Lavie & Rosenkopf, 2006). Thus, the scope of collaborative R&D activities "opens an organization's eyes to the need for accessing ideas and information from a variety of sources, [and] to exploit the research findings in a commercial context" (Powell et al., 1996: 120).

The scope of collaborative R&D activities is especially important for our sample of automakers. Automobiles are highly complex and comprise hundreds of components requiring specialized design and manufacturing expertise (Ulrich, 2003). Broad technological knowledge bases allow conceptualization of new designs by mixing and matching components over time (Sanchez & Mahoney, 1996). Table 2 shows examples of Toyota's wide investments in automobile manufacturing technologies through R&D alliances, which enhances the ability to design new concept vehicles and develop improved versions of existing models.

Equity Alliances and Action Execution Capacity

Although critical, opportunity recognition and opportunity development capacities are insufficient for increasing the frequency of competitive actions; action execution capacity is indispensable. Rapid market introduction requires support from many reliable and trustworthy alliance partners willing to invest jointly to bring products quickly to the market. Equity ownership strengthens the relationship and signals credible commitment between partners for customized investments (Dyer & Ouchi, 1993). Portfolios predominantly consisting of equity alliances partially explain performance differences in the automobile industry (Dyer, 1996). Japanese automakers achieved advantage by maintaining many alliances with *kankei kaisha* partners, that is, companies like Toyota affiliate Nippondenso in which the "parent firm will usually have a minority equity position" (Dyer, 1996: 655).

We argue that equity alliances enable firms to develop a *stable* network of *reliable* partners, which in turn increases their action execution capacity. Equity alliances involve hierarchical elements—such as authority systems, incentive systems, dispute resolution mechanisms, and nonmarket pricing systems—that align partners' interests, reduce motivations for opportunistic

Table 2
News Examples for R&D Alliance Scope and Competitive Action Types

News Examples for Toyota's R&D Alliance Scope[a]	Knowledge Domain
Toyota Motor Corp and Nissan Motor Corp planned to form a strategic alliance to manufacture and develop . . . new gasoline-electric hybrid vehicles.	Gasoline-electric hybrid vehicles
Seikusui Chemical Co Ltd and Toyota Motor Corp have agreed to jointly develop a recyclable material for use in automobile interiors. The material was a strong, lightweight composite of polyethylene resin and glass fiber. . . . Toyota planned to use the recyclable material in the ceilings of its new passenger cars.	Plastic materials and synthetic resins
Exar Corp, Texas Instruments, Motorola Inc, National Semiconductor, General Instruments, International Rectifier Corp and Toyota Motor Corp formed a strategic alliance to develop 28 design-in projects for automotive purposes. The projects call for integrated circuits and other semiconductor applications to be used in the design of car navigation systems.	Semiconductors and related devices
Toyota Motor and Volkswagen began to study the possibility of jointly developing small gasoline engines for passenger cars. The engines would combine Toyota's lean-burn engine technology and Volkswagen's aluminum engine technology.	Aluminum engine technology
EPA Ecology Pure Air Inc, a unit of EPA Enterprises Inc, and Toyoda Sankyo Co, a unit of Toyota Motor Corp, have entered into an agreement in which Toyoda was slated to test EPA's gasoline and diesel engines. . . . The CEM Catalyst was a device designed to treat fuel before it entered the combustion chamber of engines.	CEM Catalyst technology
Chrysler Corp, Ford Motor Co, Honda Motor Co Ltd, Mazda Motor Co, Nissan Motor Co, and Toyota Motor Corp joined forces to develop a conventional battery charger for electric vehicles.	Battery chargers
Matsushita Electrical Industrial Co, Toyota Motor Corp, and Toyoda Automatic Loom Works Ltd formed a joint venture to develop, manufacture, and market nickel metal hydride rechargeable batteries for automobile . . .	Nickel metal hydride batteries
Denso Corp and Toyota Motor Corp formed a strategic alliance to provide research and development services on fuel-injection pump in Japan . . .	Fuel-injection technology
General Motors Corp and Toyota Motor Corp planned to form a five-year strategic alliance (SA) to provide research and development services of cars and trucks that can run off fuel cells and other environmentally friendly alternative-fuel technology.	Alternative-fuel technology
Kuozui Motors Ltd, a joint venture between Toyota Motor Corp (TM) and Hotai Motor Co in Taiwan, and TM planned to form a strategic alliance to provide R&D services for new car models in Taiwan.	Market specific knowledge
Toyota Motor Corp (TM), Aisin Seiki Co Ltd (AS), Sumitomo Electric Industries Ltd (SE) and Denso Corp (DC) formed a joint venture to manufacture, market and develop automobile braking systems and brake parts in Kariya, Japan.	Braking systems
News Examples for Competitive Action Types[b]	**Action Type**
July 1, 1992: Ford's Lincoln unit reduces Tracer model price by $234 . . .	Pricing
February 14, 2002: Canadian jazz diva Diana Krall is taking her smoky voice on the road to promote Chrysler cars.	Marketing
March 27, 1999: General Motors is freshening the Chevrolet Cavalier for 2000. More effort was put into renovating the interior of Cavalier . . . Outside styling gets minor tweaks . . .	Product improvements
August 25, 2003: Volkswagen rolls out new Golf compact. Volkswagen expects significantly lower earnings this year, mainly because of the cost of launching fresh models, especially the Golf.	New products
October 21, 2002: GM's Saturn unit unveils new small car, the Ion . . .	
July 7, 1993: Toyota opens plant in Troy, Missouri to supply aluminum cylinder heads to Toyota Camry plant in Kentucky.	Market expansions
March 21, 1996: First shipment of Toyota Camrys to Middle East . . .	

[a]Retrieved from the SDC Platinum database: http://thomsonreuters.com/sdc-platinum/
[b]Retrieved from the Factiva database: www.factiva.com

behavior, and ensure effective interpartner coordination (Gulati, 1995; Gulati & Singh, 1998; Pisano, 1989). As a result, partners develop relational trust, which leads to more intensive exchange of tacit knowledge and proprietary information (Rowley et al., 2000; Uzzi, 1997) and encourages partners to invest in transaction-specific assets (Williamson, 1975). By aligning interests and fostering greater trust and confidence in the partnership, equity alliances provide "the glue that binds partners together" (Das & Teng, 1998: 498). In addition, equity alliances provide lower alliance turnover and ensure greater alliance portfolio stability. They are difficult and costly to dissolve because they involve shared equity and other governance mechanisms. Equity-based governance also involves dispute resolution mechanisms that reduce conflicts between partners. Finally, equity alliances, unlike nonequity alliances, are long-term oriented, creating conditions for maintaining durable partnerships (Das & Teng, 2000; Gulati, 1995; Gulati & Singh, 1998).

A stable and reliable network of partners is critical for effective and fast execution of competitive actions. Trustworthy partners are willing to invest additional resources to support novel actions, for example, by investing in new equipment, acquiring new technology, or upgrading and expanding manufacturing capacity. More important, they respond rapidly when needed, exert extra effort in helping confront competitive pressure, and confer preferential treatment (Dyer, 1996; Dyer & Nobeoka, 2000; Dyer & Ouchi, 1993; Uzzi, 1997). In addition, durable relationships with suppliers and manufacturers lead to the development of "network identity," a collective sense of shared purpose that motivates greater cooperation (Dyer & Nobeoka, 2000: 352). As a result, informal and frequent communication increases the efficiency and rapidity of new product introduction, engenders continuous product improvement, and avoids product malfunctioning and recalls (Dyer, 1996). In sum, alliance portfolios with a high proportion of equity alliances indicates that the firm has a strong support from alliance partners (suppliers, distributors, complementors, and rivals[2]) in the process of manufacturing and launching competitive actions in the marketplace.

The Joint Effect of Structural Holes, R&D Alliance Scope, and Equity Alliances

As discussed, each portfolio attribute—structural holes, R&D alliance range, and equity alliances—provides distinct competitive benefits, but individually, they are insufficient to increase competitive action frequency. The effect of each attribute is contingent on the other attributes, and the three operate synergistically. Specifically, alliance portfolios rich in structural holes provide diverse information but lack mechanisms for developing trust among partners, which is necessary for effective coordination and fast action (Obstfeld, 2005). An alliance portfolio that incorporates many equity alliances can compensate for this deficiency. As argued, equity alliances engender a stable and reliable network of trustworthy partners willing to cooperate for achieving common goals. Furthermore, exposure to diverse information does not automatically imply that firms will accurately assess the market value of those opportunities and pursue them (Shane & Venkataraman, 2000). As Moran and Ghoshal (1999) noted, to discover new uses of available resources, firms must not only have access to diverse information but also correctly assess the resources' potential. R&D alliance scope can broaden the knowledge base and expand the ability to evaluate and conceptualize new action opportunities. Hence, the effect of structural holes on competitive action frequency is contingent on R&D alliance scope to enhance opportunity development capacity and on equity alliances to increase action execution capacity.

Similarly, the benefits from R&D alliance scope are limited without diverse information about new markets, emerging technologies, new products in unrelated industries, or new patterns and shifts in customer preferences. When structural holes complement R&D alliance scope in an alliance portfolio, firms can use diverse market information to leverage the knowledge base by frequently recognizing new applications of the firm's existing resource potential. In addition, with timely information, firms can better anticipate competitive moves of other market participants (e.g., rivals, suppliers, or firms with complementary products), thus enhancing opportunity evaluation capacity. Furthermore, equity-based alliances ensure support from trustful partners critical for rapid market introduction. Lack of trust also hinders knowledge transfer between partners and limits the ability to accumulate new knowledge, thus suppressing the benefits from R&D alliance scope and slowing down the process of evaluation and conceptualization of new actions. Recent research supported this argument, suggesting that firms with diverse R&D partners benefit more from equity alliances than from nonequity alliances (Sampson, 2007). Thus, the effect of R&D alliance scope on competitive action frequency depends on the presence of both equity alliances and structural holes.

Finally, equity alliances alone are insufficient for increasing competitive action frequency. Firms may have a strong support of suppliers, distributors, and manufacturers to bring actions quickly to the marketplace but still lack capacity to discover new opportunities and design new actions. Uzzi (1997: 59) argued that a high proportion of strong ties may insulate the firm from access to diverse information and lower its potential to recognize new possibilities. Recent research also suggests that equity alliances and structural holes have synergistic effects on firm performance (e.g., Ma, Huang, & Shenkar, 2011; Rowley et al., 2000; Tiwana, 2008) and that network characteristics that stimulate opportunity recognition are different from those that support resource mobilization (Obstfeld, 2005). In addition, a stable and durable network of alliance partners tends to homogenize network knowledge, limiting the ability to develop the broad knowledge base critical for opportunity development. Thus, an effective alliance portfolio must complement equity alliances with attributes that increase exposure to diverse information (structural holes) and those that broaden its knowledge base (R&D alliance range) to compensate for the shortcomings of strong ties.

In summary, structural holes, R&D alliance scope, and equity alliances play distinctive and interactive roles in the action development process. The presence of one portfolio attribute activates the effect of the other portfolio attributes, and the absence of one portfolio attribute may suppress the effect of the other two attributes. For example, the lack of equity alliance partners dampens the firm's ability to carry out competitive actions, which diminishes the positive interactive effects of structural holes and R&D scope on competitive action frequency. Firms may recognize and design many new competitive actions, but the lack of equity alliances will hinder their ability to carry out those actions and thus will decelerate competitive action frequency. Thus, in this case, the presence of trustful equity alliance partners actuates the positive interactive effect of structural holes and R&D scope on competitive action frequency. Hence, we expect that high levels of all three attributes will lead to increased competitive action frequency, whereas low levels of any of the three attributes will diminish competitive action frequency.

Hypothesis 1: Structural holes, R&D alliance scope, and equity alliances will positively interact in explaining competitive action frequency; the effect will be strongest when an alliance portfolio configuration incorporates high levels of structural holes, R&D alliance scope, and equity alliances.

The effect of alliance portfolio configuration on competitive action frequency can vary across different action types. Previous competitive dynamics research has paid particular attention to how the various types of competitive actions affect competitive behavior (e.g., Chen et al., 1992; Chen & MacMillan, 1992). Given that competitive action is the basic unit of analysis and the most prominent and distinctive feature of competitive dynamics research (Chen & Miller, 2012), we consider action type as a critical variable that influences the relationship between alliance portfolio configuration and competitive action frequency.

In general, competitive actions vary across three dimensions: complexity, resources, and time. For example, *strategic* actions, such as developing new products, are more complex to develop and require more time and resources to develop and execute, whereas *tactical* actions, such as price cuts, require less time and resources and are typically less complex. These substantial qualitative differences between strategic and tactical actions have significant influence on competitive behavior (Chen et al., 1992; Chen & MacMillan, 1992; Smith et al., 1991, 2001).

We argue that effective alliance portfolio configurations are more critical for developing and introducing strategic actions, which are more complex and resource intensive, than for the frequency of undertaking tactical actions. For example, automobiles are complex systems comprising many components manufactured by various firms. Access to timely market information about newly developed components is critical for recognizing opportunities for new concept vehicles (Ulrich, 2003). Once opportunities are recognized, automakers must know how to integrate many capabilities to develop attractive designs, innovative features, and well-engineered products. They must be sufficiently competent to incorporate new elements into a distinguishable yet consistent brand image that will satisfy continuously changing customer preferences (Schamp, Rentmeister, & Lo, 2004). Thus, firms with exposure to diverse information (structural holes) and a broad knowledge base (R&D scope) will be more able to develop complex actions frequently. In addition, a network of trustworthy partners is particularly important because automakers must collaborate and coordinate activities with many suppliers, manufacturers, and distributors to bring complex and resource-intensive actions to the marketplace quickly. Thus, effective alliance portfolios can simultaneously increase the speed of developing complex actions, provide necessary resources for action execution, and decrease the market introduction time.

Hence, the more complex and difficult to execute are the competitive actions, the stronger is the alliance portfolio configuration's effect on competitive action frequency. In contrast, tactical actions, such as price cuts, are less complex to develop and demand smaller resource commitments to execute, so their frequency is less dependent on network resources. Thus, the joint effect of structural holes, R&D alliance scope, and equity alliances will be weaker for tactical action frequency and stronger for strategic action frequency.

Hypothesis 2: The three-way interaction effect of structural holes, R&D alliance scope, and equity alliances will be stronger for strategic action frequency than for tactical action frequency.

Method

Sample Selection

We tested our framework on a sample of global automobile industry (SIC 3711) firms selling in the North American market: GM, BMW, Ford, Honda, Nissan, Mazda, Chrysler, Daimler, DaimlerChrysler, Toyota, Volkswagen, and Mitsubishi. The automobile industry has clearly identifiable boundaries for comparing competitive and collaborative activities. The industry consists of large, visible, and newsworthy global firms that have long exhibited intense competitive interaction. In addition, automakers extensively collaborate with suppliers, competitors, distributors, manufacturers, and research institutions.

We focused on investigating the competitive activity of automakers in the passenger car segment (sedans, coupes, hatchbacks, convertibles, station wagons, luxury cars, and sports cars). We also included SUVs, pickups, and vans/minivans as suggested by the U.S. Department of Transportation Federal Highway Administration (FHWA) classification scheme (www.fhwa.dot.gov/policy/ohpi/vehclass.htm). To check the robustness of our results, we tested all models using both narrower and broader conceptualization of the passenger car segment and found consistent results. Compared with the commercial vehicle segment, the passenger car segment comprises a wide variety of vehicle makes, models, and model-line extensions and spans a wide range of prices, from $12,000 to $250,000. As a result, automakers use many competitive moves to attract customers (e.g., price cuts, promotions, sale incentives, creative advertising, product improvements, new market entries, and new vehicle versions). Because passenger cars are primarily sold to end customers (rather than business to business), the media extensively covers automakers' actions.

Competitive Actions Data

We used structured content analysis to capture automakers' competitive activity (e.g., Jauch, Osborn, & Martin, 1980; Ryan & Bernard, 2000; Smith et al., 2001). First, we identified the complete range of vehicle models in the passenger car segment for each automaker in our sample as listed in *Kelly Blue Book* (www.kbb.com). Then, we used Factiva to search for all published news articles and announcements of competitive actions the 12 major automakers carried out over a 16-year period (1988 to 2003). We applied the following search criteria within the Factiva search engine: auto company names, vehicle model names (passenger cars listed in *Kelly Blue Book*), and panel time markers (from January 1, 1988 through December 31, 2003). This first-stage data collection process yielded an initial pool of more than 14,000 news items. Because our study examined the relationship between alliance portfolios and competitive actions, we excluded news reports that related to internal or factor-market organizational actions and limited our definition of competitive actions to externally directed and product-market competitive moves related to a specific vehicle brand. To further isolate and more clearly distinguish *product-market* actions from *factor-market* actions, we collected competitive actions data at the product level (vehicle model) and alliance data at the corporate level. Thus, we examined how the properties of the alliance portfolio (access to resources available in factor markets) affected a firm's propensity to compete intensively in various product-market segments in the future period. Then we randomly selected 10% of the final set of news articles and, in consultation with two industry insiders/experts, used them to inductively and iteratively identify all possible categories of competitive actions.

Our action-coding process yielded five categories: *pricing* (e.g., price cuts and sale incentives), *marketing* (e.g., new advertising and promotional campaigns), *new products* (e.g., new brand-name models or a new generation of an existing model that involves a major redesign, such as VW Golf 2, or VW Golf 3), *product improvements* (e.g., involving only minor exterior or interior styling changes), and *market expansion* (e.g., entry into new international markets, building new manufacturing facilities, adding new dealerships). We identified 5,674 competitive actions: 376 pricing, 1,583 marketing, 1,589 product improvements, 1,056 new products, and 1,070 market expansions. Table 2 provides a complete list of our competitive action categories, examples, and earliest dates of news announcements. To test for coding reliability, we randomly selected 1% of the articles, which two graduate students independently recoded. Perreault and Leigh's (1989) reliability index was 0.88, exceeding the convention of 0.70 (Ryan & Bernard, 2000).

Alliance Portfolio Data

Our main source for alliance data was the SDC database (Thomson Financial), which is the most comprehensive (Schilling, 2009). We first identified all alliances our 12 automakers formed from 1988 to 2003. This initial search generated 1,471 unique partners. Then we searched for alliances formed by these 1,471 partners for the same period. This additional search produced 37,520 alliances formed among automakers and their partners for 1988 to 2003. This approach enabled us to capture not only an automaker's alliances but also alliances formed among the partners of the automakers, which is critical for reliable measurement of structural holes. By considering additional partners, we extend previous research that exclusively focused on alliances among competitors (e.g., Gnyawali & Madhavan, 2001; Gnyawali et al., 2006). We include alliances with competitors, suppliers, distributors, providers of complementary products, and other firms from unrelated industries (Yoshino & Rangan, 1995).

We created matrices for each year from 1988 to 2003. We followed prior research and used a moving-window approach to create matrices. This approach reduces potential bias in alliance data from often-underreported data on alliance termination. In addition, the moving-window approach captures the lagged effect of alliance portfolio attributes on future competitive activity. Prior research has used 3- or 5-year moving windows (e.g., Lavie, 2007; Stuart, 2000). We chose the more conservative 3-year moving window as most appropriate for our research. Industry experts say that the automobile industry needs an average of 1 to 4 years to develop competitive actions: several months to 2 years to develop new marketing campaigns, 1 to 2 years for minor model updates, and 3 to 4 years for new models (new model platforms can take up to 60+ months, but we interviewed an industry expert who said, "Very rarely automakers today start from brand new vehicle platforms due to duration of the cycle and investment requirements"). Thus, given that we lagged independent variables 1 year, we captured alliance portfolio effects on competitive actions within a 4-year period before introduction. Results based on 4- and 5-year moving windows produced equivalent results.

Measures

Competitive Action Frequency

We computed this variable as the total number of competitive actions initiated in a given year. Because the number of actions differs substantially by action types, we standardized the number of actions within each action category by computing *z* scores across automakers/years for each of the five action types (e.g., Miller & Chen, 1996) and computed competitive action frequency by adding the *z* scores for each action category. Higher values on this measure indicate greater competitive action frequency. On average, automakers introduced 33 competitive actions yearly (*SD* = 32; min 0, max 141).

Structural Holes

We measured access to structural holes using Burt's (1992) network constraint index: $C = \Sigma_j(p_{ij} + \Sigma_q p_{iq} p_{qj})^2$, $q \neq i, j$, where p_{ij} is the proportion of *i*'s direct relations with *j*; $\Sigma_q p_{iq} p_{qj}$ indicates the extent to which another alliance partner of *i, q*, is also partner of *j*. We used UCINET VI to compute network constraint, which is based on a firm's ego network (the term *ego network* is equivalent with the term *alliance portfolio* in this paper; both refer to a firm's collection of alliances with partners; Borgatti, Everett, & Freeman, 2002). To capture the extent to which a firm enjoys access to structural holes, we subtracted all nonzero values of this index from 1 so that the higher values will indicate a firm's access to more structural holes in its network. *Zero* cases indicate no alliance partners and thus no structural holes (Shi, Sun, & Peng, 2012; Zaheer & Bell, 2005). This measure ranges from 0 to 1.

R&D Alliance Scope

We measured R&D scope as the number of industries in which automakers have formed R&D alliances. This measure captures the breadth of new knowledge they can accumulate in any given period. From the SDC database, we first selected precoded R&D alliances. On average, 14% of portfolio alliances were R&D alliances (*SD* = 11%; min 0%, max 42%). Then, we identified the three-digit primary SIC code for each R&D alliance, using alliance-specific SICs rather than partner-specific SICs to capture more directly the technological area/industry in which the partners work together to expand their knowledge. To compute R&D alliance scope, we counted the number of unique industries an automaker has R&D alliances with (e.g., Goerzen & Beamish, 2005). We normalized this measure by dividing the count by the total number of alliances in an alliance portfolio.

Equity Alliances

We computed this measure as the number of equity alliances divided by the sum of alliances. On average, 42% were equity alliances (min 0%, max 100%). To check the robustness of our findings, we also computed an alternative measure of action execution capacity—the number of equity alliances with exploitation intent (count of alliances with primary focus on assembling, distributing, marketing, financing, logistics, transportation, supply, warehousing, and manufacturing services). On average, 34% of alliances were equity alliances with exploitation intent (min 0%, max 100%). We tested the hypotheses using both measures, with identical results.

Control Variables

Firm size. We approximated *firm size* using the firm's total asset size in a given year. We log-transformed this variable to reduce positive skewness. Larger firms may possess more resources that may affect their capability to introduce new competitive actions and their tendency to form new collaborative ties.

Number of vehicle models. We controlled for the number of models that each firm positioned in the passenger car segment in a given year. Competitive intensity may also depend on the number of vehicle models sold. On average, automakers sold 9 models per year (min 0, max 36).

Firm performance. We controlled for past performance because prior research found that past performance affects future competitive actions (Ferrier, 2001). We measured performance as return on equity.

Multimarket contact. How extensively a firm shares multiple markets with rivals can affect its propensity to introduce competitive actions (Young, Smith, Grimm, & Simon, 2000). As a result, we expect that firms with multimarket contacts with many rivals will be less motivated to compete intensively. To control for multimarket contact, we computed the extent of shared common markets: average product-market overlap. First, we counted the number of vehicles each automaker sold in SUV, van/minivan, pickup/truck, sports car/luxury, and subcompact/medium class. We then created a firm-by-segment matrix (12 × 5) and converted it into a firm-by-firm (12 × 12) similarity matrix in which each cell represents the correlation between each two firms across five market segments. For each firm/year, we computed average market overlap by averaging similarity scores across all rivals. A higher correlation coefficient indicates greater multimarket contact with rivals.

Alliance portfolio size. We controlled for total number of alliances in each 3-year period for the possibility that portfolio size rather than the other portfolio attributes explains future competitive intensity (Wassmer, 2010). We log-transformed this variable to reduce positive skewness.

R&D intensity. We controlled for R&D expenditures to capture a firm's internal innovation efforts (Lavie & Rosenkopf, 2006). We log-transformed this variable to reduce positive skewness.

Action variety. This variable controls for the range of competitive actions carried out by a firm in a given year. We computed action variety using Blau's (1977) index: $\mathrm{H} = 1 - \sum_{\alpha=1}^{5} (p_\alpha)^2$, where p_α denotes the proportion of actions in the α category.

Statistical Analysis

In selecting an appropriate statistical model, we considered several issues. First, because unobservable firm-specific factors may affect our results, we applied both fixed-effects and random-effects panel data models to account for such endogeneity problems and found consistent results. Second, we also controlled for *time-specific* factors, such as abrupt changes in oil prices or economic downturns, by including a set of dummy variables for each year. Thus, our model can be formulated $Yit = \alpha_i + \gamma_t + \beta' x_{it} + \varepsilon_{it}$, where α_i is the effect of a firm i (i = 1 to 12), γ_t is the year t effect (t = 1 to 16), $\beta' x_{it}$ is the coefficient assumed to be constant across firms, and ε_{it} are the errors assumed to be independent and identically distributed (Greene, 2003).

The dependent variable for testing Hypothesis 2 was number of competitive actions, a count variable that contains zeros and nonnegative integers exhibiting a Poisson distribution. Therefore, we estimated a fixed effects negative binomial panel regression model with time-fixed effects. We chose negative binomial rather than Poisson regression model because equi-dispersion property was violated (Baltagi, 2008). Finally, following previous research, we tested configurational hypotheses using three-way interactions (e.g., Baker & Cullen, 1993; Dess et al., 1997). Because multiplicative interaction terms in regression models can cause multicollinearity, we tested for multicollinearity using variance inflation factors (VIF). Except for firm size (VIF = 6.85), VIFs for all variables were lower than 4 (below the critical value of 10). We estimated models with and without firm size. The results were unchanged.

Results

Table 3 shows the descriptive statistics and intercorrelation matrix of variables in the analysis. Our sample size is 154. Daimler and Chrysler were considered independent companies from 1988 to 1998 (so we had 11 automakers for this period) and one merged company (DaimlerChrysler) from 1999 to 2003 (10 automakers for this period). Thus, our sample includes 171 firm/year observations (11 firms * 11 years + 10 firms * 5 years). Because of missing values for some variables and because we lagged the independent variables 1 year, the sample size in the regression analysis was reduced to 154.

As expected, larger firms introduced more competitive actions, had more models, and maintained more alliances. In addition, the joint effect of the year dummy variables was significant, $\chi^2(14) = 104.30$, $p < .000$, indicating that time-specific factors affect the automobile industry's competitive and collaborative activity. Table 4 shows the results of the regression analysis. All independent and control variables were lagged 1 year vis-à-vis the dependent variables to increase our confidence in the causality of the effects. All variables were standardized before computing the interaction terms to reduce multicollinearity.

Model 4 in Table 4 shows the results for the three-way interaction between structural holes, R&D alliance scope, and equity alliances. The coefficient for Structural Holes × R&D Alliance Scope × Equity Alliances is positive and statistically significant at the 1% level ($b = 1.04$, $p < .001$), providing support for Hypothesis 1. As predicted, firms introduce the most competitive actions when their alliance portfolios incorporate high levels of structural holes, R&D alliance scope, and equity alliances. Model 5 in Table 4 shows the results for the negative binomial panel regression model, which also support Hypothesis 1 ($b = .14$, $p < .05$). Figure 1 displays the form of the interaction effects.

Although interaction plots are helpful for understanding the nature of the interactions, they do not allow for making inferences about whether the effect of the predicted combination of portfolio attributes is statistically different from the other combinations, and whether the slope of such a combination is statistically significant in predicting competitive action frequency (Dawson & Richter, 2006). Thus, we conducted two additional significance tests: a slope difference test and a simple slope test. The slope difference tests showed that the slope of Regression Line 1 (high R&D scope and high equity alliances in Figure 1) is statistically different from the slopes of Regression Lines 2 ($p < .001$), 3 ($p < .001$), and 4 ($p < .001$).

Table 3

Descriptive Statistics and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Competitive action frequency (standardized)	0.00	4.60	—																
2 Total number of actions	33.18	31.73	0.82*	—															
3 New products	6.18	5.80	0.74*	0.90*	—														
4 Improvements	9.29	9.07	0.76*	0.89*	0.76*	—													
5 Market expansions	6.26	7.29	0.67*	0.84*	0.76*	0.69*	—												
6 Marketing actions	9.26	11.21	0.76*	0.93*	0.82*	0.78*	0.74*	—											
7 Pricing actions	2.20	3.11	0.53*	0.61*	0.56*	0.56*	0.49*	0.48*	—										
8 Number of vehicle models	9.87	8.79	0.58*	0.60*	0.66*	0.76*	0.38*	0.62*	0.60*	—									
9 Action variety	0.65	0.18	0.18*	0.18*	0.02	0.00	0.03	0.01	0.03	–0.04	—								
10 Alliance portfolio size (log)	3.30	1.53	0.28*	0.30*	0.36*	0.37*	0.23*	0.27*	0.19*	0.46*	–0.02	—							
11 Prior performance (return on equity)	3.77	19.95	0.22*	0.24*	0.10	0.24*	0.08	0.27*	0.07	0.23*	0.00	0.10	—						
12 R&D intensity (log)	7.27	1.22	–0.05	–0.06	–0.03	–0.04	–0.11	–0.05	–0.01	0.01	0.12	–0.09	–0.06	—					
13 Firm size (log total assets)	10.93	0.97	0.62*	0.64*	0.68*	0.72*	0.50*	0.63*	0.53*	0.75*	0.21*	0.58*	0.24*	–0.06	—				
14 Multimarket contact	0.48	0.23	0.10	0.09	0.00	0.15	0.00	–0.01	0.08	0.21*	–0.03	0.11	0.23*	–0.04	0.27*	—			
15 Structural holes	0.76	0.21	0.35*	0.33*	0.25*	0.32*	0.17*	0.23*	0.20*	0.28*	0.08	0.50*	0.08	–0.14	0.58*	0.22*	—		
16 R&D alliance scope	0.10	0.08	–0.08	–0.09	–0.14	–0.01	–0.13	–0.17*	0.02	0.04	0.06	0.14	–0.10	0.02	–0.01	0.14	0.22*	—	
17 Equity alliances	0.42	0.22	0.22*	0.25*	0.19*	0.30*	0.22*	0.30*	0.09	0.22*	0.10	0.35*	–0.08	–0.11	0.20*	–0.14	0.23*	0.26*	—

Note: $N = 154$.
$*p < .05$.

Table 4
Fixed-Effects Panel Data Regression Models

	Fixed-Effects Panel Data Model				Fixed-Effects Negative Binomial Panel Data Model					
	Dependent Variable: Competitive Action Frequency (Standardized by Action Type)				Total Number of Actions	New Products	Product Improvements	Market Expansion	Marketing	Pricing
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Action variety	0.32	0.37	0.43	0.48	1.31**	1.37**	1.57*	0.94	0.69	1.19
	(1.13)	(1.10)	(1.08)	(1.00)	(0.38)	(0.53)	(0.66)	(0.65)	(0.64)	(1.38)
Number of vehicle models	5.13**	5.00**	4.48**	4.44**	0.60**	0.51**	0.76**	0.23	0.87**	0.91**
	(0.72)	(0.73)	(0.72)	(0.79)	(0.09)	(0.15)	(0.14)	(0.18)	(0.14)	(0.27)
Alliance portfolio size	0.74+	0.75+	0.49	0.49	–0.11+	–0.13	–0.09	–0.01	–0.07	–0.49**
	(0.38)	(0.39)	(0.35)	(0.30)	(0.07)	(0.08)	(0.10)	(0.09)	(0.10)	(0.16)
Prior performance (return on equity)	0.68**	0.70**	0.69**	0.69**	0.05*	–0.01	0.08*	0.03	0.08**	–0.01
	(0.14)	(0.15)	(0.13)	(0.13)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)	(0.07)
R&D intensity (log)	0.01	0.00	0.01	0.03	0.01	–0.01	0.03	0.01	0.02	–0.01
	(0.16)	(0.17)	(0.18)	(0.19)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)	(0.07)
Firm size (log total assets)	4.57*	5.04*	5.63*	5.52*	0.16	0.27	0.21	0.73*	–0.04	0.41
	(1.82)	(2.09)	(2.14)	(2.15)	(0.18)	(0.32)	(0.28)	(0.30)	(0.27)	(0.69)
Multimarket contact	–0.03	–0.04	0.02	–0.06	–0.01	–0.15+	0.11	0.08	–0.02	–0.19
	(0.35)	(0.32)	(0.31)	(0.32)	(0.06)	(0.08)	(0.11)	(0.09)	(0.09)	(0.16)
Structural holes (SH)		–0.25*	–0.02	0.21	0.07	0.05	0.03	–0.01	0.06	0.26
		(0.10)	(0.26)	(0.28)	(0.06)	(0.08)	(0.09)	(0.09)	(0.08)	(0.17)
R&D alliance scope (RDS)		0.28	0.51	0.5	0.08+	–0.07	0.07	0.14*	0.01	0.28*
		(0.26)	(0.30)	(0.31)	(0.04)	(0.06)	(0.07)	(0.07)	(0.06)	(0.12)
Equity alliances (EQ)		–0.09	–0.1	–0.33	–0.09	–0.16+	–0.07	–0.03	0.08	–0.14
		(0.38)	(0.37)	(0.36)	(0.07)	(0.09)	(0.11)	(0.10)	(0.10)	(0.19)
SH × RDS			0.29	0.50*	0.04	0.01	0.04	0.01	0.02	0.1
			(0.21)	(0.23)	(0.04)	(0.05)	(0.06)	(0.06)	(0.06)	(0.10)

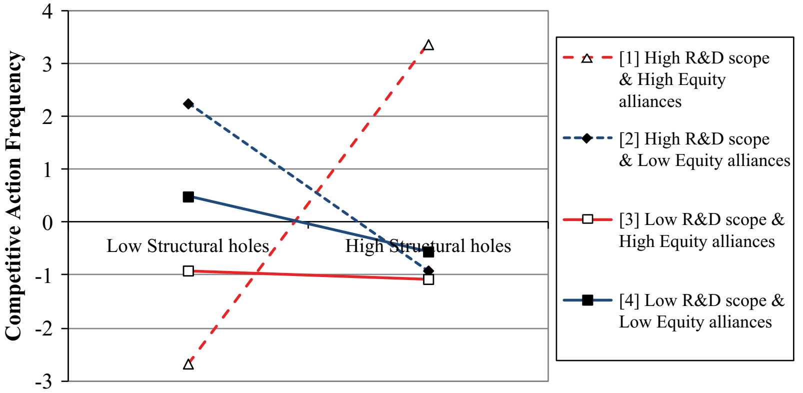
(continued)

Table 4 (continued)

	Fixed-Effects Panel Data Model				Fixed-Effects Negative Binomial Panel Data Model					
	Dependent Variable: Competitive Action Frequency (Standardized by Action Type)				Total Number of Actions	New Products	Product Improvements	Market Expansion	Marketing	Pricing
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
SH × EQ			0.03	1.26**	0.13+	0.28*	0.17	0.07	0.15	0.1
			(0.11)	(0.26)	(0.07)	(0.11)	(0.12)	(0.12)	(0.11)	(0.20)
RDS × EQ			0.27	0.16	0.04	0.01	0.1	0.03	0.04	–0.07
			(0.24)	(0.20)	(0.04)	(0.06)	(0.07)	(0.07)	(0.06)	(0.11)
SH × RDS × EQ				1.04**	0.14*	0.26**	0.21*	0.07	0.11	0.13
				(0.21)	(0.06)	(0.09)	(0.09)	(0.09)	(0.09)	(0.16)
Constant	1.04	2.68*	0.07	–0.31	2.32**	2.14**	1.17*	2.70**	2.68**	1.76
	(0.87)	(1.01)	(1.14)	(1.08)	(0.37)	(0.32)	(0.58)	(0.68)	(0.61)	(1.30)
Observations	154	154	154	154	154	154	154	154	154	154
Number of i	12	12	12	12	12	12	12	12	12	12
R^2/Wald χ^2	0.60	0.61	0.62	0.64	415.85	162.35	159.28	216.32	357.34	74.69

Note: Year dummies are included but not shown. Robust standard errors in parentheses.
$+p < .10$. $*p < .05$. $**p < .01$.

Figure 1
Three-Way Interaction Among Structural Holes, R&D Alliance Scope, and Equity Alliances



In addition, the simple slope of Regression Line 1 is positive and statistically significant ($p < .001$), providing further support for Hypothesis 1. We used +1 standard deviation and −1 standard deviation as conditional values for testing the significance of simple slopes (J. Cohen, Cohen, West, & Aiken, 2003).

Our post hoc analysis revealed another important finding. The simple slope of Regression Line 2 (high R&D scope, low equity alliances) is statistically significant and negative ($p < .001$). In addition, this regression slope is statistically different from the other regression slopes (Regression Line 1, $p < .001$; Regression Line 3, $p < .01$; Regression Line 3, $p < .04$). Thus, competitive action frequency is also high when firms maintain alliance portfolios with low equity alliances (many weak ties), low structural holes (dense network structure), and high R&D scope. This finding, which is also consistent with our configurational theoretical model, suggests that more than one portfolio configuration maximizes competitive action frequency (see the Discussion section for more detail).

Models 6 through 10 show the results for Hypothesis 2, which predicts that the three-way interaction will have a stronger effect for strategic than for tactical actions. Classifying actions as either strategic or tactical is somewhat arbitrary because actions vary across three dimensions—time, resources, and complexity—thus, we estimate models for each type of competitive action separately. Consistent with Hypothesis 2, the coefficient for Structural Holes × R&D Alliance Scope × Equity Alliances is statistically significant for the frequency of strategic actions, such as number of new products ($b = .26$; $p < .01$) and product improvements ($b = .21$; $p < .05$), whereas the same coefficient is nonsignificant for the frequency of tactical actions, such as pricing and marketing (Models 9 and 10). The form of the interaction effects for new products (Model 6) and product improvements (Model 7) is similar to that shown in Figure 1. However, contrary to our predictions, the three-way interaction effect is not significant in predicting the frequency of market expansions (Model 8), which might also be considered "strategic."

Robustness Check

We tested for possible reverse-causality problems. For example, managers might strategically decide to increase competitive action frequency, which would then motivate them to form more R&D and equity alliances. To address these concerns, we followed Makadok (1998: 688), who proposed the Granger-Sims causality test: "A causal relationship between two variables exists only if the coefficient is statistically significant when a lagged-dependent variable is also included as an independent variable in the regression." We tested our models controlling for lagged values of competitive action frequency applying a dynamic panel data model (Baltagi, 2008; Roodman, 2006). The results were identical to those shown in Table 4 (results are available on request).

Discussion

Competitive dynamics research has provided considerable evidence that firms that compete intensively by frequently introducing competitive actions gain larger market share and profits (Ferrier et al., 1999; Smith et al., 2001). Hence, an important inquiry for strategy research is, Why are some firms more able to introduce competitive actions frequently? We advance research on competitive dynamics by introducing alliance portfolio configuration as an important antecedent of a firm's ability to develop and introduce new competitive actions. Firms with mixed alliance portfolio attributes that maximize opportunity recognition, opportunity development, and action execution capacities are better able to frequently recognize new action opportunities and develop and execute many competitive actions. We find that alliance portfolios characterized by high levels of structural holes (opportunity recognition capacity), R&D alliance scope (opportunity development capacity), and equity alliances (action execution capacity) introduced 47 competitive actions per year. In comparison, firms with configurations that included low levels of R&D scope and equity alliances introduced fewer than 26 competitive actions (sample average is 33).[3]

Our study also shows that effective alliance portfolio configurations primarily drive the frequency of competitive actions that require more time, resources, and expertise, such as developing new products and improving product versions. First, automakers benefit from alliance portfolios with structural holes because developing new vehicle models or creating frequent updates and improvements of existing models requires constant information about new technologies and changes in customer preferences. Second, automakers need a broad knowledge base across a wide range of industries and technological domains to develop attractive and, more important, competitive products in terms of price and quality. Thus, portfolios with a wide R&D alliance scope enable firms to broaden their knowledge base for developing new families of derived product models by continually mixing and matching new and old components (Sanchez, 1995). Finally, automakers must collaborate closely with hundreds of component providers to hasten their manufacturing processes while avoiding product malfunctions and recalls. Therefore, they also must develop a stable network of reliable alliance partners willing to work closely with one another, to exchange timely and proprietary information, and to invest in specialized assets (Dyer, 1996; Dyer & Ouchi, 1993). Equity alliances enable firms to hasten the time to market, which in turn increases competitive action frequency. Hence, all three portfolio attributes combined—structural holes, R&D alliance scope, and equity alliances—drive the frequency of introducing new products and product improvements.

We believe industry-specific reasons explain why no support is found for alliance portfolio configuration effects on the frequency of other types of strategic actions, such as market expansions. Our sample consists of 12 global automakers that already maintain extensive worldwide dealership networks, so exposure to diverse information is less critical for discovering opportunities to enter new geographical markets. In addition, the decision to build a new assembly plant, for example, does not depend on exposure to diverse information and accumulated technological knowledge but is driven instead by the need to meet increased demand. Another reason for failing to find support for market expansion moves might be that we did not include "market scope" as a measure of knowledge base. Market scope (the range of alliance partners across different international markets) might capture a firm's accumulated knowledge relevant for evaluating and developing opportunities for market expansions more closely than R&D scope. Nevertheless, our findings show that effective alliance portfolio configurations increase the frequency of the entire competitive repertoire, an aggregate of all action types. This finding suggests that new product introductions and product improvements open opportunities for launching other actions, such as marketing campaigns, sales incentives, market entry, and capacity extensions.

Consistent with the concept of equifinality in configurational research (Meyer et al., 1993), our study suggests more than one optimal alliance portfolio configuration. We find that multiple alliance portfolio attributes can provide similar network resources. For example, both structural holes and nonequity alliances (weak ties) provide diverse information, whereas ego network density and equity alliances (strong ties) both provide support from reliable and trustful partners. First, weak ties provide access to novel and diverse information, which enhances opportunity recognition capacity (Granovetter, 1973). Second, similar to equity alliances, a dense network structure generates trustworthy and committed partners, discourages opportunistic behaviors, and motivates partners to share proprietary knowledge (Coleman, 1988; Rowley et al., 2000), which in turn increase action execution capacity. Our results support this reasoning. Figure 1 shows that competitive action frequency is high when portfolios have low equity alliances (high proportion of nonequity alliances), low structural holes (high ego network density), and high R&D scope, which is an alternative optimal alliance portfolio configuration.

We also conducted post hoc factor analysis for identifying other combinations of portfolio attributes that can maximize competitive action frequency. Our analysis suggests that structural holes, technological partner diversity, geographical partner diversity, and alliance type diversity all provide advantageous access to diverse information (Goerzen & Beamish, 2005; Jiang, Tao, & Santoro, 2010; Lavie & Miller, 2008). Similarly, we find that repeated alliances and equity alliances form a single factor, suggesting that they provide similar benefits: reliable and trustworthy partners. However, these attributes might provide distinctive and more relevant information under certain competitive situations (e.g., repeated alliances in some contexts might provide more effective mechanisms than equity alliances for ensuring support from trustworthy partners; Gulati, 1995). We encourage future research to explore the conditions under which some portfolio configurations outperform others.

Our study also advances alliance portfolio configuration research (Hoffmann, 2007; Wassmer, 2010). We propose a theoretical model for identifying effective alliance portfolio configurations. Our model explains why and how alliance portfolio attributes are interrelated and jointly affect firm competitive performance. We find that portfolio attributes have generally weak or no individual effects on competitive action frequency. Collectively, however, the three attributes dramatically increase the ability to develop and introduce competitive actions. Thus, our model unravels synergies among various portfolio attributes that collectively drive competitive action frequency.

In addition, we contribute to social networks literature by addressing the recent call for more research on the interplay between structural and relational ego network properties (Rowley et al., 2000). We provide novel theoretical explanation as to why certain relational and structural properties reinforce each other, whereas others are redundant and substitutive. Although our theoretical explanation differs, our predictions and findings are still consistent with prior research that found empirical support for the argument that equity-based alliances (strong ties) substitute for dense networks and complement and enhance networks rich in structural holes (Rowley et al., 2000).

This study has several limitations for future research to address. First, a boundary condition is the assumption that firms must continuously create new competitive advantages to outperform rivals (e.g., Brown & Eisenhardt, 1998; D'Aveni, 1994). Accordingly, our analysis focuses on combining portfolio attributes that increase competitive action frequency. However, although most industries are hypercompetitive (D'Aveni et al., 2010), some firms compete in stable competitive environments that may require different alliance portfolios configurations. Second, firms pursuing different strategies might develop and benefit from certain portfolio configurations but not from others. Thus, performance effects of alliance portfolio attributes may depend on the firm's strategy (Koka & Prescott, 2008). We encourage future research to examine how competitive contexts and strategies affect the relationship between alliance portfolio configurations and competitive action frequency.

Furthermore, some attributes can provide more than one benefit. For example, R&D alliance scope primarily increases opportunity development capacity; however, through the process of evaluation and assessment of initial ideas, firms might recognize new ideas for actions. Although R&D scope provides some potential for recognizing new opportunities, it cannot compensate for the type of information that structural holes provide. Structural holes provide fast access to diverse information about emergent markets, new ways of serving customers, recent technological advances in unrelated industries, or changes in customer preferences that R&D scope cannot provide. In contrast, R&D scope basically reflects a firm's accumulated knowledge, which in our model is important primarily for refinement of new ideas, assessing their feasibility and developing action concepts (e.g., product prototypes). We find that the sort of information that structural holes provide actually amplify the positive effects of R&D scope. Nevertheless, we encourage future research to explore the extent to which other portfolio attributes can play multiple roles in the action development process.

Although firms develop alliance portfolios for many reasons, our study shows that some alliance portfolio configurations provide greater potential for increasing competitive action frequency than others. Indeed, some portfolio attributes are easier to incorporate than others. For example, the extent to which structural holes are present in the alliance portfolio depends on the alliance partners' decisions to form alliances with one another. Nevertheless, our theoretical model can be a useful analytical tool for managers to analyze the effectiveness of their alliance portfolios and better understand the sources of their competitive advantages.

Our study suggests that effective alliance portfolio configurations can be a sustainable source of competitive advantage. At least three factors prevent rivals from imitating effective alliance portfolio configurations. Late movers may fail to find quality partners across clusters (industries or nations) to increase their exposure to diverse information. Even if alliance partners are available, finding reliable partners and developing trustworthy relationships is challenging and costly. Later movers need several years to develop necessary R&D alliance experience to expand their knowledge bases and thus increase their opportunity development capacity. Given that all three attributes—structural holes, R&D alliance scope, and equity alliances—should be simultaneously developed, rivals are further challenged in their efforts to replicate effective alliance portfolio configurations.

Indeed, firms must continuously reconfigure their alliance portfolios to keep their advantage because networks exhibit tendency toward transitive structural triads, suggesting that structural holes might diminish over time (Madhavan, Gnyawali, & He, 2004). We tested for this possibility by regressing structural holes on time. Although we find a negative relationship, it is statistically insignificant in our sample, perhaps because in the automobile manufacturing industry, automakers frequently create new structural holes by actively forming new alliances (Hagedoorn, 1995), which offsets the tendency for structural holes to close over time. Although we find no industrywide tendency for structural holes to decay, we find a large interfirm variation in the effectiveness of automakers' alliance portfolio configurations. Thus, our study suggests that alliance portfolio configurations affect competitive activity. Designing effective alliance portfolio configurations can be an important strategy for creating new competitive advantages and staying ahead of rivals.

Notes

1. Ardichvili, Cardozo, and Ray (2003: 111) considered opportunity development and opportunity evaluation as intertwined processes because "opportunities are evaluated at each stage of their development." In addition, the processes are both conceptually distinct from opportunity recognition.

2. Automakers frequently form equity alliances with rivals to increase the action execution speed. For example, consistent with "coopetition" literature (Gnyawali & Madhavan, 2001), our data reveal that automakers form equity alliances with rivals to jointly manufacture parts for their vehicles (e.g., in 1995, Mercedes-Benz and Porsche formed a joint venture to produce tops for Mercedes and Porsche Cabriolet automobiles), to provide marketing services (e.g., in 2001, GM, Suzuki, and Isuzu formed a joint venture to offer vehicle lineups and pricing via the Internet), to manufacture vehicles in new markets (e.g., in 2002, Peugeot Citroen and Toyota Motor formed a joint venture to manufacture small passenger cars in the Czech Republic), and to distribute vehicles in new markets (e.g., in 1995, Ford Motor and Kia Motors formed a joint venture to distribute vehicles in South Korea).

3. We used the estimated coefficients in Model 5 to compute the predicted values for competitive action frequency. The predicted values are anti-log transformed.

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