COMPETITIVE CONDITIONS AND PROPENSITY TO COLLABORATE: A FIRM DYAD INVESTIGATION

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ABSTRACT

Inter-organizational collaboration and the dynamics of competition have been prominent topics in strategy and organizational research over the last 25 years. Considerable evidence has accumulated supporting the notion that competitive conditions among firms in an industry are heterogeneous and that rivalry between firms varies (i.e. Cool & Dierickx, 1993; Baum & Singh, 1994; Baum & Korn, 1996; Chen, 1996). While cooperative arrangements allow firms to buffer competitive pressures, few studies (Gimeno, 2004; Park & Zhou, 2005; Trapido, 2007; Ang, 2008) have examined how competitive conditions influence alliance formation. Yet, the mechanisms underlying the development of such conditions are complex. This dissertation adopts a dyadic approach to investigate how competitive intensity experienced by two firms in a dyad as well as competitive rivalry between two firms, assessed by their level of strategic similarity and multimarket contact, impact firms' propensities to form alliances in the same industry. I find that dyad-level competitive intensity positively influences firms' propensity to form alliances; that firms from the same strategic group form alliances at higher rates than firms from different strategic groups; that the level of multimarket contact between two firms is inverted u-shaped related to their propensity to form alliances; and that dyadic resource redundancy and public ownership of alliance partners negatively moderate the positive impact of dyad-level competitive intensity on firms' propensity to form alliances in the same industry. The context of this dissertation is the United States hospital software industry, where firms provide administrative and clinical software solutions for community hospitals, between the years 1963 and 1991 (Singh, 1993).

RÉSUMÉ

La coopération interentreprise et la dynamique de la concurrence sont, depuis 25 ans, des sujets majeurs en stratégie et recherche organisationnelle. De très nombreuses données indiquent que la concurrence entre les entreprises d'une même industrie est hétérogène et que varie la rivalité entre les entreprises (Cool & Dierickx, 1993; Baum & Singh, 1994; Baum & Korn, 1996; Chen, 1996). Des ententes de coopération permettent aux entreprises d'atténuer les pressions concurrentielles, mais peu d'études (Gimeno, 2004; Park & Zhou, 2005; Trapido, 2007; Ang, 2008) se sont penchées sur la façon dont la concurrence marque la formation d'alliances. Les mécanismes qui sous-tendent cet état de choses sont complexes. C'est sous l'angle dyadique que j'analyse ici l'intensité concurrentielle de deux entreprises tant en relation dyadique qu'en rivalité concurrentielle, déterminées par leur degré de similarité stratégique et de contact multimarché, et que je tente d'établir de quelle façon cette intensité influe sur la propension des entreprises à former des alliances dans la même industrie. Les résultats de la recherche révèlent que l'approche dyadique a une influence positive sur la formation des alliances; les entreprises d'un même groupe stratégique forment plus d'alliances que les entreprises de groupes stratégiques différents; le niveau de contact multimarché de deux entreprises présente une forme de U inversé, fonction de leur propension à former des alliances; et la redondance des ressources dans un contexte dyadique et la propriété publique des partenaires de l'alliance ont un effet négatif modéré sur l'impact positif qu'a l'intensité concurrentielle dyadique en ce qui concerne la propension des entreprises à former des alliances dans une même industrie. La présente recherche expose la situation de l'industrie logicielle en milieu hospitalier américain, où les entreprises ont offert des solutions logicielles d'ordre administratif et clinique aux hôpitaux communautaires de 1963 à 1991 (Singh, 1993).

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CHAPTER I

INTRODUCTION

Inter-organizational collaboration and the dynamics of competition have been prominent topics in strategy and organizational research over the last 25 years. This major interest is owed to the fact that present day firms are increasingly exposed to dynamic changes in their environment, with reduced product-life cycles imposing high pressures to innovate thus quickly changing the competitive landscape. Yet, individual firms' resources and capabilities are limited and, as a consequence, often constrain their ability to react adequately to environmental changes. As a response, firms lacking important competencies increasingly choose to cooperate with one another in an attempt to lessen competition, close crucial resource gaps and to ultimately increase their chances of survival. Past research has shown that the rate at which firms form cooperative arrangements such as strategic alliances has increased significantly in recent years (Dyer, Kale, & Singh, 2001), and has demonstrated that alliances have the potential to reduce firms' risk of failure (Mitchell & Singh, 1996) as well as to improve firm performance (Singh & Mitchell, 2005).

Owed to their importance in firms' repertoire of strategic options, strategic alliances have been studied extensively and support has been found for substantial variation in factors

motivating firms to form credible cooperative ties. Among these factors, the level of competition in an industry constitutes a major threat to actors' chances of survival and substantial research has been dedicated to the investigation of how firms seek to ease competitive pressures through cooperative behavior. Although collaboration has the potential to improve firm performance, firms that compete simultaneously in the same industry face the additional challenge of balancing cooperative efforts with their competitive conditions. Previous research has accumulated considerable evidence that the competitive situation of firms in an industry is not homogeneous and that rivalry among firms varies (i.e. Cool & Dierickx, 1993; Baum & Singh, 1994; Baum & Korn, 1996; Chen, 1996). This suggests a dyadic structure of competition among firms in an industry with unique competitive characteristics between pairs of firms across time.

While firms' competitive conditions vary and an extensive literature suggests that cooperative arrangements allow firms to mitigate competitive uncertainty, few studies (Gimeno, 2004; Park & Zhou, 2005; Trapido, 2007; Ang 2008) have explicitly studied how competitive conditions influence alliance formation. In spite of these advances, to date, questions remain about how firm and dyad specific competitive conditions influence firm propensities to form alliances in the same industry.

Three recent studies in particular (Gimeno, 2004; Trapido, 2007; Ang, 2008) have investigated aspects of how competitive forces might impact firms' propensities to form alliances. While Gimeno (2004) explored how firms responded to rivals' alliances through the formation of new alliances and suggested that firms' reactions depended on rivals' alliance characteristics, Trapido (2007) showed how past levels of competitive rivalry between two firms impacted their likelihood of forming an alliance in the following time period and found support for a positive relationship between previous levels of competitive rivalry and alliance formation.

Finally, taking a resource-based theoretical lens, Ang (2008) found that firms experiencing low and high levels of competitive intensity formed alliances less often than firms experiencing intermediate levels of competitive intensity.

Yet, while Gimeno (2004) explored competitive influences of third-parties, Trapido (2007) focused on the effect of previous levels of competitive rivalry between two firms and Ang (2008) investigated competitive intensity at the firm level, the investigation of how dyad-level competitive forces drive collaborative activity in an industry remains widely unaddressed. This study seeks to close this gap by investigating how competitive forces measured at the dyad level impact firms' propensities to collaborate in the same industry.

The investigation of competitive conditions on the formation of alliances at the dyad level is important because characteristics of the dyad have been suggested to have specific important consequences for firm behavior (e.g. Greve, Baum, Mitsuhashi, & Rowley, 2010). Dyadic relationships are at the origin of larger network structures and their attributes can have significant impact on firms' interactions (Rowley, Greve, Rao, Baum, & Shipilov, 2005). The importance of the dyad for scholarly investigation has been acknowledged by previous research (e.g. Gulati, 1995b; Gulati & Gargiulo, 1999). For example, Scott and Davis (2007: 300) state that:

> "…the propensity to form alliances can depend on the joint characteristics of a potential pair…and on their broader surroundings."

To improve our understanding of the link between competitive conditions and firms' propensity to form alliances, this study builds on theoretical arguments about two factors that have been argued to drive levels of dyadic competitive rivalry, the degree to which two firms are strategically similar and are multimarket competitors, and links them to firms' propensities to

cooperate in the same industry. By doing so, this study also addresses important theoretical tension that exists between industrial organization (IO) economics and population ecology regarding each theory's prediction of how strategic similarity affects the dynamics of competition among firms in an industry. While IO economic theory suggests that competitive rivalry decreases as firms become more similar (e.g. Caves & Porter, 1977; Porter, 1990), organizational ecology research suggests the opposite effect, that rivalry among firms increases as they become more similar (e.g. Hannan & Freeman, 1977, 1989). Yet, while studies investigating questions related to competition often rely on measures of strategic similarity to assess competitive tension, the relationship between strategic similarity and intensity of competition remains underexplored. Thus, in this research both theoretical perspectives are taken into consideration for the development of propositions, and the study's findings might serve as an account contributing to the clarification of the tension between the predictions of both perspectives.

Propositions and hypotheses are tested in the context of the United States (US) hospital software industry. This industry includes firms that develop, produce, and market software solutions supporting hospitals in their attempts to collect, process, and manage administrative and patient information intended to be sold to community hospitals – those not affiliated to larger institutions such as universities and government branches. The initial dataset was compiled by Kulwant Singh and contains all firms engaged in the development of hospital software systems between the birth of the industry in 1961 and 1991 (see Singh, 1993, for further details).

The Core Issue Defined

The purpose of this study is to address this gap in the literature by examining the relationship between dyad-level competitive conditions and firms' propensity to form alliances in the same industry. The central question addressed in this research is:

> What is the impact of competitive conditions at the dyad level on firms' propensity to form alliances in the same industry?

This study addresses this question by: (1) Clarifying the concept of competitive conditions, particularly competitive intensity and competitive rivalry; (2) Identifying the effect of competitive intensity on firms' propensity to enter collaborative relationships, (3) Identifying the degree to which firms are strategically similar and multimarket competitors and how this affects dyadic competitive rivalry between two firms; and (4) Identifying moderating factors that affect dyads' propensities to form alliances under conditions of increased competitive intensity.

The main organizational constructs at the center of this study are multimarket competition and strategic similarity, competitive intensity, competitive rivalry, and inter-organizational cooperative linkages. The level of analysis is the dyadic relationship.

Conceptual Overview

Organizations are broadly defined as "collectivities oriented to the pursuit of relatively specific goals and exhibiting relatively highly formalized social structures" (Scott & Davis, 2007: 29). In most cases, organizations do not possess a full set of resources, capabilities, and know-how to develop, manufacture, or commercialize products or services all by themselves. For example, most firms buy components from suppliers which are subsequently combined with other acquired or self-produced parts to form a final product which is then sold to another firm or

to the final consumer. This process of sourcing components from other firms requires coordination across organizations to ensure the on-time-delivery of products in the specified quantity and quality. As a product becomes more complex, higher degrees of coordination are required as the number and difficulty of tasks increases. As a consequence, the market-oriented 'arms-length' approach of supplying inputs might lose its adequacy especially when dynamic industry environments create high pressures on firms to permanently innovate (Singh, 1993) and competition among firms is intense.

Firms compete with one another in many different forms ranging from competition for inputs to the production process such as raw materials, human resources, and financial capital to competition in the market to sell goods and services. This study focuses on investigating competition among firms in the same industry that rival against one another in attempts to develop and market products and services to the same buyer. Although competition is considered by many economists to be an industry-level phenomenon exposing all market participants to the same pressures, this research adopts the view that competitive conditions among firms in an industry vary (i.e. Hannan & Freeman, 1977, 1989; Caves & Porter, 1977; Chen, 1996) unfolding a complex and dynamic set of unique dyadic competitive relationships among firms. Especially two factors, the degree to which two firms are strategically similar (Hannan & Freeman, 1977, 1989; Caves & Porter, 1977) and the degree to which they are multimarket competitors (Edwards, 1955), have been suggested to drive competitive rivalry between two firms. As competitive dyadic rivalry varies, some firms will experience higher tension to cope with market demands, especially in industries where firms produce technologically demanding goods.

To address the complications imposed by high competitive pressures, firms might choose to engage in cooperative arrangements, such as alliances, in attempts to buffer competitive intensity and to gain access to consumer markets, resources as well as innovative technology. It is acknowledged that cooperative arrangements are only one strategic option, yet, in contrast to acquisitions, loosely coupled inter-organizational relationships have the advantage of enabling partners to coordinate their efforts more formally while remaining independent and thus being able to continue to specialize in their particular areas of expertise.

The impact of competitive conditions on firms' propensity to cooperate might not be constant over time. Instead, the relationship might be modified by pressures generated through major environmental uncertainty such as regulatory change. In these circumstances, cooperative arrangements might be particularly useful tools to access vital resources and to prepare to deal with increasing competition. Yet, they also have the potential to create serious hazards involved in choosing inappropriate alliance partners. This research addresses some of these issues by investigating how the impact of competitive intensity experienced by two firms in a dyad on firms' propensity to form cooperative arrangements differs in a time period directly preceding and following an anticipated major environmental change.

This short overview presents the core arguments addressed in this study and which it seeks to test empirically. These core arguments are: competitive conditions put pressure on firms' performance and chances of survival; to overcome competitive pressures, firms may form inter-organizational relationships in the same industry; competitive conditions affect cooperative activity differently when firms face major environmental uncertainty.

Theoretical Perspectives

This study draws from two major streams of research in the management and strategy literatures: competitive dynamics and firm cooperative behavior with strategic alliances in particular. A rich body of literature has been compiled on both subjects over the last years drawing from many theoretical backgrounds. The study is not deterministic in its theoretical foundation in that it does not adopt one theoretical perspective. It is rather open and draws from several theoretical backgrounds as they relate to the prediction of firm competitive and cooperative behavior within an industry. In fact, this study advances predictions related to strategic similarity and multimarket competition as drivers of competition based on industrial organization (IO) economics (Bain, 1956; Caves & Porter, 1977) and population ecology (Hannan & Freeman, 1977, 1989) arguments. Due to contradicting predictions of both theories about the impact of strategic similarity on the intensity of competition between two firms, competing hypotheses are advanced and empirically tested.

Although industrial organization economics and population ecology are the main theoretical foundations for this research, this study does not solely rely on them to develop predictions. Whereas this research investigates the impact of firms' competitive conditions on their propensity to form alliances by applying IO and ecological reasoning, it also acknowledges that other factors might motivate firms to engage in this type of behavior. Therefore, theoretical arguments and propositions are advanced drawing from multiple other theoretical constructs such as: power (Pfeffer & Salancik, 1978), networks (Burt, 1992), multimarket competition (Edwards, 1955), embeddedness (Granovetter, 1985), familiarity (White, 1981), and trust (Gulati, 1995a). Although not all of these theoretical explanations might be explicitly adopted in this research, the possibility that they might impact firm behavior is acknowledged and a fact that

guides the research approach for this study. As a consequence, this study borrows from a broad selection of literatures and theoretical frameworks to advance predictions and interpret results.

Note on Terminology

Although the competitive dynamics literature addresses micro- as well as macro-perspectives, attempts to develop an integrative framework are underdeveloped (Chen & Miller, 2012). As a consequence, the terminology used to capture competitive conditions is not consistent and the same terms are often used interchangeably in different contexts. For example, dynamics of competition have been the subject of investigation in population ecology research (e.g. Hannan & Freeman, 1977), studies on strategic groups (e.g. Cool & Dierickx, 1987), and research focusing on firms' competitive actions and responses (e.g. Chen, 1996). Specifically, two terms are used frequently and sometimes interchangeably: competitive intensity and competitive rivalry.

In this dissertation, the term 'competitive intensity' is used to capture 'diffuse' competitive pressures on a particular firm or pair of firms within an industry. By this, I mean the competitive intensity experienced by a firm or pair of firms resulting from the competitive activity of all other firms in a niche or industry. However, previous research has also used the term rivalry in this macro sense. For example, Porter (1980: 17) describes rivalry to occur, "…because one or more competitors either feels the pressure or sees the opportunity to improve position. In most industries, competitive moves by one firm have noticeable effects on its competitors and thus may incite retaliation or efforts to counter the move; that is, firms are mutually dependent". This definition considers rivalry to be the result of a firm's competitive actions on all other firms in an industry.

Yet, more recent research focusing on the investigation of firms' attacks and counterattacks, considers rivalry to be the dynamic exchange of specific competitive actions and retaliations between pairs of firms in an industry (e.g. Chen, 1996). For example, research investigated at the dyadic level factors predicting the likelihood of a competitive response based on attributes of an attack (Chen, Smith, & Grimm, 1992), the attacker (Chen & MacMillan, 1992), and the defender (Smith, Grimm, Gannon, & Chen, 1991; Chen & Miller, 1994). At the firm level, studies have investigated how firms' information processing capabilities (Smith, Grimm, Gannon, & Chen, 1991), firm size (Chen & Hambrick, 1995), and top management characteristics (Hambrick, Cho, & Chen, 1996) impact firms' competitive behavior (see also Chen, 2009). In this dissertation, the term 'competitive rivalry' or 'rivalry' captures dyadic competition between pairs of firms. However, it is important to note that rivalry will not be conceptualized by specific competitive actions and responses as in the action-response stream of competitive dynamics research (e.g. Chen, 1996).

In addition to 'competitive intensity' and 'competitive rivalry' the terms 'competition', 'competitive pressure', and 'competitive behavior' are used occasionally. They refer to general conceptions and conditions of competition within an industry.

CHAPTER II

CORE CONCEPTS AND LITERATURES

This chapter reviews and synthesizes the major concepts and literatures that provide the cornerstones for this research. The main focus is on the literatures on competitive dynamics and firm cooperative behavior in the form of strategic alliances. The chapter starts with an introduction to the concept of competition and outlines major developments in the literature that lead to the emergence of competitive dynamics as a field of study. In this context, two factors that have been suggested to be main drivers of dyadic competitive rivalry, the degree to which two firms are strategically similar and compete in more than one market, will be presented and empirical findings will be discussed. The subsequent section reviews the extensive research on inter-organizational relationships with a focus on strategic alliances. The chapter closes with a summary of the reviewed literatures.

The literature review is mainly based on research published in the areas of strategy, economics, organizational theory, and sociology as it relates to the dynamics of competition and firm cooperative behavior. Although sometimes huge differences in positions within areas and across fields exist, this review seeks to point out major research streams and present a thorough picture of current states of literatures. Besides broadly approaching the strategy literature, the

review of the economics literature will mainly focus on ideas advanced in industrial organization economics, while the literature borrowing organizational theoretical and sociological arguments concentrates on research in population ecology and multimarket competition.

Competitive Dynamics

The dynamics of competition are a central topic of strategic management research. To reap above average returns and thus secure organizational survival, firms seek to create competitive advantages over their competitors. Advantages can be achieved, for instance, by exploiting first-mover advantages through the introduction of new products or by increasing a firm's customer base through entry into new markets (Lieberman & Montgomery, 1988). In addition to firm actions, contextual factors such as the multimarket encounter of competitors, the competitive relationship with firms pursuing similar strategies in strategic groups as well as factors of geographic proximity or distance have been suggested to impact firm competitive behavior. However, competitive advantages cannot be maintained forever. Once other firms become aware of a competitor's advantage in a marketplace they start to erode its lead. The resulting dynamics of interactions among firms in a race for better market positions is referred to as competitive dynamics.

In the economics literature, the industrial-organization (IO) school of thought (Mason, 1939; Bain, 1956) which focuses on industry structure and competitive positioning as drivers of firm performance has been very influential for the investigation of competitive dynamics research. At the heart of the IO paradigm is the structure-conduct-performance model (Mason, 1939; Bain, 1956) which assumes that the structure of an industry determines the competitive conduct of companies thus determining industry performance. According to Bain (1968), an

industry's structure consists of organizational or market elements that impose a strategic influence on the mode of competition and pricing. Porter (1980), for example, identified five interrelated structural forces that drive competition: the threat of market entry, intensity of rivalry among existing competitors[1], pressure from substitute products, bargaining power of buyers as well as bargaining power of suppliers.

In the IO framework, competitive conduct might be seen as the "policies that participants adopt toward the market (and their rivals in it) with regard to their selling prices, the characteristics of their product, and other terms that influence market transactions" (Caves, 1987: p. 14). To generate above average returns, managers have to analyze the structural and competitive conditions of an industry and subsequently position a firm in a segment of the market which promises favorable conditions (Bain, 1956; Porter, 1980; Porter, 1996). It is important to point out that the structure-conduct-performance model is an industry-level concept and is based on the assumption that all firms in an industry are competitors and that the intensity of competition is the same, or homogeneous, for all firms.

The homogeneity assumption of competition suggests that all firms in an industry meet in one market and that the market is cleared by one price valid for all market participants. In addition, competitive conditions for all firms, irrespective of their presence in, for example, all product-categories or geographical markets, are considered to be identical.

The strong assumption that competitive conditions are homogeneous for all firms was challenged by strategy research which argued that competition varied among firms and could be characterized by dyadic relationships, an effect referred to as competitive rivalry (e.g. Chen, 1996). Research in the action-response based stream of competitive dynamics investigating the

[1] It should be noted that in this case, Porter's conception of rivalry is a diffuse concept and not dyadic as used in this study.

antecedents, characteristics, and outcomes of firms' competitive actions and responses supports the assumption of heterogeneous competition among pairs of firms. For example, at the action-response dyad level of analysis, researchers investigated factors predicting the likelihood of a competitive response based on attributes of an attack (Chen, Smith, & Grimm, 1992), the attacker (Chen & MacMillan, 1992), and the defender (Smith, Grimm, Gannon, & Chen, 1991; Chen & Miller, 1994). At the firm level, studies have investigated how firms' information processing capabilities (Smith, Grimm, Gannon, & Chen, 1991), firm size (Chen & Hambrick, 1995), and top management characteristics (Hambrick, Cho, & Chen, 1996) impact firms' competitive behavior. Studies have, furthermore, explored how a firm's competitive repertoire evolves by investigating issues such as incumbent's market share erosion (Ferrier, Smith, & Grimm, 1999), competitive inertia (Miller & Chen, 1994) and simplicity (Miller & Chen, 1996). This accumulated body of research has strengthened the argument that competition in an industry is not homogeneous and advanced our knowledge about the characteristics of competitive interaction as well as the competitive behavior among firms.

Strategic Similarity and Intra-Industry Heterogeneity

Firms might be similar, for example, with regard to their endowments in resources, capabilities, and coverage of product and geographical markets (e.g. Hatten & Hatten, 1987; Gimeno & Woo, 1996) and might have similar competitive orientations in a market. Research on hypercompetition (D'Aveni, 1994) suggests that in industries where firms are very dissimilar, actors can use their specific resources, capabilities, and market positions to exploit market opportunities and to increase competitive pressure on other market participants thus creating hypercompetitive disruption and potentially hypercompetitive escalation. In addition, moves that

might tacitly reduce competitive tension among firms in an industry, or in one of its sub-segments might be easier to coordinate (Newman, 1978).

The impact of strategic similarity on competitive rivalry has been of central concern in early strategic management research drawing from the industrial organization economics (IO) paradigm. This stream of research suggests that the larger the strategic distance between firms in an industry (they are more dissimilar), the larger the competitive rivalry among them. Porter (1979: 218) argues that firms are strategically distant to "the degree to which strategies in different groups differ in terms of the key strategic decision variables, such as advertising, cost structure, R&D, organization of production, etc. The greater this distance, other things being equal, the more difficult tacit coordination becomes and the more vigorous is rivalry likely to be in the industry". The central argument in this line of thought is that the lower the strategic distance between firms in an industry, or the more similar the firms, the higher the potential for firms to engage in collusive behavior which might result in a reduction in rivalry among firms (Caves & Porter, 1977).

Although the previously presented economics-based research predicts that rivalry decreases with an increase in similarity, Gimeno & Woo (1996) found an opposing effect. Their study showed that rivalry between competitors increased when firms were more similar whereas the degree at which firms competed simultaneously in more than one market – their level of multimarket contact – reduced the rivalry between firms. The inconsistent findings show that the relationship between strategic similarity and firm rivalry might be more complex than initially thought.

The Strategic Group Concept

The investigation of causes and consequences of intra-industry heterogeneity has received further attention in research on strategic groups (e.g. Hunt, 1972; McGee & Thomas, 1986; Cool & Schendel, 1987; Fiegenbaum & Thomas, 1990) which focused on the analysis of within industry heterogeneity and the conditions of strategically similar firms. Hunt (1972) pioneered this research by challenging the competitive homogeneity assumption of the structure-conduct-performance framework. He conducted his dissertation work in the context of the 1960s US home appliance industry and found that firms were not homogeneous across the industry but could be assigned to four distinctive groups instead. He labeled these groups within which economic asymmetry would be minimized strategic groups and argued that potential entrants to the industry would have to overcome group-specific barriers to entry.

The model was further developed by Caves and Porter (1977) who suggested that strategic groups are surrounded by mobility barriers imposing costs on firms intending to move between groups thus protecting more profitable groups and allowing member firms to consistently enjoy higher performance than firms outside the group.

Cool and Schendel (1987: 1106) defined strategic groups as "…a set of firms competing within an industry on the basis of similar combinations of scope and resource commitments." The central argument of the strategic group framework is that similar firms can be assigned to groups in which they are exposed to similar competitive circumstances and act and react similarly in a competitive setting. Mobility barriers (Caves & Porter, 1977) protect groups by making it costly for firms to enter new segments or to move across segments thus protecting firms from industry wide competition. The competitive structure of industries and strategic groups might change over time. Increasing rivalry in an industry might impose pressures on

group structures shifting the focus of rivalry from within groups to across groups over time (Cool & Dierickx, 1993). As the competitive structure of an industry changes, so does the performance of firms within it. Increasing rivalry among firms and the change of group structures as well as group positions impact competitive conditions within an industry thus changing the dynamics of within and across group rivalry and performance (Cool & Dierickx, 1993).

Research on the strategic group concept started to flourish in the 1980s and was subject to substantial criticism. McGee & Thomas (1986) reviewed pre-1985 research and concluded that studies used inappropriate constructs to assess sustainable group formation thus questioning the existence of the strategic group concept in general. To overcome this limitation, McGee & Thomas (1986) suggested the application of alternative conceptual elements such as mobility barriers, isolating mechanisms and controllable mechanisms to research the existence and phenomenon. Similarly, Hatten & Hatten (1987) suggest using multivariate methods to cluster firms instead of relying on bivariate, usually size-based, measures.

Early research on strategic groups applied mostly cluster analysis techniques to identify groups based on firms' characteristics along a selection of market scope and resource endowment variables (e.g. Cool & Schendel, 1987; Harrigan, 1985; Osborne, Stubbart, & Ramaprasad, 2001; Leask & Parker, 2007). Another related approach to identify groups of competitors draws on the social psychological concept of industry cognitive communities (Porac, Thomas, & Baden-Fuller, 1989; Porac, Thomas, Wilson, Paton, & Kanfer, 1995). This conceptualization suggests that managers develop cognitive models to make sense of their environment by grouping close competitors. Competitive groups have to be conceptually distinguished from strategic groups because their formation is based on managers' subjective perceptions whereas strategic groups are identified based on recorded archival data.

Nevertheless, Nath & Gruca (1997) found significant evidence for a convergence of group identification using archival and perceptual data.

Critics questioned the existence of groups and argued that strategic groups were artificial collections of firms that resulted from the application of specific methodological applications (cluster analysis) to separate more successful firms from less profitable ones but not a unique construct with particular structures (e.g. Hatten & Hatten, 1987; Barney & Hoskisson, 1990).

Strategic group research responded to the criticism by advancing a vast amount of conceptual and empirical research finding considerable evidence of the existence of strategic groups using multiple analytical tools. For example, a conceptual model based on economic theory provided explanations for the existence of strategic groups suggesting that strategic groups are a unique and important level to examine within industry dynamics (Dranove, Peteraf, & Shanley, 1998). Similarly, Short, Ketchen, Palmer, & Hult (2007) borrowed from systems theory and isolated environmental, strategic group and firm effects on firm performance thus further supporting the concept. Empirically, the existence of strategic groups and the effect of group membership on firm performance have been demonstrated in a study by Nair and Kotha (2001) in the Japanese steel industry. The study contrasted naturally occurring strategic groups of integrated mils and mini-mills and could separate environmental from firm-level variables to identify group effects as drivers of firm performance. The identification of just a few or only two strategic groups is not uncommon in the literature and is usually accompanied by the assignment of firms to groups based on one major variable, such as firm size (see for example, Lee & Pennings, 2002; Mas-Ruiz, Nicolau-Gonzalbez, & Ruiz-Moreno, 2005; Short, Payne, & Ketchen, 2008).

Overall, since the initial critique of the strategic group concept, extensive research using a wide selection of analytical techniques has been performed and considerable evidence has been accumulated supporting the existence of intra-industry groups of strategically similar firms (Short, Payne, & Ketchen, 2008). To strengthen this position, recent empirical findings of the strategic group concept will be reviewed in the following section.

Existence of strategic groups

Because of the serious criticism regarding the validity of the strategic group concept numerous subsequent studies were concerned with establishing evidence about the existence of such groups and their performance implications. This research initially investigated the concept based on criteria suggested by economic theory but was later complemented by a stream of research identifying and investigating strategic groups based on other frameworks such as managerial cognition (e.g. Porac, Thomas, & Bande-Fuller, 1989; Reger & Huff, 1993; Fiegenbaum & Thomas, 1995; Peteraf & Shanley, 1997).

To address methodological concerns, research applied increasingly more complex measures of strategic scope and resource deployment to identify groups (e.g Cool & Schendel, 1987, 1988; Fiegenbaum & Thomas, 1990, 1995; Ferguson, Deephouse, & Ferguson, 2000; Leask & Parker, 2007). More recently, Desarbo, Grewal, and Wind (2006) as well as Desarbo and Grewal (2008) identified groups based on a selection of demand-side variables. Interestingly, groups identified based on measures using archival sources of data and managers' cognitive perception have been shown to converge thus identifying largely identical groups (Nath & Gruca, 1997). In addition, reputation (Ferguson, Deephouse, & Ferguson 2000) and firms'

competitive interactions (Pegels, Song, & Yang 2000) have been suggested as variables determining group membership.

The improved methodological tools have been applied in a number of different contexts. Evidence for the existence of stable groups was found in the US pharmaceutical industry (Cool & Schendel, 1987), the UK pharmaceutical industry (Leask & Parker, 2007), US acute care hospitals (Nath & Gruca, 1997), Spanish banks (Mas-Ruiz, Nicolau-Gonzalbez, & Ruiz-Moreno, 2005) and among Belgian brewers (Houthoofd & Heene, 1997). In addition, groups based on manager's cognitive perceptions were identified in the Scottish knitwear industry (Porac, Thomas, & Baden-Fuller, 1989) and among bank holding companies in the Chicago area (Reger & Huff, 1993).

Several studies investigated the impact of strategic group membership on firm performance. Variation in group performance was found between groups of minimills and integrated mills in the Japanese carbon steel industry (Nair & Kotha, 2001), among leading UK pharmaceutical firms (Leask & Parker, 2007), and US property/casualty insurers (Ferguson, Deephouse, & Ferguson, 2000). Furthermore, several studies investigated performance implications of group membership based on top managers' perceptions of groups. In this context, strategic groups clustered by mental models matched those applying cluster analysis techniques (Osborne, Stubbart, & Ramaprasad, 2001; Nath & Gruca, 1997) and showed robust effects on performance (Osborne, Stubbart, & Ramaprasad, 2001). It was found that managers' cognitive perception of group complexity and group size impacts firm performance and that management teams following fewer strategies performed best in their groups (McNamara, Luce, & Tompson, 2002). Performance differences were found to be significantly larger within strategic groups than across groups (McNamara, Deephouse, & Luce, 2003).

Strategic groups and rivalry

Caves and Porter (1977) suggested that strategically similar firms are surrounded by mobility barriers that limit within industry mobility thus forming strategic groups and argued that similar firms compete less aggressively with one another an effect known in the literature as the Caves-Porter hypothesis (Peteraf, 1993).

According to this stream of research, more similar firms can coordinate their market activities better than strategically distant firms thus improving their performance. When firms are strategically more distant, tacit coordination is more difficult to achieve and the interaction among firms becomes more aggressive. Strategic distance has been defined as "the degree to which strategies in different groups differ in terms of the key strategic decisions variables, such as advertising, cost structure, R&D, organization of production, etc. The greater this distance, other things being equal, the more difficult tacit coordination becomes and the more vigorous is rivalry likely to be in the industry," (Porter, 1979: 218).

The theory underlying the strategic group concept suggests that the lower the strategic distance between two firms (or the more similar they are) the better they recognize their mutual interdependencies and reduce rivalry thus increasing firm performance. There are at least two factors leading to a reduction in rivalry among competitors. First, similar firms are likely to use the same resources and capabilities thus making it easier to coordinate efforts and to retaliate. Second, similar firms are probably more familiar with one another, acknowledge their mutual interdependence and be more likely to collude tacitly.

The Caves-Porter hypothesis has been empirically tested in several studies with inconsistent findings. In a study on US monopolist airlines' responses to potential route entries by similar or dissimilar firms, Peteraf (1993) found that when incumbents faced dissimilar

potential entrants they priced significantly lower than was the case when the potential entrant was similar thus supporting Cave and Porter's (1977) argument. Similarly, Young, Smith, Grimm, and Simon (2000) found in a sample of US computer software firms that more similar firms initiated less competitive moves and responded slower compared to dissimilar firms.

On the other hand, Gimeno & Woo (1996) demonstrated in their study on US city-pair markets the influence of multimarket contact on the intensity of rivalry in an industry. Their results show that when strategic similarity and multimarket contact are included simultaneously in a model, strategic similarity slightly increased rivalry, thus contradicting the Caves-Porter hypothesis, whereas multimarket contact has a strong rivalry reducing effect. Moreover, Smith, Grimm, Wally, and Young (1997) could not find an effect of strategic similarity on action-based competitive dynamics in the US airline industry. Deephouse (1999) finds support for an inverted U-shaped relationship between strategic similarity and firm performance arguing that firms of very high and very low similarities perform worse than firms of medium levels of similarity.

Instead, rivalry is argued to vary across groups, to shift over time (Cool & Dierickx, 1993), and to be contingent on firm size. Strategic groups of smaller firms respond more often but slower to actions of groups of larger firms while reacting more intensely to actions of strategic groups of large firms (Mas-Ruiz, Nicolau-Gonzalbez, & Ruiz-Moreno, 2005). Evidence for differences in competitive rivlary of firms across strategic groups in the US airlines industry has also been reported by Smith, Grimm, Wally, and Young (1997).

In addition, it has been argued that general economic cycles impact strategic group structures. Mascarenhas (1989) found that in times of economic decline, firms changed strategic groups more often than in times of economic stability or growth and that firms switched more often to similar groups than to dissimilar ones. In a conceptual paper, Peteraf and Shanley (1997)

proposed that strategic groups develop identities that might help managers to better understand the competitive landscape and the actions of other group members.

However, it should be noted that organizational ecology research predicts a relationship contradicting the Caves-Porter hypothesis (Caves & Porter, 1977). This stream of research argues that rivalry is highest among similar firms (Hannan & Freeman, 1977, 1989) implying that the level of competition would be higher among firms in the same strategic group than among firms from different strategic groups. In ecological research, situations of firms are often described as 'competitive' based on contextual circumstances in which firms encounter one another in zero-sum relations (Barnett, 1997) competing for the same resources. Competition is predicted to be higher in contexts where similar firms compete based on 'structural equivalence' (Burt, 1992) or their presence in the same market 'niche' (Hannan & Freeman, 1977, 1989).

Several studies in the ecology literature have found empirical evidence supporting a positive relationship between similarity and intensity of competition. For example, localized competition models suggest that organizational similarities in size, geographic location, and prices charged influence levels of competition among firms (Baum & Mezias, 1992). While Manhattan hotels chose their location based on similarity in pricing to benefit from agglomeration economies, competitive intensity was reduced through differentiation in size (Baum & Haveman, 1997). Furthermore, the resource partitioning model in ecology research suggests that competition will be more intense among large generalist firms while small specialist firms seek to avoid direct confrontation by competing in niches that are less attractive for generalist firms (Carroll, 1985).

Multimarket Competition

Multimarket competition, a situation in which firms compete simultaneously in more than one market, has received considerable attention in the management literature (for a recent review see also Yu & Cannella, 2013). A central argument of multimarket competition research is that firms' market actions do not take place in isolated independent markets. Instead, firms change their competitive behavior towards one another and seek to coordinate actions in attempts to increase profits (e.g. Bernheim & Whinston, 1990) a situation that has also been referred to as 'mutual forbearance' (Edwards, 1955).

The mutual forbearance hypothesis (Edwards, 1955) suggests that firms which compete simultaneously in more than one market recognize their interdependence and forbear from taking aggressive action against one another thus conditioning their competitive rivlary. Edwards states that, "when one large conglomerate enterprise competes with another, the two are likely to encounter each other in a considerable number of markets. The multiplicity of their contact may blunt the edge of their competition." (quoted by Scherer, 1980: p. 340). The forbearance effect does not only apply for conglomerates but also applies for any single- or multiple-product firm that competes in more than one market (Bernheim & Whinston, 1990).

When a firm attacks a multimarket competitor aggressively in a market, it has to expect retaliation not only in the market of initial attack but also in other markets where both firms compete simultaneously. Thus, the potential to retaliate is higher in scenarios where firms compete in multiple markets compared to single-market encounters (Porter, 1980) because attacks against multimarket competitors have to weight benefits against potential costs resulting from retaliation in other markets. The risk of experiencing high cost might be even higher in situations where markets are of varying importance to firms. In such a context, retaliation could

occur in markets of central importance to the aggressor thus increasing potential costs for the firm (Porter, 1980).

Karnani and Wernerfelt (1985) suggested a theoretical framework to analyze situations of multimarket competition between firms. Multimarket competition was defined as "…a situation where firms compete against each other simultaneously in several markets" (p. 87). They suggested that firms could choose among four alternatives to respond to a competitor's market entry (do nothing, defend, counterattack, and declare a total war) and proposed that a counterattack might result in a 'mutual foothold equilibrium' where firms use their strongholds to deter rivalry.

Some of these ideas were formalized by Bernheim and Whinston (1990) who developed a game-theoretic model and performed a simulation testing the relationship between firms' degree of multimarket contact and their level of cooperation. The study contrasted a situation where markets and firms were identical and returns to scale were constant with a situation where these strong assumptions were successively relaxed. Whereas multimarket contact did not have an effect on the level of cooperation in the first setting, firms changed their behavior when market conditions became heterogeneous. In markets where the number of firms, the observability of actions, and the growth rate of demand differed, firms had incentives to change their strategies by focusing on specific geographic or product markets. Furthermore, under conditions of multimarket contact and varying costs of production across markets as well as the presence of economies of scale firms could develop 'spheres of influence' allowing them to realize higher profits. Although, the Bernheim and Whinston's model assumes full observability of competitive moves, research has shown that the mutual forbearance effect also generally holds under conditions of imperfect observability of competitive moves (Greve, 2008). However, Greve

found also that firms were more likely to defect in situations where the overall level of multimarket contact was high and firms faced low levels of multimarket competitors in a specific market.

Boeker, Goodstein, Stephan, and Murmann (1997) argued that multimarket contact improves the exchange of strategic information about possible behavior among actors. The higher the market overlap between two firms the better and richer the flow of information about an adversary's resource endowments and strategic intentions thus facilitating collusive behavior. Yet, Baum and Korn (1996) tested the mutual forbearance hypothesis against economic arguments that a reduction in rivalry was due to tacit coordination based on increased familiarity and acknowledged interdependence among competitors. The study found support for a rivalry reducing effect based on mutual forbearance and could not report significant results for oligopolistic explanations.

Linked to the idea of improved distribution of strategic information, it has been suggested that increased familiarity among multimarket firms might lead to mutual forbearance (e.g. Scott, 1993, 2001). Most microeconomic theory views markets as places where isolated buyers and sellers exchange goods and services and where a specific identification of firms or the emergence of deeper relationships among actors does not occur. According to this view, atomized competitors receive information about other firms through the price clearing the market. Firms' individual actions are not observable. Instead, an 'anonymized' price mechanism conveys information about competitors' actions, resources, and other relevant characteristics equally to all other firms.

This economic conceptualization of markets was challenged by sociology researchers suggesting that "markets are self-reproducing structures among specific cliques of firms and

other actors who evolve roles from observations of each other's behavior" (White, 1981: 518). Central to his argument is the notion that firms watch their competitors and make decisions based on their observable behavior. This model of a market suggests that groups of competitors know one another, that a firm's perception of competitors' actions impacts its own behavior, and that specific firms in a group are associated with different behavioral styles (White, 1988).

This research adopts White's (1981) conceptualization of markets and assumes that firms observe their competitors in the market and that this observation varies qualitatively across firms in an industry. Consistent with White's conceptualization, firms in a market can be assigned to clusters of proximate firms that observe their behavior more attentively than they would more distant firms. Through observation, firms might gather a multitude of information about competitors potentially going beyond the observation of competitive moves.

In addition, the embeddedness literature (i.e. Granovetter, 1985) suggests that through repeated interaction actors learn about one another and become increasingly familiar. Through repeated interactions, firms increase their knowledge and information about other market participants. Familiarity generated through the observation of the competitive behavior of firms in the same market 'clique' or group (White, 1981) might thus contribute to a reduction in uncertainty about firms' behavioral reliability.

Increased familiarity among firms can result in the creation of trust between two parties. As Gulati (1995a: 92) argued, "the idea of trust emerging from prior contact is based on the premise that through ongoing interaction, firms learn about each other and develop trust around norms of equity…" This interaction-based link between familiarity and the creation of trust holds not only in situations where actors cooperate but also in those where they compete. As Shapiro, Sheppard, & Cheraskin (1992: 369) argue, trust between two actors might not only be the

outcome of cooperative interactions but also be the result of non-cooperative behavior; "even when one expects uncooperative behavior…trust can result if the behavior is predictable." This trust can be an important factor benefiting the formation and governance of interorganizational alliances (Gulati, 1995a) and can help firms to achieve a competitive advantage (Barney & Hansen, 1994).

Empirical findings of multimarket competition research

Considerable empirical research has tested the effect of multimarket contact on the level of competition. Whereas several earlier studies found results contradicting the mutual forbearance hypothesis or showing insignificant results (see for example Roadhes & Heggestad, 1985; Mester 1987; Sandler, 1988), the vast amount of more recent studies tends to supports the mutual forbearance hypothesis (Gimeno, 1999; Fuentelsaz & Gomez, 2006; Greve, 2008). Gimeno (1999) argued that some of the variation in findings might be explained by the reliance of early studies on cross-sectional econometric models whereas more recent studies applied primarily longitudinal research designs. Moreover, older studies frequently used firm performance measures as proxies to assess firms' competitive aggressiveness whereas more recent studies increasingly evaluate rivalry based on observable competitive actions (Fuentalsaz & Gomez, 2006).

In addition to studies employing firm performance as a measure of competition in multimarket contact research, another group used firms' rates of market entries and exits (see for example Baum & Korn, 1996; Baum & Korn, 1999; Haveman & Nonnemaker, 2000; Stephan & Boeker, 2001) to measure competitive activity. This methodological change made it possible to increasingly observe dynamic competitive interactions because firms' changes in the level of

multimarket contact by entering or leaving markets influenced the potential for forbearance. As a result, more studies could investigate the impact of multimarket contact on firms' likelihood to take specific action. For example, Baum and Korn (1996) used the concept of multimarket contact as a firm-specific condition that impacts the degree of rivalry between a focal firm and its competitors and found that a firm's likelihood of leaving a market was lower when multimarket contact with market incumbents was high (see also Boeker, Goodstein, Stephan, & Murrmann, 1997). On the other hand, the likelihood of a firm entering a market was found to decrease when multimarket contact with incumbents was high (Baum & Korn, 1996). The rivalry reducing effect of multimarket contact was particularly strong when a market was dominated by one large firm, an effect that was interpreted as firms granting favorable competitive conditions to competitors in one market in exchange for the enjoyment of similar conditions in other markets. Gimeno (1999) further investigated this phenomenon and proposed that firms with asymmetric market interests identify specific 'spheres of influence'. Specifically, he found that firms enjoy reduced rivalry in core markets while granting competitors similar conditions in their important markets. In these cases, the essential deterrence factor was a competitor's minor presence in a firm's core market and vice versa to threaten retaliation. Likewise, Young, Smith, Grimm, and Simon (2000) found general support for a mutual forbearance effect in the US computer software industry and report that multimarket contact reduces both the number of moves a firm undertakes relative to rivals as well as the time to respond to a rivals move and that firms with higher levels of multimarket contact are less likely to initiate attacks but, when attacked, respond more aggressively.

More recent studies were able to re-investigate the relationship between multimarket contact and mutual forbearance and to demonstrate its complexity. Whereas performance-based

studies predict a linear relationship between multimarket contact and mutual forbearance, entry-based studies tend to predict the relationship to be inverted U-shaped (Baum & Korn, 1999; Haveman & Nonnemaker, 2000; Stephan & Boeker, 2001; Fuentelsaz & Gomez, 2006).

The first study to challenge the linear relationship between the level of multimarket contact and firms' market entry and exit rates was conducted by Baum and Korn (1999) who investigated the impact of multimarket contact on dyadic interfirm rivalry among post-deregulation (1979-1984) California commuter air carriers. The study revealed that dyadic competitive interaction was more complex than initially thought by showing that firms entry and exit decisions were moderated by the level of multimarket contact with a multimarket competitor which was in both cases not linear but inverted U-shaped instead. This finding is particularly noteworthy as it shows how different degrees of multimarket contact have different effects on dyadic interorganizational interaction. In particular, Baum and Korn (1999) found that as the level of multimarket contact between two firms increases, the rate of entry into and exit from one another's markets initially increases until it peaks at a medium level of multimarket contact. Past this point both the entry as well as exit rate fall at increasing levels of multimarket contact. Baum and Korn (1999) explain this effect by an incentive for firms to establish deterrents through entry into one another's markets (Karnani & Wernerfelt, 1985) thus increasing competitive activity. This process intensifies up to a point at which firms mutually recognize their interdependence and the potential benefits of reducing competitive rivalry. It is at this point that the rate of market entry decreases between two firms with increasing levels of multimarket contact. The outcome of this process comes close to what Karnani and Wernerfelt (1985) described as 'mutual foothold equilibrium'. With regard to market exits, Baum and Korn (1999) argue that market exits initially increase as the result of competitive escalation until a 'balanced' level is reached at

moderate levels of multimarket contact. Past this point, firms' rate of market exit begins to decrease as firms experience lower levels of competitive rivalry due to mutual forbearance and 'balanced' competitive stability.

The inverted U-shaped relationship was confirmed in a study by Haveman and Nonnemaker (2000) on geographical markets in the California savings and loan industry. In addition, the study found that mutual forbearance effects were higher in markets dominated by just a few large firms and that multipoint competition not only affected multi-market firms but also firms that competed only in one geographical market.

Forbearance effects were also reported in a cross-border setting. Yu, Subramaniam, and Cannella (2009) found evidence for factors moderating mutual forbearance effects for multinational enterprises. Greater subsidiary ownership increased mutual forbearance effects whereas cultural distance, local regulatory restrictions, and the presence of local competitors reduced mutual forbearance effects.

Early studies mainly regarded the forbearance effect of multimarket contact to be the outcome of firms' purposeful strategic action (e.g. Karnani & Wernerfelt (1985). Depending on a firm's competitive situation, management would decide on an appropriate course of action. In situations where firms encounter one another simultaneously in more than one market, they would face incentives to mutually forbear potentially leading to a 'mutual foothold equilibrium' (Karnani & Wernerfelt, 1985). This view was challenged by Korn and Baum (1999) who found that rivalry reducing effects through multimarket contact were not the result of purposeful strategic action but rather the outcome of both chance contacts between firms and trait-based imitation mainly unrelated to multimarket contact thus showing an emerging relationship.

Strategic Alliances

The rate at which firms form cooperative arrangements such as strategic alliances has increased significantly over the last years (Dyer, Kale, & Singh, 2001; Wassmer, 2010). In the strategic management literature studies have demonstrated that certain alliances reduce firms' risk of failure (Mitchell & Singh, 1996) and might positively impact firm performance (Singh & Mitchell, 2005).

Most research on alliances has been conducted at two major levels of analysis. Whereas one group of studies focused on investigating the phenomenon from the point of view of a focal firm and found substantial variation in the factors motivating firms to form alliances including access to resources and firm level factors influencing the ability of firms to form credible alliances, a second group of researchers investigated the impact of external structural factors such as a firm's social capital (Ahuja, 2000a), previous ties (Gulati, 1995b), network position (Stuart, 1998) and status (Podolny, 1994) on alliance formation.

An alliance is defined as "any voluntarily initiated cooperative agreement that involves exchange sharing, or codevelopment, and it can include contributions by partners of capital, technology, or firm-specific assets" (Gulati, 1995b: 620). To identify appropriate alliance partners, information about other firms' resources, needs, and reliability is of central importance to a focal firm (Van de Ven, 1976). But the search process might contain considerable uncertainty which, according to Gualti & Gargiulo (1999), is mainly due to two factors. First, uncertainty based on the difficulty of obtaining information about the competencies and needs of potential partners and, secondly, a firm's lack of information about partner's behavioral reliability to restrain from opportunistic behavior. Unpredictable opportunistic behavior is a

major threat to a firm and can impose a lasting negative effect on its future development thus significantly lower its survival chances.

Previous research argued that firms faced with uncertainty about a partner will exploit their social ties and existing networks to lower search costs and reduce the risk of opportunistic behavior. Granovetter (1985: 490) states that 'the widespread preference for transacting with individuals of known reputation implies that few are actually content to rely on either generalized morality or institutional arrangements to guard against trouble.' Furthermore, information about a firm's reliability might be provided through prior alliances and referrals by shared alliance partners (Gulati, 1995b; Gulati & Gargiulo, 1999).

Reasons for Alliances

Alliances are a widely used tool to address resources shortages and competitive environments (Contractor & Lorange, 2002; Gulati, 1998; Reuer, 2004). Relatively high flexibility and potentially low levels of financial commitment and risk make alliances an attractive alternative for firms compared to acquisitions (Harrison, Hitt, Hoskisson, & Ireland, 2001). Although firms increasingly choose collaborative arrangements as strategic options to improve their competitive situation, a considerable number of alliances fail and positive outcomes are difficult to assess (Madhok & Tallman, 1998). A central advantage of collaborative arrangements, such as alliances, is that they facilitate knowledge flows and mutual learning (Madhavan, Koka, & Prescott, 1998). However, an increase in tie-strength also increases the level of interdependence among firms and thus their mutual vulnerability. Additional complexity is added when two firms simultaneously collaborate and compete in the same markets. Increasingly, firms form alliances with competing firms as a response to competitive pressures

(Garcia-Pont & Nohria, 2002; Gomes-Casseres, 1996). At the same time, firms might also increase competitive pressure on rivals through upstream and horizontal alliances thus significantly affecting the survival chances of their competitors (Silverman & Baum, 2002). Therefore, the identification of appropriate reliable alliance partners, especially when they are competitors at the same time, is a central requirement for the formation of successful long-term relationships.

The potential of alliances to generate value for a firm include, for example, the realization of economies of scale, the reduction of risk, the improvement of organizational learning and advantages in entering new markets. Furthermore, alliances might enable firms to buffer environmental uncertainty, reduce resource dependencies, change the competitive position relative to competitors and thus reduce competitive uncertainty. All these reasons to form alliances have in common that firms recognize their mutual strategic interdependence.

Strategic interdependence is an important factor driving firms to form alliances. Pfeffer & Salancik (1978) distinguish between 'competitive interdependence,' where one actor's gain is another's loss, and 'symbiotic interdependence,' where an actor's output is another's input. Both types do not have to be mutually exclusive but can occur simultaneously and in asymmetric form. Firms are strategically interdependent when one firm possesses a resource or capability of value to another firm which is not in possession of it (Gulati, 1995b). If two companies are strategically interdependent and a focal firm cannot acquire a resource in a factor market, it might seek to access it through entering a cooperative agreement with a strategically interdependent firm. In this line of thought, scholars of resource dependence theory (Pfeffer & Salancik, 1978) might argue that firms enter alliances to reduce environmental uncertainty and to access important resources and capabilities, a crucial condition for firms to survive.

Most research on organizational interdependencies goes back to Emerson's (1962) concept of power-dependence among individuals. Scott and Davis (2007) argue that Emerson's conceptualization is useful to study organizations and interorganizational relationships because his conceptualization of power is the outcome of actor specific needs and resources and attributes particular levels of power to an actor. This formulation goes beyond a simple zero-sum game where one actor's gains are another's losses. Instead, firms can exercise exchange-based power over one another by increasing mutual interdependencies (Pfeffer & Salancik, 1978; Scott & Davis, 2007). Emerson's formulization of power is also useful to study organizations and their bridging strategies (Thompson, 1967). Bridging mechanisms have been defined by Scott and Davis (2007: 235) as "efforts to control or in some manner coordinate one's actions with those of formally independent entities." One important bridging strategy is to cooperate with another firm through the formation of an alliance.

Competition for resources and customers might be particularly intense for firms that are active in market segments shared with many other firms. Large numbers of competitors reduce the quantity of available resources leading to resource scarcity. In this context, firms with strong financial resources might be able to pay higher prices for inputs or to finance costly research and marketing activities on their own. Yet, smaller firms might not have the necessary resources and could risk their survival by committing larger amounts of resources to the development or commercialization of costly projects. As a consequence, firms might choose to cooperate with one another to share the cost and risk of larger investments. According to Stuart (1998) three reasons might facilitate the formation of alliances among firms in crowded market areas. First, firms serving the same market and using similar technologies benefit from communication and learning advantages because applying similar technologies facilitates cooperation on research

and commercialization projects. Firms can better evaluate one another's contributions, the execution of an alliance as well as its outcomes. According to ecology reasoning, these benefits are most valuable, when firms compete in the same market niches because lack of differentiation might create incentives to cooperate "to limit, channel, or otherwise control the competitive relationship (Hawley, 1986: 71…)" (Stuart, 1998: 673). Second, alliances are more beneficial in crowded areas of the market because they permit to reduce duplication of research and commercialization efforts. When many firms are active in a niche and each firm pursues its activities individually (research and development projects, for example), plenty of resources are lost in the development of projects aiming for the same outcome. Cooperative agreements would allow firms to pool resources and to share the benefits thus saving resources for other projects. Thirdly, crowded segments might be attractive for firms that are not yet present in a niche. Forming an alliance with a firm having a strong presence in a particular segment might be an attractive option for firms outside the niche to enter without setting up entirely new and costly operations. This option might be particularly attractive when firms commercialize goods and alliance partners can share existing distribution channels. These interdependencies among firms are in most cases asymmetric where both firms are interdependent but at different degrees. Because the behavior of one actor might impact the situation of an interdependent firm, interdependence can be the source of uncertainty.

Problems of resource procurement among firms are the focus of another stream of research on interorganizational interdependencies (Gulati, 1995b). According to this line of thought, resource-based interdependencies are the main drivers for firms to collaborate. Strategic interdependencies describe "…a situation in which one organization has resources or capabilities beneficial to but not possessed by the other" (Gulati, 1995b: 621). This form of interdependence

could be the result of a lack of financial resources, know-how, or access to markets (Aiken & Hage, 1968).

The reduction of market uncertainty and the procurement of resources are two important sources of firms' environmental dependence (Galaskiewicz, 1985). Cooperation might be a potential way to reduce competitive uncertainty or to access resources or capabilities outside the organization. Oliver (1990) suggests six critical contingencies driving the formation of interorganizational relations. Five of these determinants – *asymmetry*, the desire to impose power or control over another firm's resources, *reciprocity*, the intention to cooperate with other firms and to mutually pursue business affairs, *efficiency*, the improvement of internal efficiency, *stability*, the predictability in responses to exogenous uncertainty, and *legitimacy*, the desire to increase alignment with demands of the institutional environment – are the outcome of firms' purposeful responses to environmental interdependencies.

As Trapido (2007) noted, the literature is not consistent in its prediction of the relationship between strategic interdependence and firms' likelihood to form an alliance. On the one hand, Gulati & Gargiulo (1999) conceptualize interdependence as the degree to which firms' segments in an industry are complementary, which implies that the likelihood of alliance formation is reduced when two firms compete in the same segments due to a lack of availability of complementary resources. On the other hand, Stuart (1998) suggests that firms having huge technological (or market) overlaps are more likely to form an alliance. Stuart reasoned that technologically similar firms seek to improve efficiencies by reducing effort duplication and are better able to assess know-how and to learn from technologically similar firms.

After this review of important general and conceptual reasons for firms to engage in alliance relationships, the following section will present findings of studies investigating more specific factors motivating firms to form alliances.

Alliance Formation

Early studies examining the formation of alliances focused on the investigation of classic cost-benefit analyses where firms form alliances when the benefits of complementing resources exceed the cost of managing an alliance (e.g. Buckley & Casson, 1988). Reduced transaction costs, improved competitive positioning, and organizational learning where identified as factors facilitating the formation of alliances (Kogut, 1988). Whereas these early studies were mostly based on an analysis of firms' resource or market conditions, more recent studies went beyond this approach and broadened the investigation by including market or firm-specific factors affecting the cost-benefit framework. For example, research investigated the impact of factors such as previous ties and third party referrals (Gulati, 1995b) as well as a firms' position in technological space (Stuart, 1998).

In addition to investigating joint ventures, early studies on strategic alliance formation researched a wide scope of factors motivating a firm to form an alliance (Rothaermel & Boeker, 2008). It has been suggested that firms enter alliances to overcome shortcomings of markets (Williamson, 1985; Kogut 1988), to accumulate market power (Porter & Baden-Fuller, 1986), or to benefit from mutual learning (Hamel, Doz, & Prahalad, 1989), risk sharing (Ohmae, 1989), increased legitimacy (Baum & Oliver, 1991; Dacin, Oliver, & Roy, 2006), novel competency development (Hennart, 1991), new market entry (Kogut, 1991), increased innovativeness (Shan,

Walker, & Kogut, 1994), new product development (Rothaermel & Deeds, 2004) as well as the improvement of start-up performance (Baum, Calabrese, & Silverman, 2000).

Furthermore, studies investigated internal and external relational factors having a major impact on alliance formation such as the strategic and social position of a firm (Eisenhardt & Schoonhoven, 1996), its commercial, technological, and social capital (Ahuja, 2000b), a firm's network position (Stuart, 1998), similarities in status (Podolny, 1994), the existence of previous ties (Gulati, 1995b), national institutional environments (Vasudeva, Spencer, & Teegen, 2013), geographic distance (Reuer & Lahiri, 2013), firms' resource endowments (Park, Chen, & Gallagher, 2002) as well as the combination of complementarity in geographical markets, status similarity, and social capital (Chung, Singh, & Lee, 2000).

More recent studies switched the focus and increasingly investigated alliances at the dyadic level. Chung, Singh, & Lee (2000), for example, found that capability complementarity and status similarity are positively related to alliance formation between two firms in the investment banking industry. Social capital, built through previous direct and indirect alliance experiences, was also found to play an important role in the formation of alliances between two banks. Wang & Zajac (2007) researched how combined alliance and acquisition capabilities as well as partner-specific knowledge impact the likelihood of two firms combining resources through an alliance versus an acquisition. Furthermore, in the case of an alliance between an incumbent using an old technology and a start-up using a new technology, Rothaermel & Boeker (2008) found that the positive effect of firms' resource and skill complementarities on alliance formation was negatively moderated by the age of the new firm.

In addition to relational and resource-based explanations of alliance formation, research in the management and sociology literatures (e.g. Ang, 2008; Trapido, 2007) has argued that firm

specific competitive conditions impact firms' propensity to form alliances with competitors in the same industry. For example, Ang (2008) combines Barnett's (1997) concept of competitive intensity with firm resource endowments assuming that firms with weak resources experience high levels of competitive intensity whereas firms with strong resources experience low levels of competitive intensity. According to Ang's reasoning, firms with weak resource endowments have higher interests in forming alliances, yet, are considered unattractive alliance partners thus lacking alliance opportunities. Firms with strong resource endowments, on the other hand, while being attractive alliance partners, refrain from forming alliances to maintain advantages towards competitors. As a result, firms experiencing moderate levels of competitive pressure form alliances at the highest rate because they have both an interest in forming alliances while being considered attractive partners. Ang (2008) found furthermore that collaboration leads to higher growth for firms facing lower levels of competitive intensity compared to firms facing higher levels of competitive intensity. In another study, Trapido (2007) found support for a positive relationship between the level of previous competitive rivlary and the likelihood of alliance formation between two firms in the same industry.

This study seeks to contribute to this research by investigating the impact of intra-industry heterogeneity and rivalry on firms' propensity to form alliances. As outlined before, intra-industry heterogeneity has been analyzed in the strategic group framework (e.g. Hunt, 1972; Caves & Porter, 1977; Cool & Dierickx, 1993) suggesting that strategically similar firms show similar strategic postures and patterns of rivalry within as well as across groups (Peteraf, 1993). Yet, while traditional strategic group research assigned firms to groups based on measures of similarity in resource endowments and market scope (e.g. Hatten & Schendel, 1977; Cool & Schendel, 1987; Fiegenbaum & Thomas, 1990), this study investigates the impact of dyad-level

competitive intensity and rivalry on firms' propensity to form alliances in the same industry thus providing a more fine grained investigation of the underlying mechanisms.

A Synthesis

The previous section provided reviews of two different literatures. First, research on the dynamics of competition outlined how research challenged the homogeneity assumption of competition suggested by traditional economic models. The review investigated in particular two factors that have been argued to drive competitive rivalry among firms: the degree to which they are strategically similar and their level of multimarket contact.

The strategic group concept has been a prominent framework to investigate the impact of strategic similarity on a wide spectrum of factors including competitive rivalry among firms within the same group as well as across groups. This rich body of research has not only provided strong support for within industry competitive heterogeneity but also strengthened the argument that the strategic group level might be a more fine grained and useful level to analyze firm behavior within an industry thus revealing insights that might otherwise not be observed.

The imperfection and heterogeneity of markets has been further supported by research on multimarket competition which has shown that multiple contacts in product or geographical markets influence firms' competitive behavior thus suggesting the existence of distinctive competitive relationships between pairs of firms. Although, multimarket competition research is consistent in its core argument that the level of multimarket contact impacts competitive rivalry, studies are not consistent in the prediction of this relationship. Whereas some research argues for a linear relationship other studies suggest a more complex relationship where competitive rivalry

between two firms increases at early levels of multimarket contact but starts to decrease once mutual interdependence is recognized and increased familiarity is established.

Secondly, research on strategic alliances was reviewed. The review outlined that firms specialize on tasks they can perform best and, due to this specialization, have only incomplete resources and capabilities under their control. In addition to sourcing missing components in factor markets, alliances have been shown to be valid means to overcome deficiencies. Through cooperation, firms can complement their assets with those of other firms or pool resources to realize scale economies.

In addition, firms can cooperate with one another to reduce competitive intensity imposed by market forces. When competitive intensity becomes too strong single firms might not be able to withstand those pressures. In contrast to being acquired in whole or in parts by another company, firms might decide to cooperate with competitors who lack sufficient scale or possess complementary resources and capabilities.

In short, both the level of strategic similarity as well as firms' degree of multimarket contact have been shown to impact firm's competitive rivalry while inter-organizational relationships have the potential to reduce competitive pressures.

What is missing from this prior research is how competitive forces at the dyad-level impact firms' propensities to form alliances in the same industry. In what follows, I will shed light on this question by investigating how competitive intensity experienced by two firms in a dyad as well as dyadic competitive rivalry between two firms motivate firms to collaborate in the same industry. More specifically, the study will commence with the investigation of diffuse dyad-level competitive intensity, then proceed with shedding light on dyadic rivalry caused by levels of strategic similarity as well as multimarket contact between pairs of firms, and, finally,

explore the effect of factors moderating the relationship between dyad-level competition and firms' propensity to collaborate.

CHAPTER III

THE HOSPITAL SOFTWARE SYSTEMS INDUSTRY

Introduction

Each year, huge amounts of money are spent on the provision of healthcare systems providing health services to patients and jobs to millions of people. In 2011, $2.55 trillion were spent on healthcare in the United States which accounts to approximately 17% of its annual gross domestic product (Organization for Economic Co-Operation and Development iLibrary, 2013). Each day, thousands of patients enter and leave healthcare facilities imposing tremendous pressures on both clinical personal and administrators to cope with huge amounts of information. Dependent on the size of a healthcare facility, the complexity and cost to collect, process, maintain, and control information, including data about patients and their specific treatments as well as the management of small practices, hospitals, and other healthcare organizations, might increase substantially. To cope with these vast amounts of information and to support healthcare professionals and administrators, computer systems and task specific software applications are of crucial importance.

Computers were used to support hospital research projects as early as the late 1950s and the first firms to produce specific software applications for community hospitals in the United

States went to market in the early 1960s. Over time, more comprehensive sets of software became available to hospitals commonly referred to as hospital information systems (HIS) which included applications in several different administrative and clinical sub-areas such as patient management, clinical laboratory, pharmacy, radiology, and nursing. Yet, although software solutions for hospitals carried a lot of promise in the early years and both healthcare professionals and software developers had considerable hopes, the implementation and extensions of systems turned out to be rather complex and difficult. The following section presents the historical development of the US hospital software industry with a focus on the time period between the early 1960s when software solutions became available for US community hospitals and the early 1990s, the end of the observation period for the empirical context of this study.

Historical Development

Before the emergence of the computer and software solutions to administer healthcare processes, medical records and administrative tasks were performed manually on paper. Physicians kept notes about patients' conditions and their recommended course of action as protocols for consultation when patients returned to the health professional at a later point in time. Initially, these records served exclusively to facilitate the interaction between a patient and a doctor and where only seldom shared with individuals or organizations outside a practice. Administrative and clinical information requirements were relatively low, making the process of tracking the diagnosis and treatment of patients on paper manageable.

With the development of new diagnostic and therapeutic techniques and increased connection to healthcare providers outside a clinic, requirements to manage larger amounts of

information increased substantially. This was true in particular for hospitals where several different medical and administrative departments provided services to patients and clinical staff and information had to be shared more widely. At the same time, hospitals were under consistent pressure to increase their clinical as well as operational efficiency to comply with external healthcare providers such as insurance firms and state-run health programs.

Before electronic digital computers were available, automatic computing applications for medical purposes were first used in the late 19th century. Health relevant data for public health surveys and epidemiological studies was gathered using electromechanical punched-card card systems before electronic digital computers became available in the late 1940s (Collen 1995). These early information recording devices can be seen as the predecessors of modern information and data processing facilities.

After the introduction of computers into the healthcare industry in the late 1950s, the first software applications were developed and marketed to help hospitals cope with increasing levels of complexity in the early 1960s. These first software components provided solutions for administrative processes such as financial and patient management and it took several more years until the first patient care applications were introduced to the market. Among the early adopters of new computer based hospital information systems were mainly large medical research institutions such as the Texas Institute for Research and Rehabilitation, the Massachusetts General Hospital in Boston, the University of Utah and University of Missouri-Columbia hospitals, and the Kaiser Permanente Medical Center in Oakland (Collen, 1991). Yet, problems with the usage and implementation of computers and useful software tools resulted in a rather low adoption rate. By the year 1962 only 39 out of a population of roughly 6000 hospitals used computers in some form (Veazie & Dankmyer, 1977) and by 1966 only eight hospitals used

computer based systems where administrative and clinical applications were integrated (Ball & Jacobs, 1980; Singh, 1993). Most of these early adopters developed their own software solutions or relied on software provided by hardware producers for most of the 1960s (Singh, 1993) and by 1970, 25 firms provided healthcare facilities with software solutions (Ball & Jacobs, 1980; Ball & Boyle, 1980) that were still mostly developed in projects led by larger hospitals (Singh, 1993). Yet, expectations about the future of software applications in the healthcare industry were very high during these early years.

The hospital software industry experienced a growth push following the introduction of the Medicare health insurance program in 1966 when the federal government increasingly started to regulate the healthcare industry (Shaffert & McDowell, 1978; Hodge, 1981; Singh, 1993). Under this new regime, hospitals had huge incentives to record the cost and information of treatments to be reimbursed by Medicare or other providers. As a consequence, demand for hospital software solutions started to increase, the industry started to flourish and more software solutions were developed and became available in the market.

Despite these advances, the development of software solutions was closely tied to the development of hardware components with monolithic mainframe systems and minicomputers dominating the 1970s (Shortliffe & Blois, 2006). Mainframe computers were integrated systems consisting of one major computer that was shared among different departments. The advantage of these systems was that all information was centrally stored and could be accessed by every area. Yet, the obvious disadvantages were strong localization constraints as information had to be brought to the mainframe computer to be stored and processed as well as software limitations. The usage of mainframe systems was particular difficult in larger hospitals were physical distances were wide and patient as well as administrative information was difficult to transmit. In

addition, the usage of one large computer limited the options to customize software applications to specific departmental needs as a general data processing scheme was used for all areas.

Distance and software problems could be reduced using several smaller computers called minicomputers which also became available in the 1970s. These distributed designs permitted departments to buy computers with specific hardware specification to process information close to places where patients were treated or where administrative data was generated. The usage of decentralized minicomputers also allowed the development of specialized software solutions that could focus entirely on specific departmental needs and became, therefore, very popular. Yet, hardware decentralization and customization of software applications often distanced departments in healthcare facilities as information could not be shared effectively. Often, areas used different hardware components that focused on optimizing departmental needs with the consequence that software solutions were only very limited compatible across areas. This lack of cross-departmental communication constituted one of the major disadvantages of early decentralized designs and created the foundation for the development of very area specific software applications in healthcare facilities adding considerable complexity to operations and making the merger of systems challenging up to this day. Yet, continuous technological and process improvements by hardware and software developers as well as increasing collaboration of hospitals led to the usage of computers in most hospitals by the mid-1970s. By 1975 close to 80% of hospitals used computers in their operations in some form (Lindberg, 1979; Abdelhak, 1982; Dorenfest, 1992; Singh, 1993).

The usage of computers in health facilities was revolutionized in the late 1970s and early 1980s when computers using microprocessors, also called personal computers, became widely available to organizations and individuals (Shortliffe & Blois, 2006). These affordable systems

quickly spread within hospitals and led to much wider use of computers. Effective information sharing across departments became possible in most hospitals with the emergence of network technologies in the early 1980s (Simborg et al., 1983). The increased availability of computers led to a boom among software producers as numerous new firms entered the market offering more specialized software solutions.

The demand for more specialized software was particularly intensified after the introduction of the prospective payment system in 1983 (Kimberly et al., 1989). Instead of paying hospitals for their services on a per-case scheme, hospitals were now reimbursed based on pre-set schedules that determined reimbursement amounts based on the diagnosis. In other words, hospitals were only reimbursed a fixed amount for a particular treatment and any deviation from this amount either generated a surplus or a deficit for the hospital. As a consequence, hospitals were under increased pressure to lower the cost of their health services and computer-based administrative and clinical applications were an efficient way to achieve this goal. While opportunities for software developers increased substantially in this favorable environment where hospitals had to comply with new operational and reporting requirements, increased demand invited also considerable entries of new competitors leading ultimately to the failure of many firms (Doyle, 1988). The following quotes illustrate the increased pressure on hospitals to improve the efficiency of operations:

> "In order to survive and deliver quality healthcare…information technology will be essential....And if you chose not to implement it, your competition will, and they'll have the competitive edge."
>
> (Les A. Clonch Jr., information systems director for Wuesthoff Health Systems, Inc., a major healthcare provider in east-central Florida; in: Dunbar & Laughlin, 1992)

> "Today, MIS departments are called upon with increasing fervor to lower costs while at the same time boost system performance; this challenge is compounded by the fact that competition has drained the internal budgets of many hospitals."
> (Pollock, 1990)

With the increased rate of entry of new firms in the 1970s, the industry grew from very low sales in the 1960s to close to 3 billion USD by the late 1980s (Pollock, 1990; Singh, 1993). Yet, the industry remained competitive as many developers of medical software solutions had to exit the industry due to underestimations of both the complexity of developing hospital software solutions by software firms and the resource and organizational requirements of implementing sophisticated software solutions by hospitals. Due to this complexity, the adoption of clinical components of hospital information systems lags still behind those in administrative departments (Degoulet et al. 2003). The following accounts reflect the competitive situation of producers of departmental software applications for hospitals in the United States:

> "MIS [management information systems] vendors exist in a highly competitive industry." (Trotter, 1990)

> "First and foremost the industry has changed significantly, most dramatically in the notion of competition." (Gross, 1990)

”We've got a competitive environment and a very tough financial environment. There have been some tremendous changes in hardware and lots of software available with the average hospital having 10 or more vendors."

(Douglas A. Ryckman, worldwide managing partner for the healthcare segment of Andersen Consulting; in: Computers in Healthcare, 1991)

While competitive pressures among software producers remained intense, hospitals demanded increasingly interconnected applications to facilitate information exchanges across departments. Yet, in the early years of the industry, software was developed at the departmental level. The resulting ‘departmentalization’ of applications led to vast incompatibilities that made integration difficult and complex throughout the 1990s up to the present day. Yet, while the integration of different software components remained challenging, economic pressures as well as the necessity to provide improved health services to patients increased the need to intensify the interconnectedness of applications. The following statements by industry experts illustrate this process:

“The laboratory information system (LIS) has evolved from a strictly departmental application to a complex communication system, paralleling the rapid change in healthcare that has occurred over the last five years. To be competitive in this technological arena, the LIS vendor must address an expanding array of communications needs with innovative, cost-effective solutions… In the past, LIS communications issues were secondary to basic functionality. Instrument interfaces were relatively simple, and there was no perceived need for extensive healthcare networking since each facility was largely an autonomous unit. Between facilities, cooperation was the exception rather than the rule.” (Weitzel, 1988)

> "… The competition in this industry is forcing people to run operations on a more integrated basis than they used to, which is creating a bigger demand from the buyer. There have been tremendous advances in technology, which means there are many more options in terms of how you accomplish the systems-integration process. Another component is that there are literally thousands and thousands of specialized computer products out there now that people are looking at different subsets and wanting them as part of the overall picture. That, coupled with expectations of the buyers, has created an environment where the systems integrations are much more difficult and much more complex, and there's a whole spectrum of ways to structure the systems integration transaction."
>
> (Steven Heck, vice president of systems integration, First Consulting Group in: Computers in Healthcare, 1991)

Yet, while the usage of software applications in the health sector lagged behind those in other industries and software departmentalization was a widespread phenomenon, many specialized firms chose to cooperate with competitors to complement their skills and resources and to develop or offer more integrated software solutions. The following accounts illustrating cooperative agreements between software producers attest to this phenomenon:

> "Our companies share a strategic vision of the completely automated radiology department of the 1990s. We are committed to making that vision a reality and have already implemented technical development projects that are bringing us nearer to that goal,"
>
> (Richard Corley, group manager healthcare and pharmaceutical industries marketing at Digital Equipment Corporation (DEC) commenting on the announcement of DEC and Siemens Medical Systems, Inc. to develop a Picture Archiving and Communication (PAC) system integrating medical images and patient information into departmental and organization wide computer networks; Computers in Healthcare, 1988)

“Through the integration of Digimedics and Hewlett-Packard by using high level communications protocols, customers now have the integrated solution they have been searching for”.

> (Scott Pine, president of Digimedics Corporation commenting on the company’s plan to form a joint marketing agreement with Hewlett Packard's Health Care Information Systems group; Computers in Healthcare, 1988)

“Technicon Data Systems Corp. and Management Science America Inc. (MSA) have signed an agreement which will result in the marketing of a fully integrated system to handle all aspects of hospital information management. Technicon's Medical Information System (MIS), which manages all aspects of a patient's hospital stay, has been shown to result in dramatic dollar savings for hospitals. Technicon's product includes a new patient accounting system providing billing, insurance records, collections and management reports. The MSA product, Information Expert, permits borderless reporting, screen painting, a fourth generation programming language and a link for personal computer access to mainframes. MSA will also offer a financial application for general accounting and hospital cost accounting.” (Computers in Healthcare, 1986)

“The trend in hospital computing has evolved from financial-based systems to hospital information systems (HIS) that link various departments to totally integrated computer systems…When selecting an HIS, key considerations are appropriate software, flexibility and the ability to serve multiple hospitals. Physicians are increasing their use of computers and hospitals are taking an increasing role in supplying physicians with computer capabilities.” (Computers in Healthcare, 1983b)

“The combination of MEDITECH;s software expertise with National Data’s marketing ability and experience should allow the two companies jointly to provide a broader level of support…than either company has been able to provide on its own.”

> (Lawrence Polimeno, Vice President and General Manager of Meditech; Computers in Healthcare, 1983a)

As the quotes illustrate, firms in the US hospital software industry formed alliances for different reasons such as the joint development of new technologies, commercialization of products, combination of expertise in complementary areas, and the realization of scale economies to serve larger customers. Yet, although alliances might differ in their focus and ultimate goal, the quotes also illustrate that a fundamental reason for firms to form a cooperative agreement was to improve the communication across software applications destined for different departments in a hospital in attempts to offer more integrated and complete solutions to customers.

A Synthesis

With increased amounts of information to be processed within hospitals and rising requirements to share data with external actors in the healthcare industry, hospital software packages have become integral parts of healthcare operations. Computer-based hospital information systems assist both healthcare professionals as well as administrators in their daily work through specific software applications that increasingly integrate components. Yet, hospital software components are complex systems and their integration is a challenging task up to this day.

Much of the difficulties to integrate components are owed to early developments in the industry which were tied to innovation of hardware. The lack of network structures and the initial usage of largely autonomous computers led to the independent development of specific software solutions aimed to organize tasks in specific departments making the integration of systems difficult up to the present day. Although operating and managing hospitals requires the

processing of large amounts of administrative and health-related data, healthcare institutions lag behind other industries with regard to the amounts of money spent on information technology.

CHAPTER IV

PROPOSITIONS AND HYPOTHESES

The purpose of this study is to investigate the impact of dyadic competitive conditions on firms' propensity to form alliances in the same industry. Previous studies have found initial support for a positive relationship between competition and collaboration. Building on Barnett's (1997) conceptualization of competitive intensity as a firm-level attribute and applying a resource-based theoretical framework, Ang (2008) found in a sample of firms in the Singapore manufacturing industry a positive relationship between the competitive intensity experienced by a firm and its likelihood of forming an alliance. Similarly, proposing a sociological framework of 'competitive embeddedness', Trapido (2007) suggests that a history of more intense competitive rivalry increases the likelihood that two firms form an alliance in the US venture capital industry. Hence, research indicates the existence of a positive relationship between firms' competitive conditions and their propensity to form alliances.

However, competitive conditions among firms are complex and many questions remain unanswered. This research seeks to address some of these questions by investigating the impact of 'diffuse' competitive intensity on firm dyads and a more fine-grained look at the impact of dyadic competitive rivalry. Finally, a set of factors that potentially moderate the relationship

between dyad-level competitive intensity and firms' propensity to form alliances will be investigated.

It has been suggested that dyadic competitive relationships are significantly impacted by two factors: the level to which firms are strategically similar and the extent to which they compete simultaneously in more than one market. Considerable research has investigated the impact of strategic similarity on rivalry. In particular, strategic group research has devoted plenty of attention to within-industry effects of firm similarity (e.g. Caves & Porter, 1977; Cool & Dierickx, 1993; Peteraf, 1993). In addition, the level to which firms compete in more than one market, or their level of multimarket contact, has been found to impact the degree of rivalry between two firms (e.g. Edwards, 1955; Bernheim & Whinston, 1990; Baum & Korn, 1996; Gimeno, 1999; Fuentelsaz & Gomez, 2006; Greve, 2008). Empirical evidence, especially more recent studies, support a rivalry reducing effect of multimarket contact based on the mutual forbearance argument (Edwards, 1955).

While competitive dynamics research has outlined some of the complexities around the relationship between intra-industry heterogeneity and competitive conditions, our understanding of how competitive intensity impacts alliance formation remains incomplete. Specifically, we do not know how dyad competitive conditions and antecedents of competitive rivalry – the degree to which two firms are strategically similarity and are multimarket competitors – impact the likelihood that two firms form an alliance in the same industry (hypotheses are summarized in Figure 4.6).

Competitive Intensity and Alliance Formation

Firms are consistently confronted with varying levels of environmental uncertainty such as the availability of supplies, changes in consumer preferences, and actions of competitors. Within-industry competitive conditions, situations in which competitors impose pressures on firms through the development of new products, or the improvement of production process efficiencies, for example, have been suggested to be major sources of environmental uncertainty (e.g. Thompson, 1967; Lawrence & Lorsch, 1967; Duncan, 1972; Hannan & Freeman, 1977; Miles & Snow, 1978; Pfeffer & Salancik, 1978; Milliken, 1987). The competitive intensity experienced by a firm or pairs of firms might result from factors such as lower pricing or increased innovative activity by other market participants and can constitute a major threat to firms' profits and, ultimately, survival.

To address the challenges imposed by competitive uncertainty, firms might enter cooperative agreements such as alliances to re-arrange exchange relationships with other firms in the same industry (Pfeffer & Salancik, 1978). As Pfeffer & Salancik (1978[2003]: 43) state, "the typical solution to problems of interdependence and uncertainty involves increasing coordination, which means increasing the mutual control over each other's activities, or, in other words, increasing the behavioral interdependence of the social actors". The competitive intensity, that is the diffuse competitive pressure imposed by the competitive environment on individual firms or pairs of firms in an industry, can be a major source of uncertainty. To reduce this uncertainty, the formation of an alliance might be a valid option to offset high levels of competitive intensity through, for example, accessing complementary resources, capabilities, markets, or by developing new products, thus improving firms' market position compared to competitors.

Compared to acquisitions, which might be a valid alternative to address competitive uncertainty caused by resource constraints, alliances are more flexible options that usually require lower levels of financial commitment and risk (Harrison et al., 2001), thus making alliances a more flexible option in dynamic competitive settings. These advantages of alliances gain in importance as firms' competitive conditions intensify, financial resources are scarce, and time to act is limited. Under increased competitive intensity, the potential of alliances to provide access to innovation through R&D agreements, economies of scale through production alliances, or entry to new markets through partner distribution networks, for example, can be of crucial importance for firms in their attempts to create value and ultimately secure survival. Furthermore, alliances have the potential to help firms to reduce competitive pressures through moderating environmental uncertainty and changing competitive positions (Garcia-Pont & Nohria, 2002; Gomes-Casseres, 1996) as well as increasing competitive pressure on rivals (Silverman & Baum, 2002).

Therefore, firms confronted with increased competitive uncertainty in their environment might seek to reduce these pressures through the formation of an alliance that would provide, for example, access to new markets, technological skills, financial means, and skilled labor. At the dyad level, pairs of firms can be expected to form alliances at higher rates when the competitive intensity is high on both firms. On the other hand, firms in a dyad experiencing lower levels of competitive intensity are argued to be less likely to form alliances. Therefore, the following hypothesis suggests that diffuse competitive intensity experienced by two firms in a dyad positively impacts the likelihood that the two firms form an alliance in the same industry (see also Figure 4.1).

Hypothesis 1: The higher the competitive intensity experienced by two firms in a dyad, the higher the likelihood that they form an alliance with one another in the same industry.

Similarity, Competitive Rivalry, and Alliance Formation

After proposing in the previous section a relationship between diffuse competitive intensity experienced by two firms in a dyad, the following set of hypotheses suggests relationships about the impact of dyadic competitive rivalry, captured by the degree of strategic similarity and level of multimarket contact between two firms, on the firms' propensity to form alliances with each other.

The impact of strategic similarity on competitive rivalry has been of central concern in early strategic management research drawing from the industrial organization economics (IO) paradigm. This stream of research suggests that the larger the strategic distance between firms in an industry (they are more dissimilar), the larger the competitive rivalry among them. Porter (1979) argues that tacit coordination among firms is more difficult to achieve as firms become increasingly distant strategically. The central argument in this line of thought is that the lower the strategic distance between firms in an industry, or the more similar they are, the higher the potential to engage in collusive behavior which reduces the level of rivalry (Caves & Porter, 1977).

Rivalry might be reduced by the fact that similar firms might also be similar in their competitive orientations in the market which would facilitate coordination among market participants. Firms might respond to market disturbances in similar ways and anticipate one another's market behavior. On the other hand, coordination might become more difficult when firms are more dissimilar (D'Aveni, 1994) and actors can use their specific resources,

capabilities, and market positions to exploit market opportunities and to increase competitive pressure on other market participants thus creating hypercompetitive disruption and potentially hypercompetitive escalation. A rivalry reducing effect among similar firms has received empirical support in a study on U.S. software firms (Young et al., 2000), and across groups of dissimilar firms in the city-pair markets of U.S. airlines (Peteraf, 1993).

If the relationship between strategic similarity and dyadic competitive rivalry holds, as predicted by the Caves-Porter hypothesis, and at the same time, competitive rivalry increases the likelihood that two firms form an alliance in the same industry, then more dissimilar firms in an industry should form alliances at a higher rate than more similar firms. Thus, the likelihood that two firms form an alliance will be lower the more similar they are (see also Figure 4.2) [2].

> **Hypothesis 2a:** The higher the similarity between two firms in an industry the lower the likelihood that they form an alliance.

Predictions about the relationship between firm similarity and competitive rivalry are, however, not all consistent with the Caves-Porter hypothesis. Contradicting the previous argument, organizational ecology research has suggested that rivalry is highest among similar firms (Hannan & Freeman, 1977, 1989). Ecological research argues that firms' situations are often described as 'competitive' based on contextual circumstances in which firms encounter one another in zero-sum relations (Barnett, 1997). Competition among firms is expected to be higher

[2] It is acknowledged that previous research has suggested complementarity (or strategic interdependencies) as an alternative explanation for alliance formation (e.g. Gulati, 1995b; Arora & Gambardella 1990; Rothaermel, 2001; Nohria & Garcia-Pont, 1991; and Teece 1992). The core argument is that potential resource and market complementarities motivate firms to form alliances in attempts to make their products and services more attractive to customers. In addition to general empirical investigations of the impact of complementarities on alliance formation (e.g. Harrigan ,1985; Lorange & Ross, 1992; Rothearmel, 2001), several studies have used non-overlapping market niches to approximate firm complementarities (e.g. Gulati, 1995b; Chung, Singh, & Lee, 2000; Rothaermel & Boeker, 2008).

in contexts where firms compete for the same resources because of, for example, their 'structural equivalence' (Burt, 1992) or their presence in the same market 'niche' (Hannan & Freeman, 1977, 1989). In this market-level conceptualization, competition increases with the proportion of zero-sum relationships among actors in a market.

Competition among organizations is, thus, the outcome of their need for the same resources. At the bipolar ends of the spectrum, rivalry will be maximized among identical organizations targeting the same resource space whereas competition will be minimized among very dissimilar organizations requiring different resources. Between these two extremes, varying levels of similarity among organizations result in a wide spectrum of different levels of rivalry. Several studies found support for a positive relationship between similarity and competitive rivalry. For example, Carroll and Wade (1991) found that adding a competitor had stronger competitive effects on geographically proximate organizations in the U.S. brewery industry (see also Swaminathan & Wiedenmeyer, 1991, for similar findings in the German brewing industry). Similarity was also argued to impact rivalry when resource niches overlapped (Baum & Singh, 1994). The relationship between similarity and competitive rivalry was further developed and formalized in the localized competition hypothesis (Baum & Mezias, 1992) which suggests that the level of rivalry between firms is the result of their overlap in resource requirements. As Baum and Mezias (1992: 581) state, "the more similar a focal organization is to its competitors, the greater the intensity of competition it will experience", implying that dyadic rivalries increase among those firms. Based on this localized competition argument, I propose an alternative hypothesis to H2a stating that more similar firms form alliances at a higher rate (see also Figure 4.2).

Hypothesis 2b (alternative): The higher the similarity between two firms in an industry the higher the likelihood that they form an alliance.

Strategic Groups

Based on the two alternative predictions about the relationship between strategic similarity and firms' propensity to form alliances, hypotheses are advanced at the intra-industry strategic group level. As argued by the Caves-Porter hypothesis (Caves & Porter, 1977), strategically similar firms experience lower levels of rivalry. Firms in the same strategic group have been assigned to the group based on their similarity in industry specific factors likely to create mobility barriers. Mobility barriers create costs that other firms have to overcome if they want to enter a group. Based on their strategic similarity, firms likely have similar strategic orientations, use the same resources, and are able to anticipate one another's market actions. It follows, that rivalry is expected to be lower among firms within strategic groups than between firms from different groups.

At the same time, it has been suggested that a history of high rivalry between firms is positively related to firms' propensity to form alliances (Trapido, 2007). Since firms in the same strategic group are similar and rivalry is expected to be lower, firms are less likely to form an alliance with firms from the same strategic group than with firms from other strategic groups.

Hypothesis 3a: The likelihood that two firms form an alliance is lower when they are members of the same strategic group than when they are members of different strategic groups.

Parallel to hypothesis 2a and 2b, the localized competition argument (e.g. Hannan & Freeman, 1977; Baum & Mezias, 1992; Baum & Singh, 1994) makes different predictions about the level of rivalry among similar firms. The argument suggests that similar firms are more intense competitors because they rely on the same set of resources. Thus, an alternative hypothesis is advanced suggesting more alliance activity within strategic groups than across strategic groups (see also Figure 4.3).

> **Hypothesis 3b (alternative):** The likelihood that two firms form an alliance is higher when they are members of the same strategic group than when they are members of different strategic groups.

Multimarket Contact

Another factor that has been argued to influence the intensity of rivalry between firms in the same industry is the degree to which they compete in more than one market or segment. Larger market overlaps provide firms opportunities to collude and to lower competitive rivalry. A central theoretical argument in multimarket competition research is the mutual forbearance hypothesis (Edwards, 1955; Bernheim & Whinston, 1990). The theory suggests that the intensity of rivalry between two competitors is reduced when they compete with one another in more than one market, an argument that has received considerable empirical support in the literature (Baum & Korn, 1996).

As discussed in chapter 2, the rivalry reducing behavior of multimarket competitors might be explained by two theoretical arguments. First, a deterrence effect might explain a reduction in rivalry across markets. If attacked, a multimarket competitor might retaliate in other markets thus increasing potential losses of aggressive attackers. As a consequence, firms might

be reluctant to initiate aggressive competitive attacks as the number of mutual market presences increases. The rivalry reducing effect of multimarket contact seems to be particularly strong when a market is dominated by one large firm an effect that is interpreted as firms granting favorable competitive conditions to competitors in one market in exchange for the enjoyment of similar conditions in other markets (Baum & Korn, 1996; Gimeno, 1999). Thus, if multimarket contact reduces rivalry between two firms, firms with high multimarket contact will have less need to buffer competitive uncertainty and form alliances less often.

Secondly, firms might reduce competitive rivalry and forbear one another based on the recognition of interdependencies (Baum & Korn, 1996). Firms in an industry watch one another and make decisions based on competitors' observable behavior (White, 1981). This observation varies qualitatively within an industry and firms in a market can be assigned to clusters of proximate firms observing their behavior more attentively than that of more distant firms (White, 1988). Through closer observation firms might gather more and better quality information about competitors and become more aware and acquainted with their behavioral characteristics (White, 1981). Thus, I propose a negative effect between firms' level of multimarket contact and their likelihood of forming an alliance in the same industry (see also Figure 4.4).

> **Hypothesis 4a:** The likelihood that two firms form an alliance decreases with their level of multimarket contact.

On the other hand, it might be argued that increased familiarity among firms improves their mutual knowledge about one another thus facilitating alliance formation. The embeddedness literature (i.e. Granovetter, 1985) suggests that actors can learn about one another

through repeated interaction and become increasingly familiar. Familiarity gained through observing the competitive behavior of firms in the same market 'clique' or group (White, 1981) might thus contribute to a reduction in uncertainty about firms' behavioral reliability and its suitability as an alliance partner potentially leading to the creation of trust between two parties. As Gulati (1995a: 92) argued, "the idea of trust emerging from prior contact is based on the premise that through ongoing interaction, firms learn about each other and develop trust around norms of equity…" This interaction-based link between familiarity and the creation of trust holds not only in situations where actors cooperate but also in those where they compete. As Shapiro, Sheppard, and Cheraskin (1992: 369) argue, trust between two actors might not only be the outcome of cooperative interactions but also be the result of non-cooperative behavior; "even when one expects uncooperative behavior…trust can result if the behavior is predictable." This trust can be an important factor benefiting the formation and governance of interorganizational alliances (Gulati, 1995a) and can help firms to achieve a competitive advantage (Barney & Hansen, 1994).

Increased familiarity requires an acknowledgment of firms' interrelationship and of the potential consequences in case of defection. Firms competing simultaneously in more than one market might be more familiar and possess more information about one another. As a result, the risk of opportunistic behavior might be reduced when two firms are multimarket competitors. Uncertainty in the identification of appropriate alliance partners originates from two main sources: the difficulty of obtaining information about the competencies and needs of potential partners as well as a lack of information about the partner's behavioral reliability to restrain from opportunistic behavior (Gulati & Gargiulo, 1999). Considered that a firm intends to form an alliance with a firm in the same industry, a potential partner's reliability is of particular concern.

Faced with uncertainty about a partner, firm might exploit their social ties and existing networks to lower search costs and reduce the risk of opportunistic behavior. Granovetter (1985: 490) states that 'the widespread preference for transacting with individuals of known reputation implies that few are actually content to rely on either generalized morality or institutional arrangements to guard against trouble.' Furthermore, information about a firm's reliability might be provided through prior alliances and referrals by shared alliance partners (Gulati, 1995b; Gulati & Gargiulo, 1999). Yet, in the absence of these ties and referrals, a firm might still gain valuable information through encounters with potential alliance partners across several markets. The argument of a firm being able to better assess another firm's resource endowments and its behavioral reliability might be even stronger considered that the outcomes of multimarket contact result from an ongoing process. The process starts with one firm entering the market of a competitor. Although the market entry might be noticed by the incumbent firm, its information about the entrant might be limited. As multimarket contact increases, competitor moves are likely to become of higher interest to the other firm thus increasing information and judgment capabilities about the potential partner. This suggests the following alternative hypothesis (see also Figure 4.4).

> **Hypothesis 4b (alternative):** The likelihood that two firms form an alliance increases with their level of multimarket contact.

In the previous section, it was suggested that the outcomes of multimarket contact might result from an ongoing process and be established over time. Although cases might exist where two firms grow very fast or a new firm enters incumbent markets rather quickly, thus

establishing high levels of multimarket contact in short periods of time, in most cases the development of higher market overlaps occurs over time. It follows that when the level of multimarket contact between two firms increases over time, so does the level of rivalry reducing forbearing behavior (see Figure 4.5). In fact, research has shown that the relationship between multimarket contact and mutual forbearance might not be linear but inverted U-shaped instead (e.g. Baum & Korn, 1999; Haveman & Nonnemaker, 2000; Stephan & Boeker, 2001; Fuentelsaz & Gomez, 2006). In other words, the rivalry between two multimarket competitors might increase at low levels of multimarket competition and then flip at a medium to high level of multimarket contact; a point where the mutual forbearance effect kicks in and rivalry decreases. As a consequence, the impact of competitive conditions on firms' propensities to form alliances might not be linear. Instead, the likelihood of cooperation might vary with the level at which two firms are multimarket competitors (see Figure 4.5 for a graphic illustration). Assumed that the total number of competitors in a market is not very low, firms might not be very aware of one another at low levels of multimarket contact. This effect might be even stronger when the size of two multimarket competitors and their mutual awareness is very asymmetric. For example, a large firm competing in many markets might not pay much attention to the entry of a small firm entering one of its markets whereas a small firm, confronted with the entry of a large firm, might closely monitor the entrant's actions. As a consequence, the level of competitive rivalry between two firms might increase at low to medium levels of multimarket contact.

After the level of multimarket contact between two firms reaches a certain level at which the two firms become increasingly aware of their interrelationship, the mutual forbearance effect might start to work and rivalry between firms starts to decline. As the level of multimarket contact increases further, the level of rivalry continues to decline.

Alliance formation activity might be relatively low at low levels of multimarket contact (Phase 1 in Figure 4.5). At this stage, firms lack rich information about one another and are not very familiar. Risks about firms' behavioral reliability and resource endowments remain relatively high at this level. In addition, at this low level of multimarket contact, competitive motivations might still be stronger among firms and cooperative behavior not as promising. An effective competitive deterrent has not been established due to the lack of market overlap and competitive behavior might not be as costly as in situations where a strong counterstrike could be executed in several markets. As a consequence, firms might not be aware of alliance opportunities or reluctant to form an alliance with another firm.

As the level of multimarket contact increases, the rivalry between two firms increases. They become increasingly familiar and might possess more information about potential partners' behavioral reliability and resource endowments. As a consequence, they are able to make better judgments about potential partners' reliability. In addition, after becoming more familiar with one another, firms might increasingly realize the benefits of market complementarities potentially allowing them to benefit from partners market strengths.

After the level of multimarket contact reaches a medium-level, firms start to acknowledge their competitive interdependence and rivalry starts to decline with further increases in multimarket contact (Phase 2 in Figure 4.5). At this point, firms have established effective deterrence mechanisms which, in addition to increased familiarity, produce the mutual forbearance effect. From this point on, rivalry among multimarket competitors shrinks with further increases in market overlap. If firms are simultaneously competitors in a sufficient number of markets to trigger a forbearing effect, the benefits from mutual forbearance reduce competitive uncertainty thus reducing the need to form alliances. Thus, the relationship between

firms' level of multimarket contact and their likelihood of forming alliances is suggested to be inverted U-shaped (see also Figure 4.4).

> **Hypothesis 5:** The likelihood that two firms form an alliance and their level of multimarket contact are related in an U-inverted manner. The likelihood of alliance formation is low at high and low levels of multimarket contact, whereas it is high at medium levels of multimarket contact.

A summary of all hypotheses up to this point is provided in Figure 4.6.

Competitive Intensity - Interaction Effects

In addition to the general dyad-level relationship hypothesized in the first part of this research (H1), a more focused analysis is performed to investigate how the impact of diffuse competitive intensity on firms' propensity to form alliances might be moderated by certain variables (hypotheses about interaction effects are summarized in Figure 4.10). The following section will advance hypotheses concerning the impact of variables that potentially interact with dyad-level competitive intensity. More specifically, it will be investigated how firms' ownership structure and redundancy of resources in a dyad affect the relationship between competitive intensity and firms' propensity to form alliance. In addition to these dyad level characteristics, it will be investigated how the competition-alliance formation relationship is affected during a time period ultimately before and after an anticipated major environmental change. Except for the period effect, the section follows the previous structure by advancing two competing hypotheses for each set of variables.

Resource Redundancy

The degree to which different types of resources are at the disposal of firms might vary considerably in an industry. Some firms might be in the possession of specialized resources and focus on the production of just one or a few related products whereas other firms might have access to broader sets of resources that allow them to produce several different types of products and be active in several market segments. While firms with limited resources might use those to develop expertise in specific differentiated segments of the market and can be successful in commercializing products to a particular group of customers, firms that are in possession of wider ranges of resources usually market their products to a broader range of buyers, thus targeting in most cases several different segments (David & Strang, 2006). Firms' access to resources is not static but might change over time instead. While firms with limited specialized resources might grow and increase their control over and access to wider sets of resources, resource rich firms might reduce their activities and thus resource endowments.

Because firms in possession of specialized resources are likely to be more focused in their strategies to develop and commercialize products, an alliance between two specialized firms could potentially lead to redundancy of resources. The duplication of resources might reduce the potential benefits from entering an alliance and might make a partnership between two firms in possession of specific resource pools a less attractive option. This might particularly be the case under conditions of intensified competitive pressure where margins of error might be narrow and strategic mistakes can quickly result in failure.

It is therefore suggested that although firms with specialized resource endowments might feel higher pressures to form an alliance under conditions of increasing competitive intensity, they will be less likely to form alliances with one another. Instead, they might seek to form an

alliance with firms that are in possession of wider pools of resources and organizational slack. Firms with broader resources, on the other hand, might search for specific resources complementing their wider pool of resources potentially providing them better access to niche markets. Furthermore, an alliance with another firm that is in possession of wider resources might be a less attractive option because it would duplicate already available resources and potentially increase inefficiencies. Under conditions of increased competition, firms with a broad resource pool might seek to access novel resources and form alliances more often with firms in the possession of more specialized resources. Therefore, when faced with increased competitive pressure, the likelihood that two firms form an alliance is reduced when both firms have a similar breadth of resources (see also Figure 4.7).

> **Hypothesis 6a:** The positive effect of dyad-level competitive intensity on firms' propensity to form alliances decreases when potential partners are both limited to specialized resources or both have access to wider sets of resources.

Alternatively, it might be argued that firms seek to pool similar resources with other firms in the industry when confronting increased competitive pressures. Rising levels of competition and narrower margins to maneuver might increase the risk of failure for firms with specialized resources by 'watering' their appearance in the market. The application of specialized resources requires a clear recognition in the marketplace since they are intended to target a specific group of buyers. Cooperative efforts with firms in possession of wider resource pools might 'dilute' firms' market recognition in specific market segments and reduce their appeal to customers.

A firm with specialized resources might avoid this trap by forming an alliance with a firm showing the same characteristics. Although, potentially using similar resources, the two firms might continue to focus on different market segments while maintaining high levels of recognition with their customer base. This might be owed to the fact that firms with specialized resources are less visible in other segments of the market whereas firms with broad resources might be recognized in all markets.

In addition to protecting market recognition, two firms with specialized resources might decide to cooperate with one another to improve their positions in the same market segment by pooling their resources. Through cooperation, two firms might foster their market position in the same segment when faced with increased competitive pressure. By doing so, both firms could maintain their market recognition and benefit from the realization of increased scale economies.

When faced with increased competitive intensity, firms that have access to wider sets of resources might, alternatively, decide to coordinate their activities with similar firms in attempts to increase efficiencies and to leverage their size in the market. These types of firms can, on average, be assumed to be larger in size and to be active in more segments within an industry. They could, therefore, seek to consolidate their market power through cooperative efforts. An alliance would potentially allow two firms in possession of wide resource pools to coordinate their research as well as commercialization efforts, thus reducing operational inefficiencies. It is argued that these attempts to improve the efficiency of operations are intensified when both firms encounter increasing levels of competitive intensity. Thus, an alternative hypothesis to H6a proposes that when faced with intensified competitive pressures, the likelihood that two firms form an alliance increases when they possess similar resources (see also Figure 4.7).

Hypothesis 6b: The positive effect of dyad-level competitive intensity on firms' propensity to form alliances increases when potential partners are both limited to specialized resources or both have access to wider sets of resources.

Ownership Structure

There are many possible ownership arrangements that firms, either for profit or non-profit, can adopt. Broadly, firms in an industry can be separated in being either public or private. Among the many factors that distinguish public from private firms, the degree to which firms have to disclose information to investors and the larger public is of major importance. For most private firms, information disclosure requirements are much less stringent than they are for their public counterparts. To inform current as well as potential investors about the condition of their business, public firms have to disclose financial information about the current state of affairs. In addition, public firms have to report on their current business situation and lay out strategic intentions about their plans for the future. As a consequence, public firms are more visible to other firms in an industry and richer information is available about their actions and strategies.

In addition, public firms are required to disclose information about their affairs on a regular basis which might lead to higher levels of visibility, increased reputation, thus potentially increasing their attractiveness as alliance partners. Other firms in an industry might become increasingly familiar with a public firm disclosing company information on a regular basis. Familiarity can be achieved in many ways including tracking of competitive behavior in the marketplace but also improved intelligence about competitors' financial health and strategic intents. As a consequence, based on public exposure and facilitated access to information, public firms will be able to be better assessed by potential alliance partners.

This increased availability of information might be a factor that improves firms' likelihood of entering collaborative relationships under conditions of intensified competition. In situations of increased competition, when resources are scarcer and margins thinner, alliances might become an option for firms to secure survival. To enter meaningful alliances, information about a potential partner is of essential importance. Public firms might, therefore, benefit from their increased exposure to one another and be more likely to enter alliances with one another when competitive intensity increases (see also Figure 4.8).

> **Hypothesis 7a:** The positive effect of dyad-level competitive intensity on firms' propensity to form alliances increases when both potential partners are public firms.

Alternatively, it might be argued that public firms do not form alliances at higher rates under conditions of increased competitive pressure but instead form alliances at lower rates. Often, public firms have better access to capital markets potentially increasing their options in situations of high competitive intensity. With increased access to financial resources, public firms might choose to strengthen their capital base and to grow internally or to acquire other firms providing assets of interest instead of forming alliances with other firms in the same industry. When competitive conditions intensify and actors in an industry are under increased pressure to act, large firm might use their larger financial resources to buffer those pressures and might be less prone to form alliances with other large firms in the same industry. Therefore, an alternative hypothesis is advanced suggesting that, when under increased competitive pressure, public firms are less likely to form alliances with other public firms (see also Figure 4.8).

Hypothesis 7b: The positive effect of dyad-level competitive intensity on firms' propensity to form alliances decreases when both potential partners are public firms.

Private firms, on the other hand, are required to disclose less information about their current affairs and strategic intents compared to their public counterparts. In most cases, this type of information is exclusively accessible to investors and not to potential future investors and the public in general. This lack of transparency might make it more difficult for private firms to gain public exposure and to become an attractive alliance partner for other firms in the same industry. The lack of market exposure also potentially reduces the chances that two private firms become increasingly familiar with one another.

In addition, reduced information disclosure requirements might make it more difficult for potential alliance partners to asses one another's resource endowments. In most cases, private firms don't have to disclose large amounts of information and it is consequently difficult to assess their real resource endowments and gain a realistic idea about the usefulness of their assets. Thus, it is more difficult to assess a potential alliance partner's resource endowments and assets.

The reduced availability of information might be a factor that reduces private firms' likelihood of entering collaborative relationships under conditions of intensified competition. Intensifying competition puts pressure on firms' margins and alliances might become vital options to secure firms survival. As a consequence, the choice of the right alliance partner becomes of crucial importance. Due to limited publication requirements and visibility of private firms, potential partners might refrain from forming alliances with unknown private firms when competitive conditions create higher pressures. Therefore, as competitive pressures increase and

room to maneuver for market participants shrinks, alliances between two private firms become less likely (see also Figure 4.8).

> **Hypothesis 8a:** The positive effect of dyad-level competitive intensity on firms' propensity to form alliances decreases when both potential partners are private firms.

Private firms, on the other hand, possess, on average, fewer resources than public firms and their chances of surviving periods of intense competition by themselves might be lower. During periods of intensified competition, firms often use slack resources to compensate thinner margins or losses that result from firms' struggle to stay in the market. Yet, private firms might possess less of these buffers and, therefore, be more in need to compensate shortcomings in resources and capabilities through forming partnerships with another firm providing complementary resources to develop or market products in the same industry.

Firms could gain access to financial resources through capital markets. Yet, most private firms lack wide access to external capital. Because private firms do not have to disclose financial information as well as strategic plans like their public counterparts, they might be considered 'black boxes'. Investors might find it increasingly difficult to assess the financial and competitive situation of a firm without conducting an extensive audit. In the absence of this information, investors would have to rely on the firm's managements not to misrepresent the enterprise's condition. As a consequence, private firms have less access to capital markets potentially reducing their maneuverability in situations of high competitive pressures.

Furthermore, it might be argued that because private firms are usually smaller than their public counterparts they might be niche players that provide technological expertise in one or

just a few specific areas. These specialized firms would rely on just a small section of the entire market and intensified competition might affect their margins and, ultimately, their existence more intensely than those of their public generalist firms. While larger publicly listed generalist firms are active in several segments of the market and might be able to compensate reduced margins in one market with revenues from other segments, smaller privately owned firms wouldn't have this opportunity.

Instead, privately owned firms might opt to form an alliance with another private firm in the same industry because of scarcity of resources and reduced ability to offset thinner margins in more competitive markets with revenues from less competitive markets. Through bundling expertise and sharing of risk, both firms might strengthen their position in the market, improve performance and, ultimately, increase their chances of survival. It is argued that the necessity for private firms to form alliances increases with the intensity of competition they experience. Therefore, an alternative hypothesis suggest that two private firms form alliances at higher rates than any other combination of private and public firms under conditions of increased competition (see also Figure 4.8).

> **Hypothesis 8b:** The positive effect of dyad-level competitive intensity on firms' propensity to form alliances increases when both potential partners are private firms.

Time Period Effect

A final hypothesis suggests a relationship between dyad competitive intensity and a potential time effect in a period surrounding a major anticipated environmental change. Period effects are an important instrument to investigate longitudinal organizational phenomena. A

period effect is defined as "an historical discontinuity that has a similar impact on all organizations or organizational members in a population, without regard of their ages" (Aldrich & Ruef, 2006: 167). A strong environmental change has the potential to shatter existing business practices and to strongly change the way business is conducted in an industry. Previously successful business models might not be appropriate under the new conditions and new better suited business practices might prevail. The following section advances a general hypothesis about the impact of a time period with a major regulatory change on the relationship between dyad-level competitive intensity on firms' propensities to form alliances.

Time period of major environmental change. A major environmental change such as an important regulatory modification has the potential to substantially change the way 'business is done' in an industry. Business practices that might have been established over many years and have proven to be successful for firms under the old regime might suddenly not work anymore thus threatening firms' survival. To cope with the new challenges, firms have to adapt to the changed business environment which might, for various reasons, include the formation of a cooperative relationship with another firm.

A major regulatory change can shake-up existing business practices in an industry and introduce new 'rules of the game' (Aldrich & Ruef, 2006), for example. Yet, these changes hardly occur very suddenly and unexpectedly. In most countries, they are the outcome of longer periods of negotiations among major interest groups and more general stakeholders. After the acknowledgement that a new regulation is necessary, a first draft might be proposed and the parties involved can declare their positions and concerns. In addition, to guarantee a smooth change, new important regulations might require the adjustment of other regulations that might

be affected. Effective implementation, monitor, and control mechanisms have to be developed and employed in collaboration with other agencies. In short, the process of introducing a major regulatory change can take several years to be finalized and affected firms will closely monitor developments in attempts to reduce the impact of the change.

During the time period immediately before and after an anticipated major environmental change, uncertainty will be higher than in more stable periods. For example, firms will become increasingly aware of major regulatory change that has been debated over time and the impact on existing business practices might become visible imposing important consequences on firms' strategic decisions and important resource commitments.

As the uncertainty regarding a major environmental change increases, firms experiencing higher levels of competitive intensity might experience higher pressures to join forces with other market participants in attempts to increase their ability to compete. Compared to firms experiencing lower levels of competitive intensity, firms experiencing high competitive intensity might face more severe consequences of failed investments and therefore be more prone to share risk through the formation of alliances. Thus, the final hypothesis suggests that firms experiencing higher levels of competitive intensity will form alliances at higher rates during the time period ultimately preceding and following a major anticipated environmental change (see also Figure 4.9).

> **Hypothesis 9:** The positive effect of dyad-level competitive intensity on firms' propensity to form alliances increases during the years of a major environmental shock.

CHAPTER V

METHODOLOGY

Data

To test the hypotheses proposed in the theoretical framework, I analyze data on the U.S. hospital software industry between 1963 and 1991. As mentioned before, the dataset was compiled by Kulwant Singh and generously made available as a basis to generate the dyad dataset and the construction of dyadic variables; additional information might be retrieved from Singh (1993). This unique dataset was used and presented in previous research investigating issues such as the impact of collaboration on the survival of firms commercializing complex goods (Mitchell & Singh, 1996), the impact of technological complexity and cooperation on firm survival (Singh, 1997), and the interrelatedness of collaboration and firm sales (Singh & Mitchell, 2005). Based on variables from the initial dataset (Singh, 1993), I constructed new dyad-level measures and added new variables. Although, the initial dataset included observations for the years 1961 and 1962, these were not sufficient to construct dyads and were thus excluded from my analysis. In the following section, the context of the empirical test, the U.S. hospital software industry, will be presented and limitations concerning the structure of the data will be addressed.

The U.S. Hospital Software Systems Industry

The initial dataset (Singh, 1993) includes firms in the U. S. hospital software systems industry that developed administrative and clinical software for community hospitals. According to the American Medical Association community hospitals are defined as all "'non-federal short-term general and other special hospitals, excluding hospital units of institutions, whose facilities and services are available to the public' (American Medical Association, 1991: xxiii)" (Mitchell & Singh, 1996: 176)." The firms in the dataset produce software solutions specifically for application in this type of hospitals. According to software practitioners, the production of hospital software is designed according to specific requirements and can be regarded as a unique vertical market (Mitchell & Singh, 1996).

Computers were used to support hospital research projects as early as the late 1950s and the first firm recorded in the dataset to produce specific software applications for community hospitals went to market in 1961. The first applications introduced in the early 1960s facilitated the management of patients and financial operations. Later, the scope of applications broadened and software supporting activities in areas such as clinical laboratory, pharmacy, and radiology became available by the mid-1960s and early 1970s. Mitchell and Singh (1996: 176) provide a classification of hospital software applications into 13 different product classes (the year indicates the first time a product was sold). The product classes are: accounting (1961), business, and finance; patient management (1961); materials management (1963); clinical laboratory (1964); pharmacy (1965); radiology (1965); nursing (1965); other administrative tasks (1966); blood bank (1967); patient care (1968); bedside (1969); operating room (1969); dietary (1971). Figure 5.1 presents more detailed information about the different product classes.

The initial dataset included 973 firms commercializing software applications for U.S. hospitals over a 30 year period between 1961 and 1991 (see also Mitchell & Singh, 1996). Both hardware manufacturers providing software solutions as well as exclusive producers of software are included. With a few exceptions, the large majority of firms in the industry were based in the United States. The data was collected through content analysis of business press articles, government publications, corporate reports, and other public sources and subsequently aggregated at the national level (Singh, 1993). In most cases, it could be confirmed that the first time a firm was recorded in the dataset was identical to its first year in the industry. As Mitchell and Singh (1996) report, after low early levels of revenues, the number of firms and the overall sales in the hospital software industry increased rapidly after the introduction of the Medicare health insurance program in 1966. The introduction of this program created opportunities for hospitals to receive reimbursements for their expenditures. Hospitals increasingly recorded their costs in ways qualifying for reimbursement from Medicare or other parties. As a consequence, hospitals sought increasingly administrative software solutions to support this process throughout the 1970s and almost all hospitals used administrative software by the beginning of the 80s. Administrative software programs were continuously refined and their applications became broader in scale and scope. In addition, hospitals started to use increasingly software systems in their clinical divisions by the second half of the 1970s. By 1991 most hospitals used medical software applications in their clinical branches (Mitchell & Singh, 1996). The distribution of active firms in a particular year between 1961 and 1991 is displayed in Figure 5.2.

Figure 5.2 shows that while few firms develop hospital software systems in the early 1960s, the number of firms rapidly increased following the introduction of the Medicare program in 1966. The growth in number of firms slowed down in the early 1970s but regained momentum

in the late 70s when more and more hospitals started to use software applications in a wider range of areas. After years of steady increases in the number of firms, growth came to a halt in the early 1980s following the introduction of the Prospective Payment Reimbursement System and the increased use of selective contracting by third-party payers (Zajac & Shortell, 1989).

The Prospective Payment Reimbursement System was introduced in 1983 and constituted a major change for firms in the U.S. hospital software industry. The program changed the way hospitals were reimbursed for their services putting increased cost-saving pressures on hospitals. Instead of being reimbursed on a fee-for-service basis, as in the case of the 1966 Medicare system, hospitals were now reimbursed based on a predefined diagnosis-related group schedule. Other healthcare insurers also started to increasingly reimburse hospitals based on fixed-rate contracts around that time. As a consequence, hospitals were forced to increasingly focus on improving their operational efficiency (Fennel & Alexander, 1993).

Overall, the initial dataset (Singh, 1993) includes 973 businesses which were active during the thirty-year period and firms followed individual as well as collaborative approaches to compete in the U.S. hospital software systems industry. Collaborative relationships were identified based on the formal announcement of a collaborative agreement in a published government, business, or industry source (Mitchell & Singh, 1996). The following agreements were identified as cooperative agreements: licensing, technology sharing, marketing, distribution, value-added relationships, licensing to third parties, and other cooperative agreements. Whereas collaborative agreements were not that common in the 1960s and 1970s they became quite popular during the 1980s and further approached the number of firms taking independent approaches in the early 1990s, an observation consistent with previous research (Harrigan, 1986). In total, 248 of the 973 firms in the dataset were found to have formed

alliances, some more than once, and 703 firm-level (non-dyadic) collaborative agreements were identified (see also Singh, 1993).

The dataset has two major limitations that are frequently found in longitudinal alliance research (Mitchell & Singh, 1996). First, the data provides no qualitative information about cooperative agreements and treats all events equally. A distinction between very close ties and more loose arrangements is not possible. Second, the dataset reports only alliance formation events and does not provide information about the duration of the cooperative agreement. Firms report the termination of an alliance much less often than its formation and data tracking the complete duration of alliances is very difficult to collect. Hence, the dataset provides information about alliance formation events in a particular year and not about whether an alliance is active during subsequent years. Figure 5.3 shows the distribution of formations of cooperative agreements over the observation period.

To analyze dyadic relationships between firms, I used the initial variables (Singh, 1993) and generated a dataset including all possible dyads in a particular year. Per year, the set of dyads comprises $(n(n\text{-}1))/2$ dyadic relationships, where n is the number of firms active in the industry in a particular year. I constructed the dataset with the help of the 'dyads' command of the STATA statistical software package (Ferguson, 2011) resulting in a total of 1,191,816 dyadic relationships over the observation period.

Based on the available data, the clear identification of both alliance partners was not always possible for all alliances, reducing the number to 546 firm-level alliances (or 273 alliance-dyads) formed by 138 distinct firms, some of which engaged in multiple alliances over the years.

Operationalization – Dependent Variable

The data in this research was made available by Kulwant Singh (see Singh 1993). The construction of most dyad-level measures is based on firm-level variables drawn from this initial dataset. The description of variables in the operationalization section is largely based on information provided in Singh (1993). Where variables are newly generated, it will be explicitly mentioned.

Alliance Formation

The dependent variable 'alliance formation' is a dummy variable which I coded 1 if two firms entered a cooperative agreement within a particular year and 0 if otherwise. Alliance formation events are reported in cases where two firms entered licensing, technology sharing, marketing, distribution, value-added relationships, licensing to third parties, or other agreements during the observation period from 1963 to 1991. In the initial dataset, alliances were identified based on public announcements of formal as well as non-formal non-equity cooperative agreements. Joint-ventures were not considered as they require the creation of a new independent legal entity controlled by parent firms lacking the fundamental characteristics of hybrid forms of organization. Whereas most alliances were formed between firms in the hospital software industry, roughly 10% of the cases involved firms that did not develop hospital software solutions, non-hospital medical software firms, and medical firms. Yet, all firms operate at the same level within the industry and commercialize hospital software and were thus competitors. In the final dataset, 273 dyadic alliance formation events were recorded that I consequently coded as 1. 1,191,543 dyadic relationships did not result in an alliance and were coded as 0.

Operationalization – Covariates

Competitive Intensity

I constructed the measure of diffuse competitive intensity experienced by two firms in a dyad (hypothesis 1), by an index based on the ratio of the sum of the aggregated segment densities of both firms to the maximum density of all dyads in a particular year. In other words, the measure is based on the sum of the annual number of firms across all segments two firms in a dyad compete in. The measure is similar to measures of niche density (Hannan & Freeman, 1989) in ecology research. The concept of niche density is well known in the ecology literature and is frequently used to assess the intensity of competition in organizational studies. Whereas the basic density framework usually applies a 'diffuse' measure of competition at the population level, the current measure captures competitive heterogeneity within the population of firms and is therefore a more 'direct' measure of competition (Carroll & Hannan, 2000). Niche density has several properties. First, the density of niches, and thus competitive conditions, are in most cases different across niches. Second, densities within segments change over time. As a consequence, competitive conditions of firms in segments change and information is transmitted about the distribution of all competitors across segments. Finally, segment densities are smaller than population densities unless only one segment exists containing all firm in a population. In this study, annual density measures are calculated for each firm in the 13 product segments (see Figure 5.1). The level of competition for firm *i* is measured as the sum of all firms across all segments firm *i* is active in in a particular year. To assess the level of competition in a dyad, the scores of the two firms forming the dyad are added and then put into relation to the maximum dyad-density found in each year. The formal expression of the measure can be found in Appendix A.

Firm Similarity

Previous research has assessed firms' strategic similarity in several different ways. The traditional approach uses sets of strategic variables and subsequently performs cluster analysis techniques thus grouping more strategically similar firms. Strategic similarity variables were in most cases selected to capture characteristics of resource and scope dimensions (i.e. Cool & Schendel, 1987; Fiegenbaum & Thomas, 1990; Smith, Grimm, Wally, & Young, 1990; Ferguson, Deephouse, & Ferguson, 2000; Osborne, Stubbart, & Ramaprasad, 2001). Whereas most studies in this area rely on the application of clustering techniques, some studies used similar data sources to construct dyadic levels of firm similarity without assigning firms to specific groups (i.e. Gimeno & Woo, 1996; Fuentelsaz & Gomez, 2006). A second approach groups firms based on managers' or experts' cognitive perceptions of the competitive landscape. Instead of relying on accounting or other archival data to assess firm similarity, the cognitive approach groups firms based on cognitive or mental models resulting from interviewing managers making strategic decisions (i.e. Porac, Thomas, & Baden-Fuller, 1989; Reger & Huff, 1993; McNamara, Luce, & Tompson, 2002). The resulting competitive maps identify similar firms competing in the same markets for the same customers. Some other studies identified similar firms based on specific industry characteristics suggesting the existence of some number of 'natural groups'. An example for this kind of firm separation would be the distinction between integrated mills and minimills in the Japanese steel industry (Nair & Kotha, 2001) or the classification of banks into national, regional, and local institutions (Mas-Ruiz, Nicolau-Gonzalbez, & Ruiz-Moreno, 2005). A detailed description of important measures of firm similarity can be found in Table 5.1.

To assess firm similarity (hypotheses 2a and 2b), I constructed measures for three categories of variables that are of crucial importance for software firms to create value (Young, Smith, Grimm, & Simon, 2000). These variable categories are: firms' market experience, technological skills (Manasian, 1993), and customer base (Church & Gandal, 1992).

The experience of a firm is important because over time, a firm can build stronger relationships with its customers. In addition, Stinchcombe (1965) argued that the *founding date* of a firm will 'imprint' the conditions prevalent at the time in firms' structures and strategies. These early settings of structure and strategy are very resilient and difficult to change. Thus, following Stinchcombe (1965), I use the proximity of the years in which two firms were founded as a proxy to measure their similarity. The 'date of founding' concept will be measured by a zero-to-one range normalized difference measure of firm founding years (Giemeno & Woo, 1996). The measure ranges from zero to one. It is equal to zero when the difference in founding dates of two firms is maximized (minimum similarity) and takes a value of one when the founding dates of two firms are identical (maximum similarity). A formal expression of the measure can be found in Appendix A.

Technological similarity will be assessed by two product-related measures: the type of computer the software was engineered for and the complexity of the software produced. Three different computer types were used during the study period between 1963 and 1991. The types of computers reflect to a large extent the evolution of hardware in the computer industry. While mainframe systems dominated the market in early years of the industry, minicomputers, and personal computers entered the market and became important alternative platforms. This evolution of computer hardware had an important impact on the application of hospital-software which addressed changing technological requirements by developing systems for different

hardware types. It should be noted that to test H6a and H6b, a different measure capturing broader firm-level redundancy of resources beyond product-related technological aspects will be constructed and presented later in this section.

To measure the technological similarity of two firms, I created an index indicating the extent to which two firms overlapped in their production of *software type* for the same computer platform - mainframe computers, minicomputers, or personal computers. The index ranged from 0, when two firms produced software for completely different technological platforms, to 1, when two firms produced simultaneously only for the same technological platforms.

In a first step, I established whether two firms produced software for the same technological computer platform and aggregated the positive outcomes for each dyad, resulting in 307,726 dyads in which two firms did not produce for the same computers at all, 743,793 dyads where firms produced the same software for one computer technology, and 126,454 and 13,843 dyads where the two firms produced simultaneously software for two and all three types of computers. In a second step, I calculated for how many computer-types two firms in a dyad produced software solutions overall. It should be noted that the measures generated in step one and two need not be equal. For example, two firms might simultaneously produce software for one type of computer (which would be captured in step 1) and, at the same time, produce each different software for one other type of computer (captured in step 2). Finally, I divided the score for simultaneous production of software applicable on the same computer type (step 1) by the sum of all computer types the two firms produced software for (step 2). For example, if two firms in a dyad produced both software for mainframe computers and at the same time one firm also produced software for personal computers whereas the other firm produced software for

minicomputers, the final measure would be calculated as 1/3 = 0.34. A formal expression of the measure can be found in Appendix A.

In addition, to the computer type software was engineered for, I measured the technological dimension by the complexity of the technology a firm applied. The measure of *complexity* was based on a survey of industry experts who assigned the software produced for each of the 13 product classes to one of three categories: low, medium, and high complexity (Singh, 1993). Firms that commercialized at least one high-complexity system in a particular year were considered to have high-complexity technology whereas firms that commercialized at least one medium-complexity system, but no high-complexity system, were considered to use medium-complexity technology (Singh, 1997). Finally, firms that commercialized solely low-complexity systems were considered to have low-complexity technology. Based on these classifications, I generated a dummy variable, coded 1, when two firms were classified in the same technological complexity category, and 0, if otherwise. A formal expression of the measure can be found in Appendix A.

Furthermore, similarity is assessed by firms' similarity in *customer bases* which will be measured through firms' size. Firms of equal size might follow similar strategies, strive for similar resources (such as human talent and financial capital), and likely serve similar customers. Organizations of very different size, on the other hand, might apply very different strategies and might be in need of different sets of resources (including customers) as suggested by the size-localized competition argument (Hannan & Freeman, 1977). I measure size by using the annual hospital software system sales (in 1982 USD) for every firm and every year in the dataset. Firm similarity with regard to customer base will be measured by an index (Gimeno & Woo, 1996) that expresses dyadic similarity in a particular year ranging from zero (minimum similarity) to

one (maximum similarity). To construct the measure, I calculated the absolute difference in sales between two firms in a particular year and divided the number by the maximum difference between two firms in that particular year. The resulting quotient was subtracted from 1, thus generating the index of relative similarity in customer bases of two firms in a dyad. A formal expression of the measure can be found in Appendix A.

Strategic Group Membership

I divided the U.S. hospital software industry into groups of similar firms based on five categories of variables drawn from Singh (1993). The first criterion was firms' *industry experience*, or industry tenure, which was measured as the count of years a firm was active in the industry. Note that the measure of industry experience is different from the measure of similarity in founding dates, which was based on the relative proximity of firms' founding years. Whereas the industry experience measure captures only the period of time in which a firm was present in the U.S. hospital software industry (tenure), the similarity measure based on founding dates takes the entire lifespan of firms into consideration; some of which existed and/or were active in other industries prior to entering the hospital software industry. The second block included dummy variables indicating the *firm type*. Three different firm types were included in the initial dataset: sole software producers, software and hardware producers, and firms that initially provided just processing services. Thirdly, the major *market* of a firm was assessed by a dummy variable indicating whether the major clients were small hospitals (less than 100 beds), medium size hospitals (more than 100 and less than 350 beds), or large hospitals (more than 350 beds). Fourthly, firm 1982 USD sales was used to assess the *extent of firm operations*. Finally, dummy variables indicated the *industry of origin* of a firm. The variables were coded 1 if a firm was a

specialist in the medical information systems industry or a more general medical industry specialist and 0 if otherwise. Based on this set of variables, I generated three clusters of similar firms using Ward's method algorithm which minimizes within-cluster sum of squares (Hair, Anderson, Tatham, & Black, 1998). Whereas some studies have applied clustering techniques and averaged results over specific time periods (e.g. Cool & Schendel, 1987) this study assigns firms to strategic groups on a yearly basis (see also Leask & Parker, 2007). Based on the results, a dummy variable was created coded as 1 if both firms were members in the same group and 0 if otherwise.

Multimarket Contact

Multimarket contact is defined as the simultaneous presence of two firms in at least two different product markets during the same year (hypotheses 4a, 4b, and 5). I define a market as any of the 13 product segments of the U.S. hospital software industry. Thus, two firms are multimarket competitors when they are both present in at least two software market segments during a specific year.

Previous research has measured multimarket contact among competitors in three major ways as outlined by Gimeno and Jeong (2001). Measures at the market-level (e.g. Evans & Kessides, 1994; Feinberg, 1985) intend to capture the overall effect of multimarket contact among firms in a focal market as characteristics of that market. Measures at the firm-in-market level, on the other hand, have been designed to capture the degree of multimarket contact between a focal firm and its competitors in a particular market (e.g. Baum & Korn, 1996; Boeker, Goodstein, Stephan, & Murmann, 1997; Gimeo & Woo, 1996; Haveman & Nonnemaker, 2000). Thirdly, several studies have developed measures to capture overall degrees

of multimarket contact between two firms across all their markets (e.g. Baum & Korn, 1999). Considering the focus and level of analysis of this study, a measure of dyadic firm-in-market multimarket contact (Baum & Korn, 1996; Boeker, Goodstein, Stephan, & Murmann, 1997) was used. For this study, I constructed a measure that counts the number of markets in which two firms meet one another in a particular year. The number of market counts ranged from 0 to 12 over the observation period. A formal expression of the measure can be found in Appendix A.

Ownership Structure

A dummy variable was created indicating whether firms in a dyad showed the same ownership characteristics. Public firms are usually more visible and often benefit from higher levels of reputation than their private counterparts, thus making it easier to gather quality information about potential alliance partners. While the likelihood that two firms form an alliance might be increased when they are both public, it might be lower when they are private. Thus, two dummy variables were created indicating whether two firms in a dyad showed the same ownership characteristics, coded as 1 when both firms were *private* or *public*.

Redundancy of Resources

In the previous section, I constructed a measure to assess firms' similarity based on two technological product characteristics: whether software was produced for the same computer type and its technological complexity. While these measures seek to specifically assess firms' similarity regarding product-related technological capabilities, they fall short in providing meaningful assessments of hardware-related resources, such as product development and

production capabilities, as well as know-how related to the distribution of non-software-related technologies and firm infrastructure, for example.

To measure redundancy in the combination of firms' broader, more general resources, I created a dummy variable. Whereas some dyads were created by firms that were sole *software producers,* and thus had more limited specialized resources, others were formed by firms that were also active as *hardware producers* and, therefore, possessed wider ranges of resources. The dummy assessing resource redundancy was coded as 1 when two firms in a dyad were either both sole software producers or were both also active as hardware producers. If a dyad was composed of one software producer and one hardware producer it was coded 0, accordingly.

Time Period Effect (interaction models only)

Sudden environmental shocks have been suggested to impact firms' cooperative behavior (i.e. Mitchell & Singh, 1996). Yet, regulatory changes seldom occur very suddenly. Instead, the process of crafting and implementing major regulatory changes often takes several years. Just splitting the data in a period before and one after the implementation might, therefore, not capture the dynamics of the process leading to the change (Suchman & Edelman, 1996). To investigate how the process of regulatory change surrounding a major reform interacts with the impact of firms competitive conditions on their propensity to form alliances, I constructed a dummy variable to capture time-period effects caused by a major regulatory change – the introduction of the prospective payment system in 1983.

The dummy I constructed indicates the period between 1981 and 1985 surrounding the implementation of the Prospective Reimbursement Plan in 1983. I chose this time frame because the issue of a financially unbalanced medical system received considerably more political

attention after Ronald Reagan won the 1980 election in the United States (Marmor, 2000). In 1980 New Jersey tested a Prospective Payment Scheme with diagnosis-related groups which showed extensive similarities with the federal Prospective Payment System of 1983. The experiences gained by the states adopting rate-setting programs in 1976 and the political development converged by 1981 (Oberlander, 2003) paving the way for a major reform. After the implementation of the reform plan in 1983, some changes were made in the following years and the end of the time-period was, therefore, set for 1985 (Suchman & Edelman, 1996).

Operationalization – Control Variables

Form of Entry. To control for firms' mode of *entry* to the industry, I generated dummy variables indicating whether two firms used the same strategy to enter the market. Firms either entered the market through internal development or an acquisition. The entry mode is an important factor, as firms entering through an acquisition have shown their capability and readiness to acquire other firms and might be more likely to use the same strategy in the future. On the other hand, firms entering an industry through internal development might be less inclined to grow through acquisitions and choose to expand by forming alliances instead. Thus, I generated two dummy variables, coded as 1 if the choice of entry of two firms in the dyad was identical (*internal development* or *acquisition*) and 0 if otherwise.

Previous Alliance Experience. *Previous alliance* experience might impact the likelihood that a firm forms alliances in the future (Gulati & Gargiulo, 1999). To address this issue, a variable coded as 1 when one of the firms had previous alliance experience with another firm and 0 if otherwise was generated.

Industry Concentration. To control for competitive effects at the industry-level, I constructed a C4 index of *industry concentration*. The measure expressed the ratio of annual sales of the 4 largest firms to total industry sales in a particular year.

Uncertainty. To control for uncertainty in the larger economic environment, I generated a variable capturing annual changes in the real gross domestic product (GDP) in the United States (base year 2009) and added it to the model.

Statistical Methods

To test the impact of firms' dyadic competitive conditions on their propensity to form alliances, I calculated binomial logistic regression estimates with the *logit* command of the STATA statistical software package. The logit command fits maximum likelihood models with the binary dependent variable. The model can be formally presented as:

$$\Pr(y_j \neq x_j) = \frac{exp(x_j\beta)}{1 + exp(x_j\beta)}$$

In this model, the outcome variable is the likelihood that two firms in a dyad form an alliance in a particular year given the set of independent variables. For each estimated coefficient, the odds ratios are easy to calculate by applying the formula $\text{OR} = e^{\beta_i}$. The odds ratio is a measure of association that approximates how much more or less likely a positive outcome in the dependent variable is for each one-unit increase in the independent variable (Hosmer & Lemeshow, 2000). Since the focus of the hypotheses in this study is on the direction of effects, results are reported as coefficients and not as odds ratios. As Mitchell & Singh (1996) and Singh (1997) point out, logistic-regression techniques produce robust estimates when the conditional probabilities of positive outcomes in the dependent variable are low in each time period (Hosmer & Lemeshow, 2000) which allows violating the underlying independence assumption of observations by not choosing a longitudinal design to analyze the data. This condition is met in the present study since the ratio of positive outcomes to negative outcomes in the dependent variable is extremely low.

In addition to performing a logit regression on the full sample of dyads, a logit regression was performed on a sample using a subset of dyads generated through endogenous stratification (Cosslett, 1981; Manski & Lerman, 1977). In models with a binary dependent variable, the prediction and interpretation of probabilities can be very difficult when the ratio of positive outcomes is very small compared to the number of negative outcomes (e.g. King & Zeng, 2001). To avoid this problem, endogenous stratification involves dividing the full dataset into one set containing all positive outcomes of the dependent variable and another containing only negative outcomes and drawing, subsequently, observations at random. Endogenous stratification has been used in previous research predicting rare events such as wars, epidemiological infections, venture capital investments, and acquisitions (e.g. King & Zeng, 2001; Sorenson & Stuart, 2001;

Chakrabarti & Mitchell, 2013). Because the dataset in this research contains only 273 positive alliance formation events compared to 1,191,540 negative events that could have resulted in alliances but did not, the over-representation of negative outcomes is a serious concern. For this reason, an endogenous sample was drawn from the population randomly selecting for each positive alliance formation event, or '1', five dyads for which alliances did not materialize or where the dependent variable was coded '0'. The resulting sample contained 1,638 dyads. Because the fraction of positive outcomes in endogenously stratified samples is different from the one found in the population, a weight-based correction was performed referred to as weighted exogenous sampling maximum likelihood estimation (WESML) (Manski & Lerman, 1977); (for more details on the usage and robustness of the WESML estimator see Chakrabarti & Mitchell, 2013). The WESML estimator (Manski & Lerman, 1977) maximizes the weighted log likelihood

$$\ln L_W(\beta|y) = -\sum_{i=1}^{n} w_i \ln[1 + \exp\{(1 - 2y_i)x_i\beta\}]$$

where y is the probability, $w_i = w_1\, y_i + w_0(1 - y_i), w_1 = \frac{\tau}{\bar{y}}, w_0 = \frac{(1-\tau)}{(1-\bar{y})}$, τ = the fraction of positive outcomes in the full dataset = 273/1,191,813, and $\bar{y}$ = 273/1638 the fraction of the positive outcomes in the sample.

To identify strategically similar groups of firms (hypotheses 3a and 3b), this study applies Ward's hierarchical cluster analysis technique (Ward, 1963). In this method, all observations are initially treated as separate groups and the two closest observations are subsequently merged into one group. This process is repeated until all groups belong to just one group, thus generating a

hierarchy of clusters. Ward's algorithmic technique forms hierarchical clusters based on squared Euclidian distances using the set of variables indicated in the previous section to minimize within-cluster sum of squares (Hair, Anderson, Tatham, & Black, 1998). Ward's method algorithm can formally be expressed as:

$$d_{ij} = d(\{X_i\}, \{X_j\}) = \|X_i - X_j\|^2.$$

Since (dis)similarity of observations is assessed using both continuous and binary data, the Gower dissimilarity coefficient (Gower, 1971) is applied to assign observations to groups. There may be cases when applying hierarchical cluster analysis produces ties where more than one group is generated at a particular (dis)similarity measure. To deal with this problem, the 'fewer' command (StataCorp, 2011b) was applied which produces the maximum number of groups equal to or less than the number of groups requested.

CHAPTER VI

RESULTS

Descriptive Statistics

Table 6.1 and Table 6.2 report pairwise correlation coefficients, means, and standard deviations of all variables in the model, for the full and reduced sample respectively. Table 6.3 reports results for models predicting the impact of dyadic competitive intensity, strategic group membership, similarity, and multimarket contact on alliance formation using full data, whereas, Table 6.4 reports WESML estimates using the endogenously stratified sample. The interaction terms were investigated using the WESML sample only and results are reported in Table 6.5.

The correlation tables show that most variables have low to moderate correlations with the exception of the measures for competitive intensity and multimarket contact (0.70 and 0.76). This can be explained by the similarity of both measures considered that the competition measure is constructed as the sum of firm densities across all markets two firms compete in and the multimarket competition measure is the count of markets two firms compete in simultaneously.

Competitive Intensity and Alliance Formation

As the results reported in Table 6.3 show, the measure of competitive intensity is positive and strongly significant in both partial model 1 ($p<0.001$) and full model 6 ($p<0.01$) thus strongly supporting hypotheses 1 which stated that the intensity of competition experienced by two firms in a dyad increases the likelihood of alliance formation. Results for the measures linking the similarity of firms to their likelihood of alliance formation are not consistent, though. On the one hand, both similarity in software type which is significant in partial model 2 ($p<0.001$) and full model 6 ($p<0.001$) as well as similarity in technological complexity, which is significant in partial model 2 ($p<0.01$) but not in full model 6, show a positive relationship with alliance formation. On the other hand, similarity in customer bases shows a significant negative effect in both model 2 ($p<0.001$) and model 6 ($p<0.001$). The measure of similarity in firm founding dates shows a negative relationship in the both partial model 2 and full model 6 both of which are statistically not significant. Thus, the present analysis could not clearly adjudicate between the alternative hypotheses linking firms' strategic similarity to alliance formation (hypothesis 2a and 2b).

The significant, yet inconsistent findings of the similarity measures raise interesting questions about the underlying reasons for these differences. Both product-related technology measures, the complexity of an application as well as the used software type were found to be positive and significant. This indicates that rivalry between two firms driven by technological factors has an important effect on firms' likelihood of alliance formation. Firms using similar technologies compete for the same inputs such as highly skilled employees and potentially the same customers thus experiencing higher levels of dyadic competitive rivalry. Competition for qualified employees might be particularly sensitive in the software industry where talented

programmers can apply their skill across many different product segments. For example, a software engineer can apply his or her skills to produce administrative as well as clinical software. Similarity in customer bases, on the other hand, showed a negative relationship with firms' propensity to form alliances. Different from technological factors, similarity in customer bases might raise mutual awareness of firms and allow them to collude with one another, thus reducing the need to form strategic alliances.

The coefficient for identical strategic group membership of two firms is also positive and significant in both model 3 ($p<0.01$) and model 6 ($p<0.01$) thus supporting hypothesis 3b which stated that firms in the same strategic group are more likely to form alliances than two firms from two different groups. Hypotheses 4a and 4b advanced alternative predictions about the impact of the level of multimarket contact between two firms and their propensity to form alliances in the same industry. The analysis showed that the measure of multimarket contact was positive and statistically significant in model 4 ($p<0.001$) thus supporting hypothesis 4b. However, the inverted U-shaped relationship proposed in hypothesis 5 was also supported. The squared term of multimarket contact was negative and statistically significant in model 5 ($p<0.001$). Results for both the measure of multimarket contact as well its squared term were confirmed in full model 6 ($p<0.01$; $p<0.001$). Thus, whereas the relationship between multimarket contact and likelihood of alliance formation is positive at low to medium level of multimarket competition, it turns negative at medium to high levels.

To verify that the maximum of the inverted U-shaped relationship between levels of multimarket contact and the logarithmic odds of alliance formation falls within the data range (0-10), I calculated the first derivative of the coefficients drawn from model 5. The result shows that the tipping point of the inverted U-shaped function is located close to 5 ($\max\{y=0.703x-0.064x^2\}$

= 5.492) in model 5 and close to 4 in full model 6 (max{y=0.385x-0.049x^2} = 3.928). In the case of model 5, this implies that the ln-odds of two firms forming an alliance increase up to a point where two firms are simultaneously active in five markets. Beyond that point, the multiplier of the ln-odds begins to decrease. A graph of the function for model 5 is displayed in Figure 6.1 in the appendix.

To illustrate the findings from analyzing the full dataset, I draw coefficients from full model 6. To evaluate the effect of dyad-level competitive intensity, identical strategic group, similarity in software type as well as similarity in customer bases on alliance formation, I calculated a multiplier for the variable mean by applying the formula exp(β*μ). Based on the findings and holding all other variables constant, when a firm dyad experiences the mean level of competitive intensity (0.27), the likelihood of alliance formation between two firms is multiplied by a factor of 1.678 (exp(1.918*0.27)). The measure of competitive intensity is an index ranging from 0 (theoretically, no relative competitive intensity) to 1 (maximum relative competitive intensity) in a particular year. This is a considerable effect and underlines the importance of dyad-level competitive intensity on alliance formation. The effect for dyads composed of firms coming from identical strategic groups is also significant with a factor of 1.163 for the variable mean. Considering the similarity measures, similarity in software type multiplies the rate of alliance formation at a factor of 1.722, while similarity in customer bases reduces the rate by a factor of 0.452 (both for variable means).

As previously pointed out, analyzing a full dataset with binary-dependent variables can raise serious concerns about the reliability and interpretation of estimated effects and probabilities when the ratio of positive outcomes is very small compared to the number of negative outcomes (e.g. King & Zeng, 2001). Because this is the case in the present study, a

weighted exogenous sampling likelihood estimation (WESML) was conducted to estimate coefficients using an endogenously stratified sample. The results are reported in Table 6.4 and overall confirm the results reported previously. As in the full sample analysis, hypotheses 1 received strong support in both partial model 1 ($p<0.001$) and the full model 6 ($p<0.05$). Using the WESML method mainly confirmed the mixed results for hypotheses 2a and 2b. Similarity in software type showed a statistically significant positive relationship in the partial model 2 ($p<0.001$) as well as full model 6 ($p<0.001$). The measure of similarity in customer bases confirmed the negative relationship in partial model 3 ($p<0.001$) but was insignificant in the full model. The measure for similarity in software complexity remained, different from the analysis of the full dataset, insignificant in both the partial model 2 and full model 6. As proposed in hypothesis 3b, the coefficient for identical strategic group membership was positive and significant in both model 3 ($p<0.05$) as well as full model 6 ($p<0.05$). Similarly, hypotheses 4b received support in both model 4 ($p<0.001$) and model 6 ($p<0.01$). Finally, the inverted U-shaped relationship proposed in hypothesis 5 was also supported in the endogenously stratified sample. The squared term of the level of multimarket competition was found to be negative and statistically significant in model 5 ($p<0.001$) as well as full model 6 ($p<0.01$).

As for the full dataset, it was verified that the maximum of the inverted U-shaped relationship between levels of multimarket contact and the logarithmic odds of alliance formation falls within the data range. Results were mainly confirmed indicating that the tipping point of the inverted U-shaped function is located close to 5 ($\max\{y=0.929x-0.09x^2\} = 5.161$) in model 5 and between 3 and 4 in full model 6 ($\max\{y=0.658x-0.092x^2\} = 3.576$). Consistent with the findings using the full dataset (model 5), the ln-odds of two firms forming an alliance increase up to a point where two firms are simultaneously active in five markets. Beyond that

point, the multiplier of the ln-odds begins to decrease. A graph of the function for model 5 is displayed in Figure 6.2 in the appendix.

As for the analysis of the full dataset, findings using the endogenously stratified sample are illustrated drawing coefficients from the fully specified model (6) and applying them to variable means. The results indicate that competitive intensity multiplies the rate of alliance formation by a factor of 2.063 which is considerably higher than the factor resulting from the analysis of the complete dataset. Dyads composed of firms coming from identical strategic groups, increase the rate of alliance formation by a factor of 1.247 whereas similarity in software type multiplies the rate at a factor of 1.739.

It should be noted that some of the other variables also showed interesting significant results. For example, dyads composed of public firms were in both the full and the sampled dataset more likely and dyads of private firms were less likely to form alliances than dyads composed of one private and one public firm. This effect might be attributed to the fact that public firms are, on average, more transparent and have more public exposure than their private counterparts, making it easier to evaluate firm' resources and behavioral liability. Public firms might also follow a more aggressive growth strategy and possess more resources, leading them to form alliance more often with one another. Furthermore, dyads of sole software producers were consistently less likely and dyads of firms that also produced hardware components were more likely to form alliances (statistically significant only in sampled dataset) than dyads composed of software and hardware producers. Yet, different from analyzing the full dataset, a statistically significant positive relationship was found for dyads composed of firms producing also hardware components in the endogenously stratified sample. This effect might indicate that software producers might be interested in securing access to resources and capabilities outside of

their expertise such as building ties with firms that also produce hardware components, potentially in attempts to bundle software and hardware components which could make the product more attractive to customers. Finally, previous alliance experience by one of the firms had a strong and consistent positive effect on alliance formation in both regression models.

Furthermore, in addition to testing the initial set of hypotheses, it was investigated whether the relationship between dyad level competitive intensity and firms' propensity to form alliances was moderated by a group of selected factors. Results of this investigation are reported in the following section.

Competitive Intensity – Interaction Effects

The following section reports results of an investigation of how certain factors moderate the impact of competitive intensity experienced by two firms in a dyad on firms' propensity to form alliances. More specifically, it is investigated how the relationship is moderated by firms' resource redundancy, ownership structure, and a time period of a major environmental change.

Logistic regression estimates for the endogenously stratified sample are reported in models 7-11 in Table 6.5. The measure of competitive intensity continues to have a positive impact on firms' propensity to form alliances at strong to very strong levels of significance. Both, the estimates for membership in the same strategic group as well as level of multimarket contact and its squared term provide results consistent with previous models at strong levels of significance.

As reported in model 7, the interaction between the level of dyad competitive intensity and resource redundancy is negative and moderately statistically significant ($p<0.1$). In full model 11, the coefficient remains negative, yet gains statistical significance ($p<0.01$) thus

providing support for hypothesis 6a. Results in model 8 support hypothesis 7b ($p<0.05$) which suggests that public firms are less likely to form alliances with one another when dyad competitive intensity increases. The finding could be confirmed in full model 11 ($p<0.05$). As reported in model 9, the interaction of competitive intensity and private ownership is positive but statistically non-significant. The effect remains positive and statistically insignificant in full model 11. Both models 10 and 11 could not support hypotheses 9 which predicted that the likelihood of alliance formation between two firms increases under conditions of higher dyad competitive intensity during a time period of major environmental change. The effect is positive but shows no statistical significance.

To evaluate the interaction effects with dyad-level competitive intensity, I draw coefficients from the fully specified model 11 in Table 6.5. When two firms in a dyad experience the mean level of competitive intensity (0.30), alliance formation between two firms based on the redundancy of resources is reduced by a multiplier of 0.371 (exp(-3.302*0.30)). In the same way, the factors for dyads composed of two public firms are calculated resulting in a reduction by a multiplier of 0.373.

CHAPTER VII

CONCLUSIONS

The key findings of this research are that dyad-level competitive intensity shows a positive relationship with firms' propensity to form alliances; that two firms from the same strategic group form alliances at higher rates than firms from two different strategic groups; that the level of multimarket contact between two firms is inverted u-shaped related to their propensity to form alliances; and that dyadic resource redundancy and public ownership of alliance partners reduce the positive impact of dyad-level competitive intensity on firms' propensity to form alliances in the same industry. This chapter discusses the implications of the study for management practice and theory and outlines some limitations.

Managerial Implications

The most important finding of this research is that dyad-level competitive conditions impact firms' propensities to form alliances in the same industry. Although this might appear as an intuitive proposition to managers and theorists alike, the finding is important as it outlines some of the complexities underlying the relationship between competitive conditions and alliance formation that all too often remain unnoticed. While managers frequently take

competitive influences at the macro-level such as the industry-level competition into consideration when making decisions, effects at the micro-level such as conditions at the group and dyad-level remain often unrecognized. This study contributes evidence to the more complex underlying micro-structure of competition and its impact on firms' propensity to form alliances. By acknowledging the impact of dyad-level competitive conditions, practitioners can improve alliance partner selection decisions, thus potentially leading to better and longer alliance relationships. The investigation of competition at the micro level and its relationship with firms' propensity to form alliances provides a foundation for a more detailed and fine-grained investigation of underlying mechanisms.

Intra-industry competitive pressures can create major problems for firms seeking to form alliances in the same industry. While this constitutes a general risk involved in the formation of alliances, the consequences of losing resources or capabilities to a competitor might potentially harm a firm's survival chances considerably. This underlines why it is important that managers are aware of those mechanisms and seek to understand how within-industry and dyadic competitive conditions motivate alliances formation. This is particularly relevant in the context where two firms are strategically similar or compete in more than one market.

This research has found evidence indicating that firms' propensity to form alliances increases, when two firms are more similar and belong to the same strategic group. This is an important insight for practitioners as it points to heterogeneity among potential alliance partners regarding their degree of similarity. This finding can help managers in their attempts to analyze competitive environments and support them in identifying appropriate alliance partners by focusing the search process on strategically similar firms thus reducing their search costs.

Moreover, the study found evidence for an inverted u-shaped relationship between dyad-level competitive rivalry and firms' propensity to form alliances. This finding supports the notion that multimarket encounters influence firms' competitive and cooperative behavior in an industry. Although managers might unconsciously take multimarket encounters into consideration when making decisions, this study provides empirical evidence about some of the mechanisms linking multimarket competition to alliance formation. The findings suggest that firms might find alliance partners more often when they share medium levels of multimarket presences whereas very high and low levels of multimarket contact reduce the likelihood of alliance formation between two firms.

Finally, it was found that when two firms use the same resources as well as in situations when two firms in a dyad were public firms, the positive relationship between dyad-level competitive intensity and firms' propensity to form alliances was reduced. These findings have important implications for managers and should increase their sensitivity when forming alliances. These results seem to support that public firms might be reluctant to form alliances with other public firms when environmental conditions impose uncertainty such as increased competitive intensity. The reasons for this behavior might be public firms' preference to cooperate with partners whose resources and capabilities are dissimilar. On average, public firms tend to be larger, possess more resources as well as organizational buffers, and can be the centers of innovation and growth within an industry. It could be possible that under conditions of increased competition, larger firms use their resources and organizational slack to overcome uncertainty. This could suggest that large public firms are less affected by increased competitive intensity than their smaller private counterparts. Furthermore, public firms could potentially take a more hostile stance towards one another and build ties to smaller firms providing specialized

knowledge and expertise when competitive conditions intensify. The result might be a struggle of groups of firms building ties and forming network-like clusters of organizations.

In addition to differences in firms' ownership structure, redundancy in resources was found to impact firms' propensity to cooperate with one another. The effect of competitive intensity on firms' propensity to form alliances was found to be weakened when both firms possessed the same resources. This finding is important as it provides managers with insights about the interaction of firms' resource characteristics and competitive situations. When competitive conditions increase uncertainty, firms might prefer to ally with firms providing complementary resources. This finding might also indicate some mechanisms underlying the tension between competition and resource complementarity as drivers of firm cooperative behavior.

Theoretical Implications

Firm competitive conditions are an important factor influencing the success and ultimately the survival prospects of firms in an industry. To cope with competitive pressures, firms lacking important competencies increasingly choose to cooperate with one another (Dyer, Kale, & Singh, 2001). Among the factors motivating firms to form alliances, the intensity of competition in an industry is of high importance. While firms can potentially improve their performance through collaboration, they face the challenge of balancing cooperative efforts with competitive conditions when forming an alliance with a firm from the same industry (Park & Zhou, 2005). Yet, whereas previous research suggests that firms' competitive situations vary (i.e. Cool & Dierickx, 1993; Baum & Korn, 1996; Chen, 1996), research explicitly investigating the impact of complex competitive conditions on firms' propensity to form alliances is still rare.

This study sought to address this issue by investigating how dyad-level competitive conditions impact firms' propensities to form alliances.

Most generally, the findings of this study contribute to research linking firm competitive conditions to alliance formation in the same industry. While this study contributes evidence for a general positive relationship between firms' competitive intensity and likelihood of alliance formation, it took a novel dyad-level approach and showed that the likelihood that two firms formed an alliance was highest, when both firms experienced high levels of competitive intensity and lowest when both partners experienced low levels of competitive intensity. This novel insight reveals some of the underlying complexities inherent in the competition-alliance formation link and adds to existing research that investigated how competitive forces impact alliance formation activity. While Ang (2008) found that firms experiencing low and high levels of competitive intensity formed alliances less often than firms experiencing intermediate levels of competitive intensity and Trapido (2007) showed how past levels of competition between two firms impacted their likelihood of forming an alliance in the following time period, this research has demonstrated that the competitive intensity experienced by two firms is positively related to alliance formation. This new insight complements in particular the study of Ang (2008), who found that firms experiencing medium-levels of competitive intensity formed alliances most often. The findings of this study indicate that at the dyad level, firms experiencing high levels of competitive intensity form alliances at the highest rate with one another. The differences between the two studies might be attributed to the dyad-level conceptualization of this research, thus providing new insights into the relationship between competitive conditions and firms' propensity to form alliances. A more detailed exploration of the mechanisms underlying this puzzle would be an interesting and promising venue for future research.

In addition to investigating dyad characteristics, the finding also has important implications for research investigating larger network structures which are built on dyadic relationships as the competitive and cooperative moves of network actors have consequences for other actors (Silverman & Baum, 2002). This study shed some light on the dyad-level competitive conditions under which firms' propensity to form alliances is elevated. As such, it might provide insights to larger network dynamics under conditions of changing competitive conditions. When competitive uncertainty increases, firms experiencing higher levels of competitive intensity within a network might be more likely to extend their cooperative ties with other firms than firms experiencing lower levels of competitive intensity. These ties might be formed with organizations from within as well as outside the existing network. In both cases, a new tie might change the relationship of a firm with its existing alliance and network partners.

The study also contributes to research investigating the behavior of firms in groups of similar firms. While existing theory predicts rivalry within groups of similar firms to be lower (Caves & Porter, 1977) and, thus, suggests a lower likelihood of alliance formation events among firms within the same group, this research finds that firms in the same group formed alliances at higher rates than firms belonging to different groups. This finding is important as it underlines how intra-industry complexity impacts the relationship between competitive intensity and alliance formation. The relationship between competitive intensity and alliance formation could change over time because factors such as increased acknowledgement of mutual interdependencies among members of the same group weaken the relationship or, as an industry ages, changes in rivalry occur between firms from the same and different groups (Cool & Dierickx, 1993).

Furthermore, the study has important implications for research investigating the influence of multimarket competition on firm behavior by revealing an inverted U-shaped relationship between firms' level of multimarket contact and their likelihood of alliance formation. This finding is consistent with existing theory which predicts competitive rivalry to be highest at medium levels of multimarket contact and lower at high and low levels of multimarket contact (e.g. Baum & Korn, 1999; Haveman & Nonnemaker, 2000; Stephan & Boeker, 2001; Fuentelsaz & Gomez, 2006) and suggests a link to firms' likelihood to cooperate with one another. The present study extends existing research by finding support for an inverted u-shaped relationship between dyadic competitive rivalry, as captured by the level of multimarket contact between two firms, and their propensity to cooperate with one another in the same industry. This finding indicates that alliance formation events are more likely between two firms experiencing medium-levels of dyadic competitive rivalry than between two firms experiencing low and high levels of rivalry. This complements Ang's (2008) findings which suggest that alliance formation events at the firm-level are most likely when firms experience medium-levels of competitive intensity by showing that at the dyad-level, the likelihood of two firms forming an alliance with one another is highest when both firms experienced medium-levels of competitive rivalry. Approaching the question from a multimarket contact perspective, indicates that although firms' likelihood of alliance formation increases overall, it increases the most for those firms experiencing moderate levels of competitive rivalry.

Finally, the findings of this study shed some light on the theoretical tension between IO economics and population ecology regarding the impact of strategic similarity on competitive rivalry between pairs of firms. This study finds initial evidence for a positive relationship, thus supporting the effect suggested by population ecology. The positive relationship was found

between firms that are members of the same strategic groups, and although the industry-wide assessment of similarity did not provide coherent statistical support, the direction of effects also supported the relationship suggested by ecology research. This is an important finding that might serve as a starting point to further investigate why and under what conditions either of the two theories holds. The initial support for ecology reasoning found in this study has important consequences, as it challenges arguments and findings of studies using alternative theoretical explanations (such as IO economics) that rely on degrees of similarity to assess levels of competition between firms. A clarification of the question of how strategic similarity drives competitive conditions between firms is of central importance to management research.

Limitations and Future Research

The study has limitations that suggest further research. First, although the dataset encompasses almost 30 years of data, it does not include observations beyond the year 1991. A study with a more comprehensive dataset including the years after 1991 might reveal additional effects especially with regard to time-dependent population effects. In addition, for the construction of firm-dyads, information on alliance partners was not always available and a dataset representing dyads formed by all firms in the industry would be preferred. Second, the investigation of the impact of competitive intensity on likelihood of alliance formation was conducted treating all alliances equally and was unable to distinguish between alliances aimed at facilitating research and development or the commercialization of products, for example. More insights might be revealed from a more fine-grained investigation of types, strengths, and motivations of alliances. Third, the study focused on the formation of alliances as a strategic option for firms to respond to competitive conditions ignoring acquisitions as valid alternatives.

An investigation including alternative options to cope with competitive conditions in an industry might reveal additional dynamics. Fourth, the current study does not investigate the full complexity of inter-organizational cooperative linkages. Over time, firms might become increasingly directly and indirectly connected to other firms resulting in the emergence of clusters of interconnected or networked firms. A future study might investigate how these network effects influence the relationship between competitive intensity and alliance formation. Fifth, the study could not completely rule out alternative explanations for firms' propensity to form alliances such as resource complementarity. In Chapter IV, it was acknowledged that complementarity (or strategic interdependencies) as an alternative explanation for alliance formation (e.g. Gulati, 1995b; Arora & Gambardella 1990; Rothaermel, 2001; Nohria & Garcia-Pont, 1991; & Teece 1992) suggesting that potential resource and market complementarities motivate firms to form alliances in attempts to make their products and services more attractive to customers. In addition to general empirical investigations of the impact of complementarities on alliance formation (e.g. Harrigan ,1985; Lorange & Ross, 1992; Rothearmel, 2001), several studies have used non-overlapping market niches to approximate firm complementarities (e.g. Gulati, 1995b; Chung, Singh, & Lee, 2000; Rothaermel & Boeker, 2008). Yet, the current study finds strong support for a persistent effect of firms' degree of rivalry, assessed by their level of multimarket contact. Although these alternative explanations cannot be ruled out entirely, the present study contributes evidence that firms' competitive conditions impact their propensity to ally (e.g. Ang, 2008; Trapido, 2007). A future study might investigate how alternative explanations of alliance formation might be separated from or interrelated with the relationship suggested in this research.

A further limitation of this study is its focus on one industry and national context, the US hospital software industry, thus limiting the potential to generalize the findings. The context for this study was a high technology industry with firms that developed, produced, and commercialized technologically complex products. A replication of the tests performed in this study in a different industry or national setting might help to accumulate further insights and would provide an opportunity to reveal and explore additional factors influencing the competition-cooperation link.

The study shows that the level of competitive intensity influences firms' likelihood of forming alliances and, thus, has important implications for strategy research. Considered that dyads of firms face varying levels of competition, it is important to continue to investigate how additional dyadic characteristics such as status, network position, and previous alliance experience, for example, interact with competitive factors and impact strategy formulation, implementation, and firm outcomes.

FIGURES

Figure 4.1
Relationship between Dyad Competitive Intensity and Firms' Propensity to form Alliances

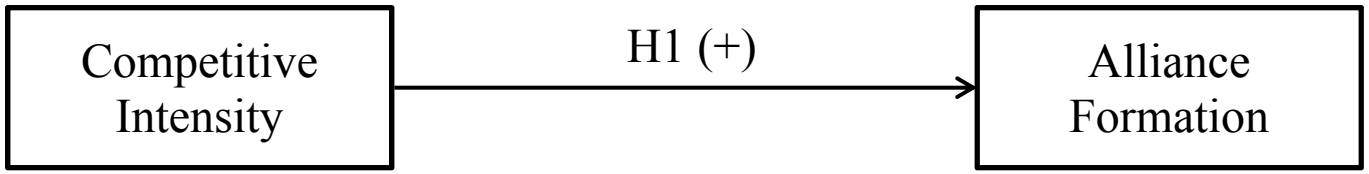

Figure 4.2
Relationship between Strategic Similarity and Firms' Propensity to form Alliances

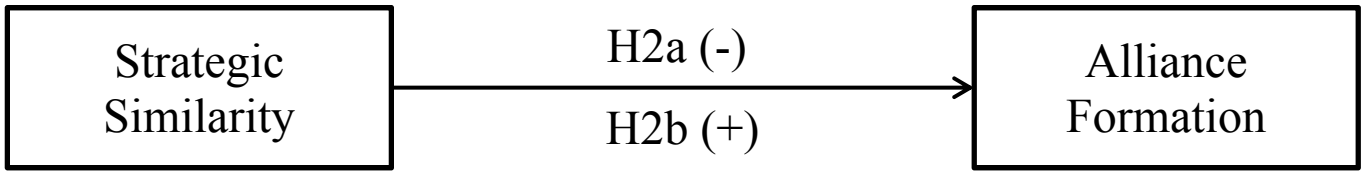

Figure 4.3
Relationship between Strategic Group Membership and Firms' Propensity to form Alliances

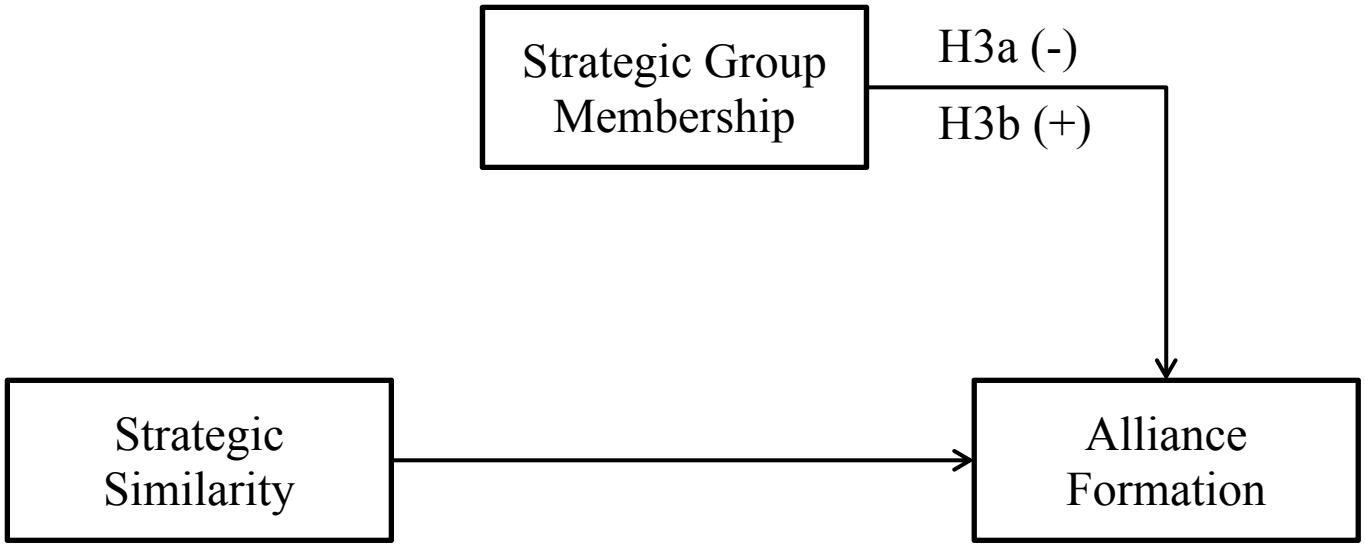

Figure 4.4
Relationship between Multimarket Competition and Firms' Propensity to form Alliances

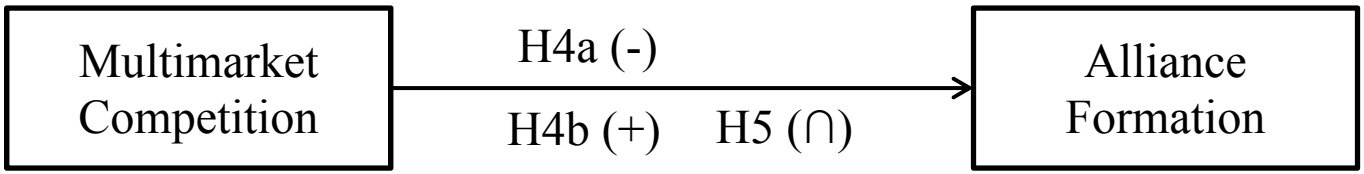

Figure 4.5
Inverted U-shaped relationship between Multimarket Competition and Firms' Propensity to form Alliances

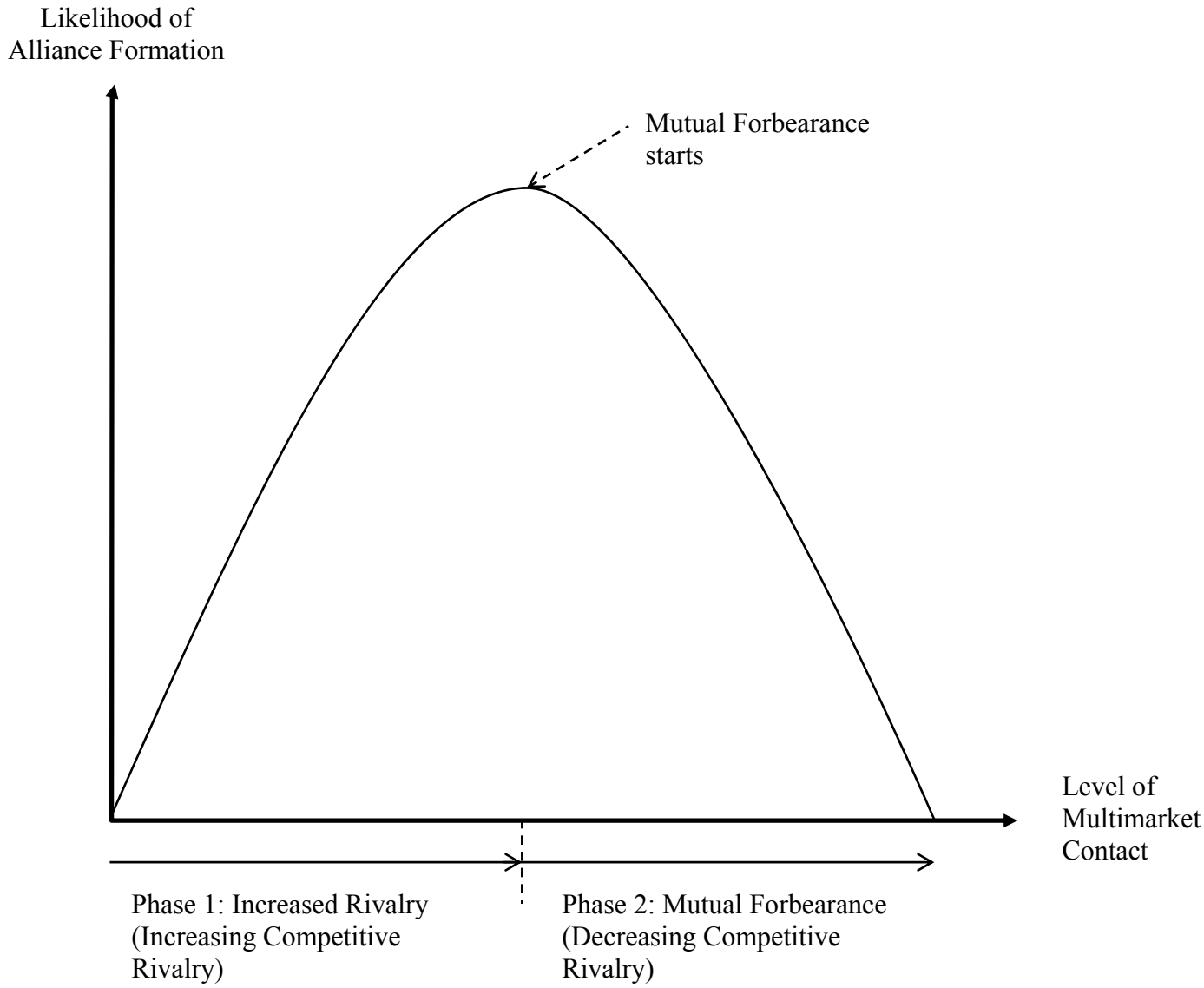

Figure 4.6
Summary of Hypotheses (without Interaction Terms)

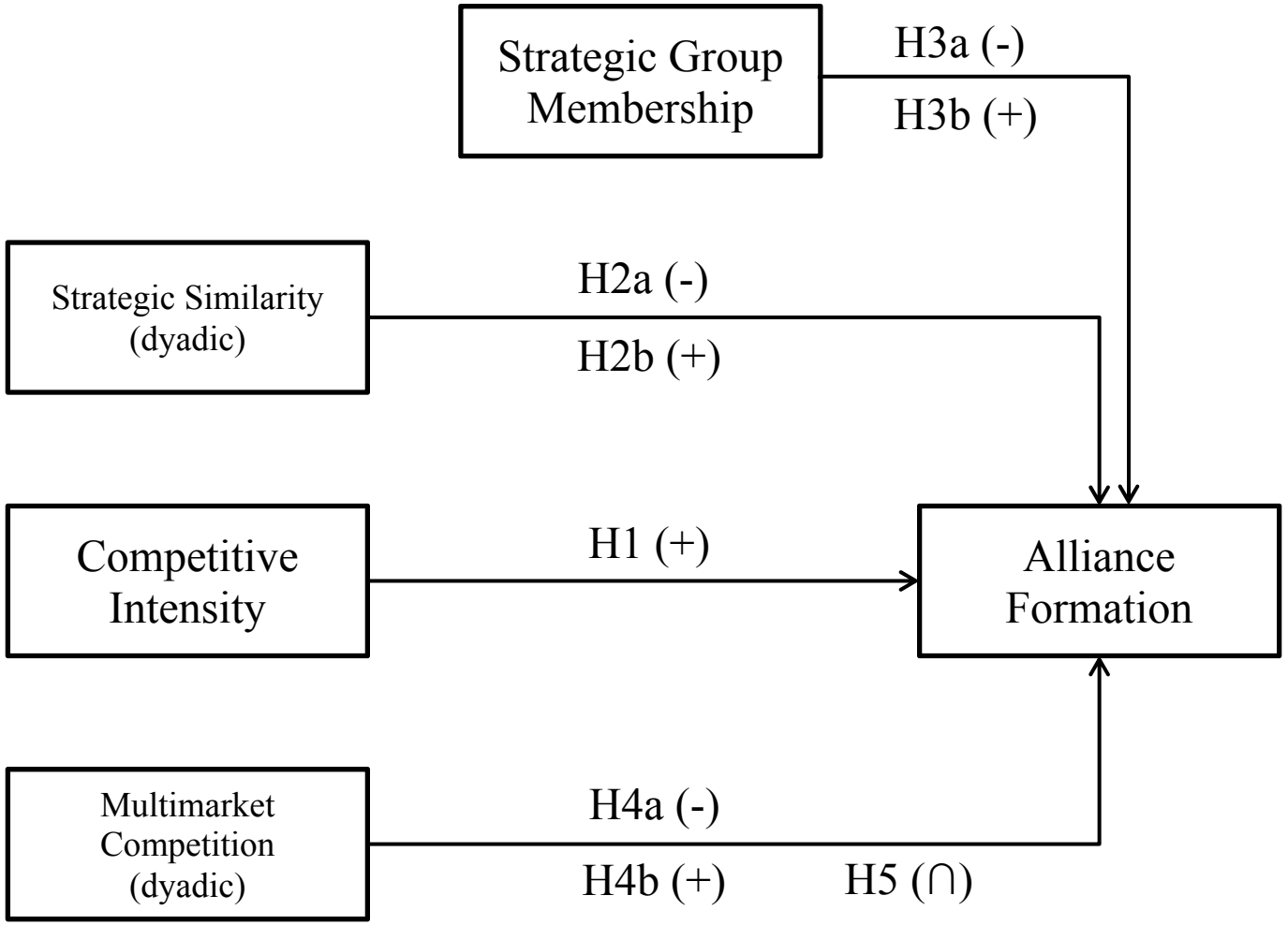

Figure 4.7
Interaction of Competitive Intensity and Resource Redundancy

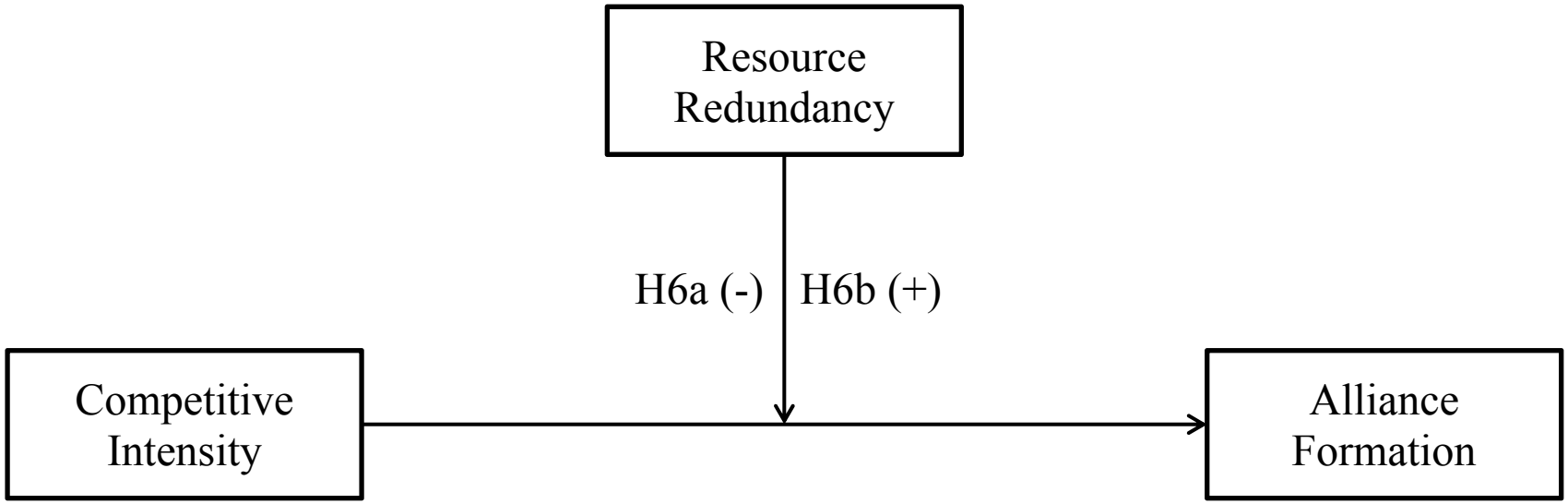

Figure 4.8
Interaction of Competitive Intensity and Ownership Structure

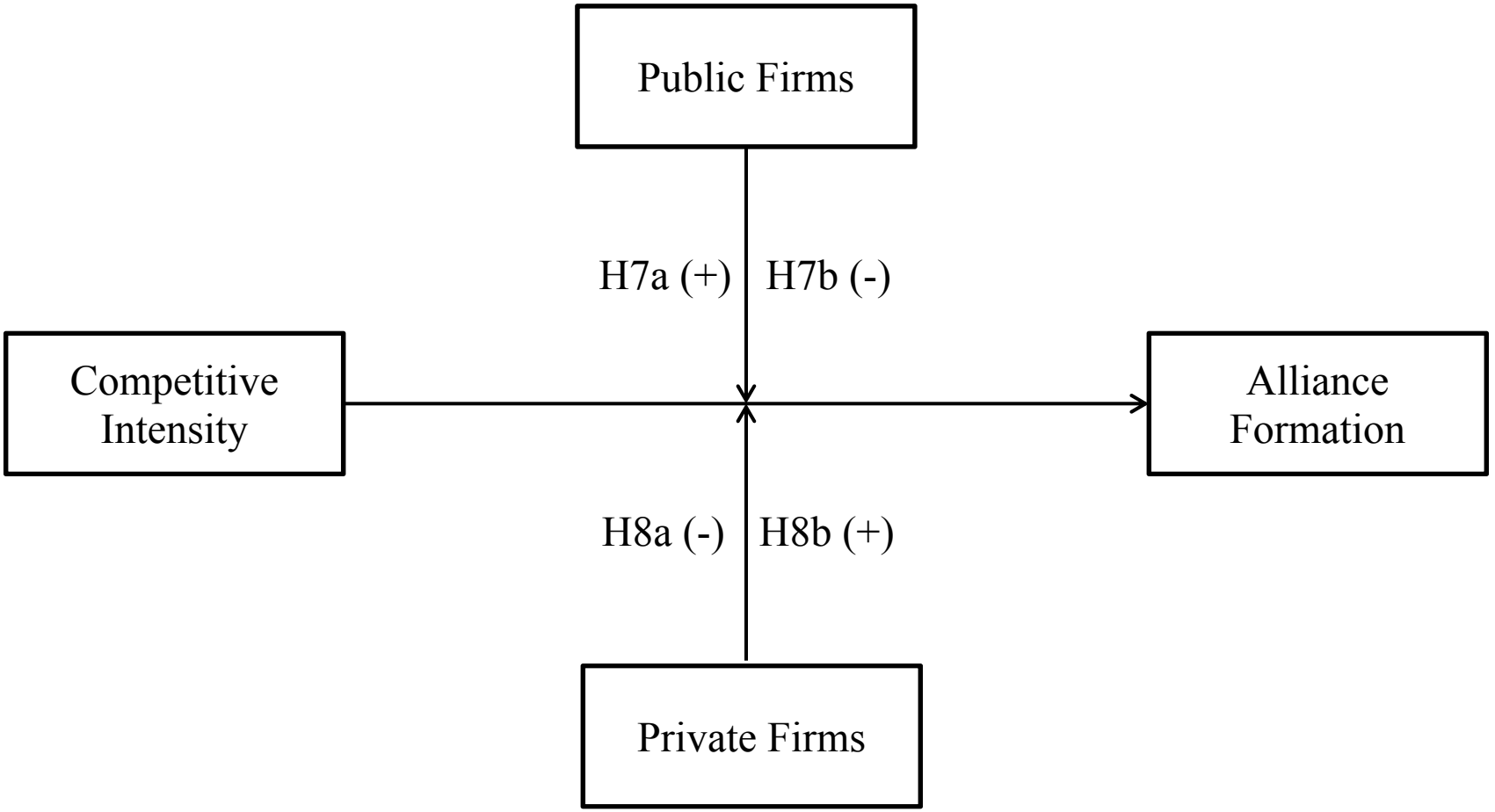

Figure 4.9
Interaction of Competitive Intensity and the Time Period during major Environmental Change

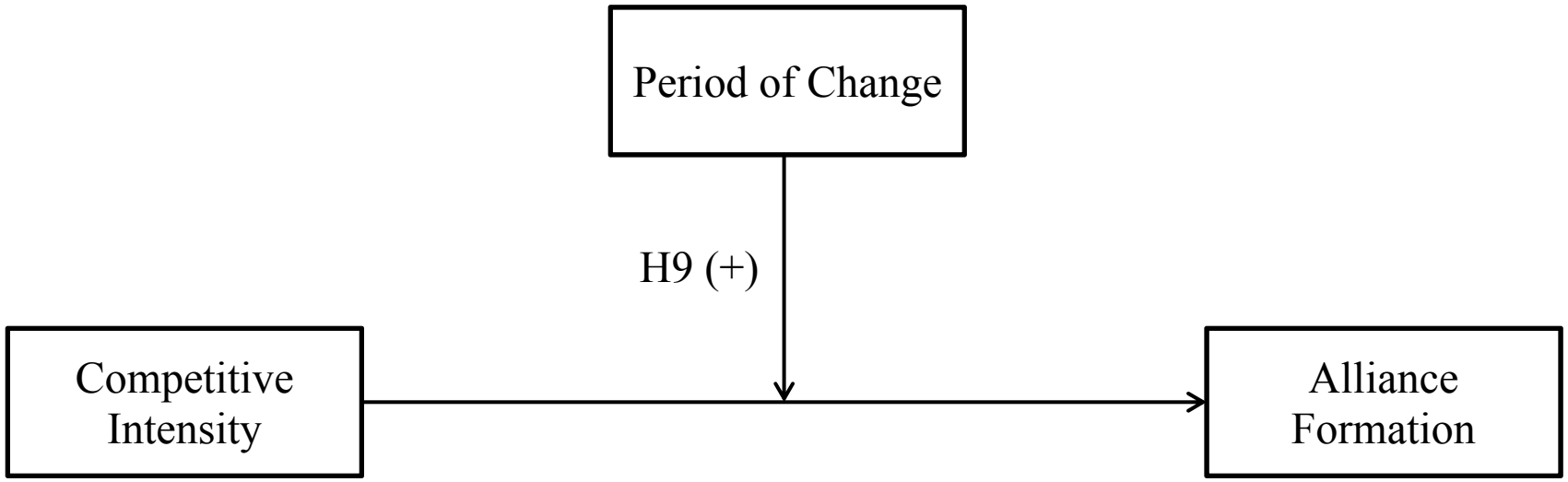

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Figure 4.10
Summary of Hypothesized Interaction Terms

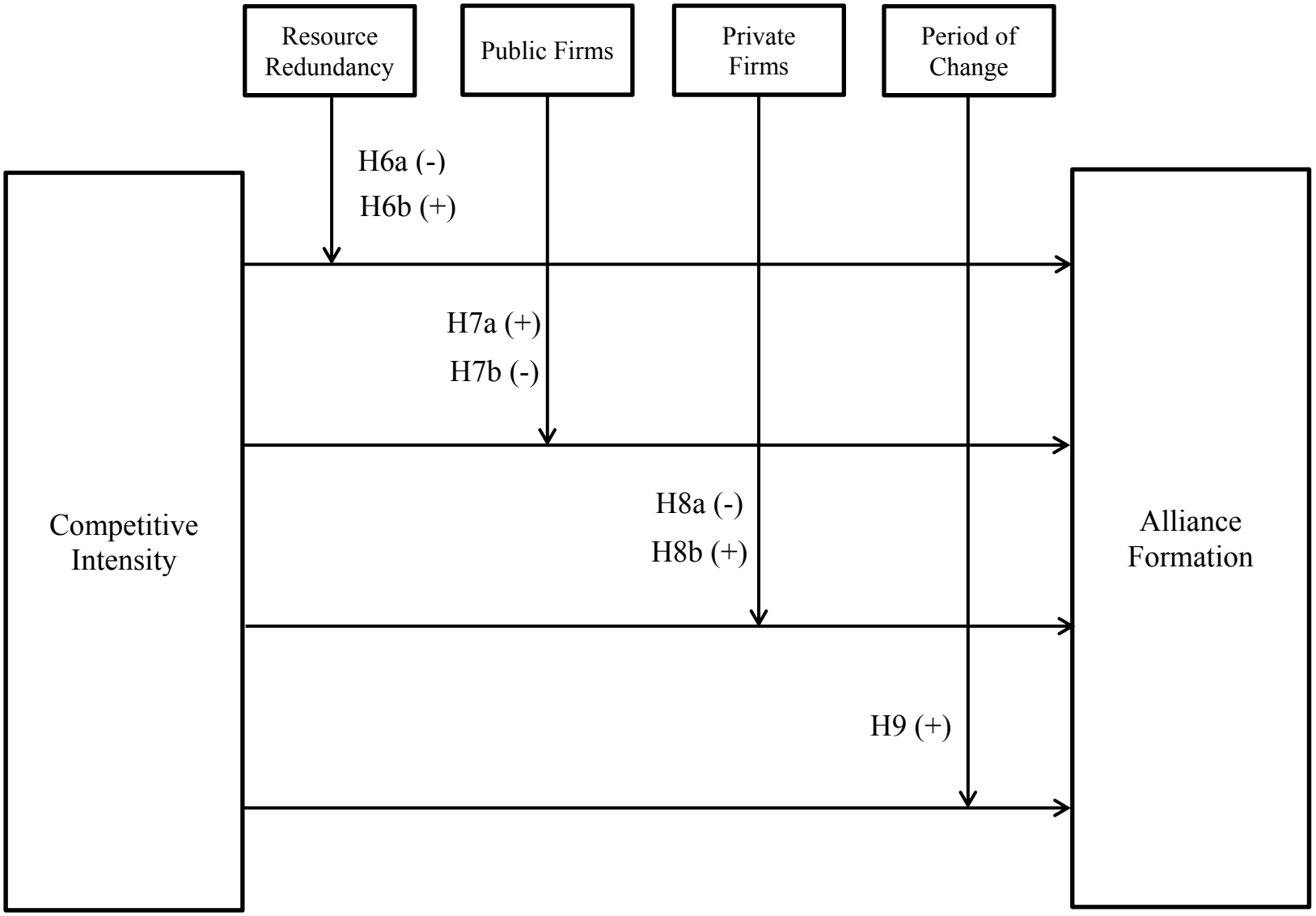


Figure 5.1

Hospital software system product classes

(first year sold; number of businesses that offered products by 1991)

1. Accounting, business, and finance *(1961; 491):*
   Financial and business office operations
2. Patient management *(1961; 258):*
   Patient admissions, discharge, transfer, and scheduling
3. Materials management *(1963; 170):*
   Inventory and purchasing management
4. Clinical laboratory *(1964; 294):*
   Laboratory department management and test result reporting
5. Pharmacy *(1965; 212):*
   inpatient and outpatient pharmacy management
6. Radiology *(1965; 148):*
   Radiology department management, picture archiving and communications systems
7. Nursing *(1965; 125):*
   Nursing department management
8. Other administrative *(1966; 175):*
   Miscellaneous administration
9. Blood bank *(1967, 34):*
   Blood bank management
10. Patient care *(1968; 218):*
    Medical records management
11. Bedside *(1969; 37):*
    Point-of-care-management
12. Operating room *(1969; 82):*
    Operating room management
13. Dietary *(1971; 57):*
    Dietary management and kitchen operations

reproduced from Singh and Mitchell (1996)

Figure 5.2
Distribution of Firms

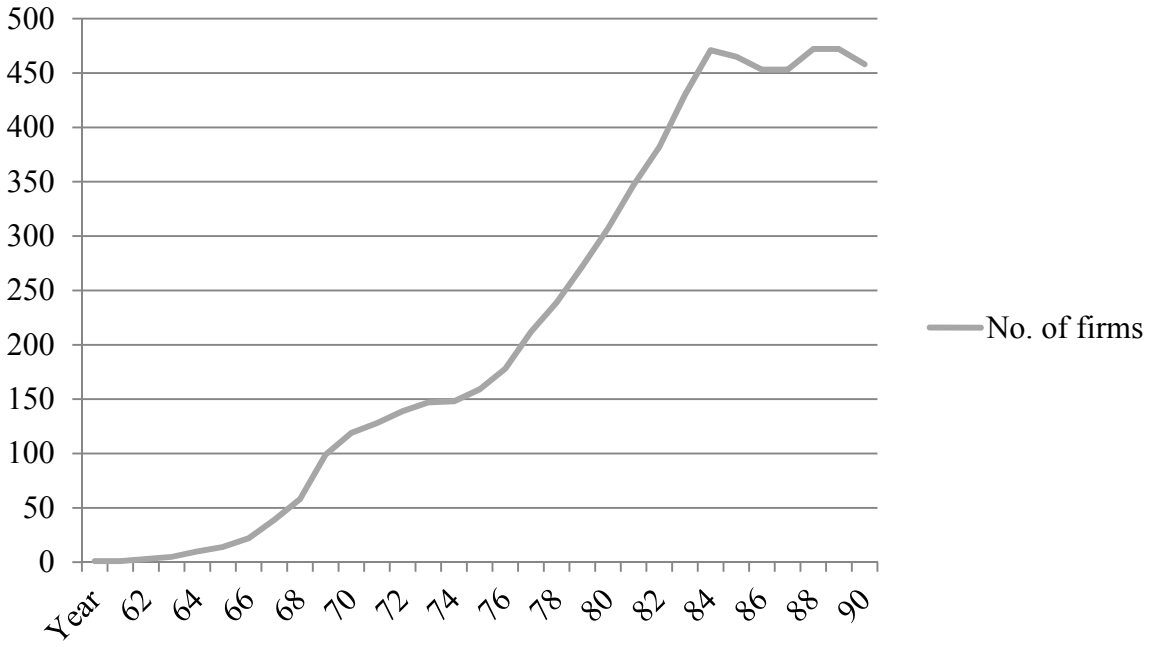


Figure 5.3
Distribution of Firms and Alliances

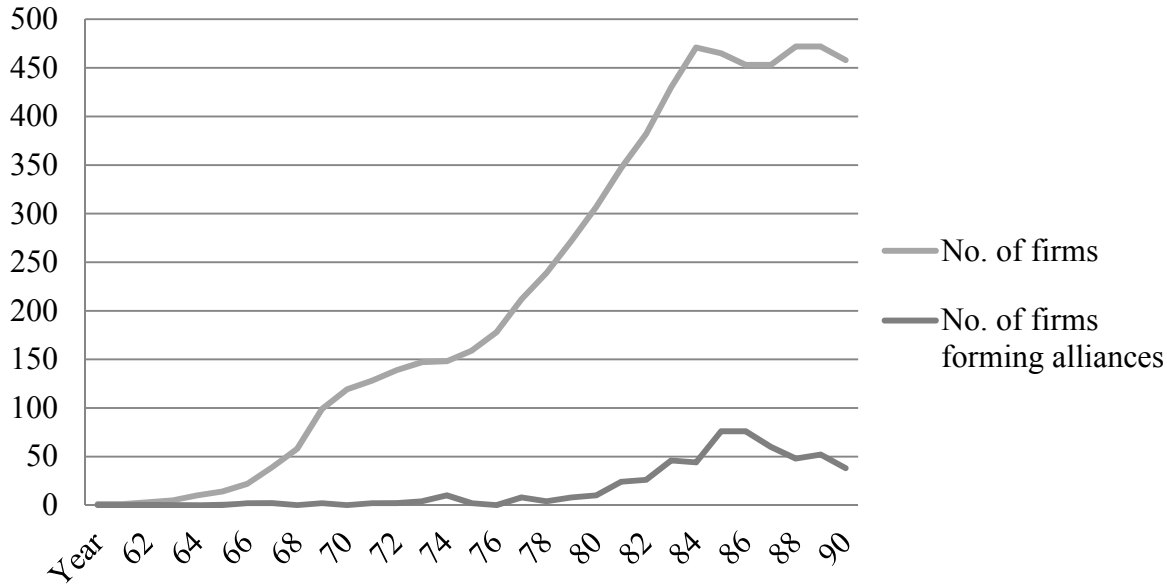
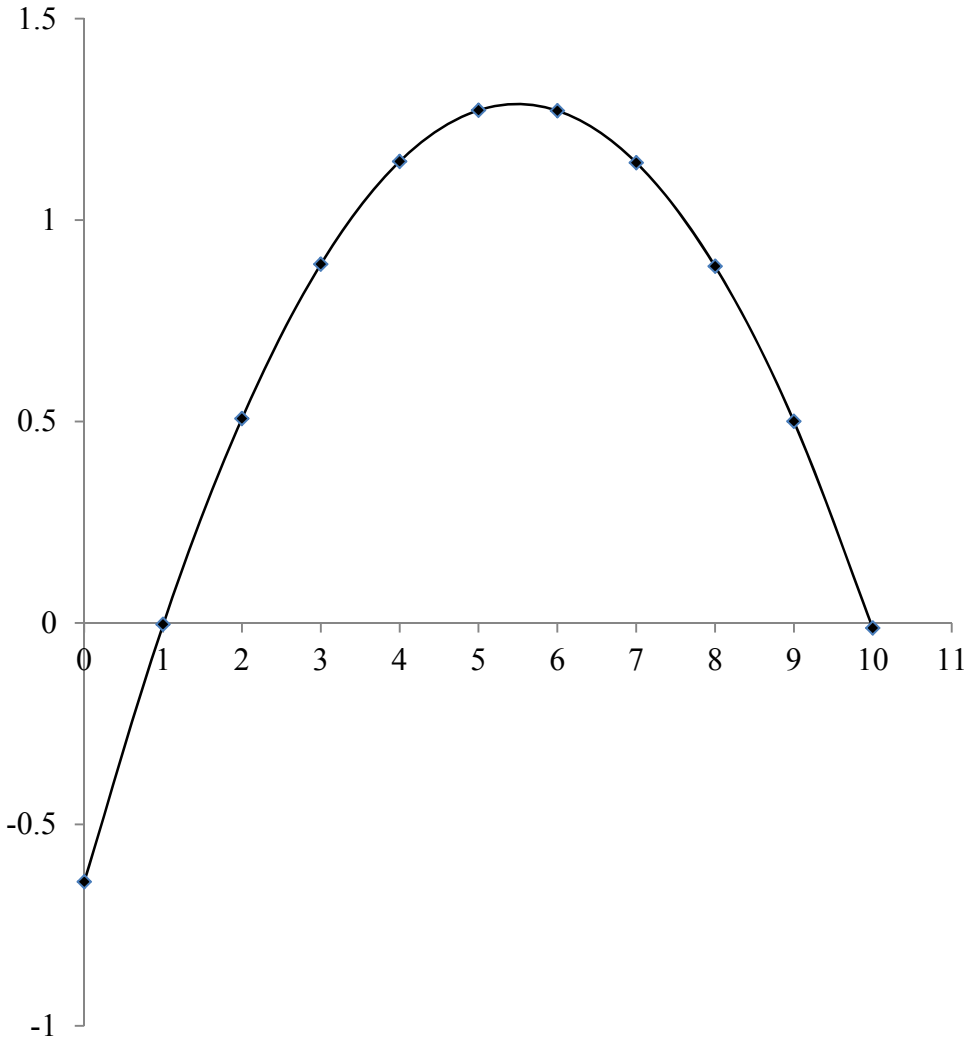
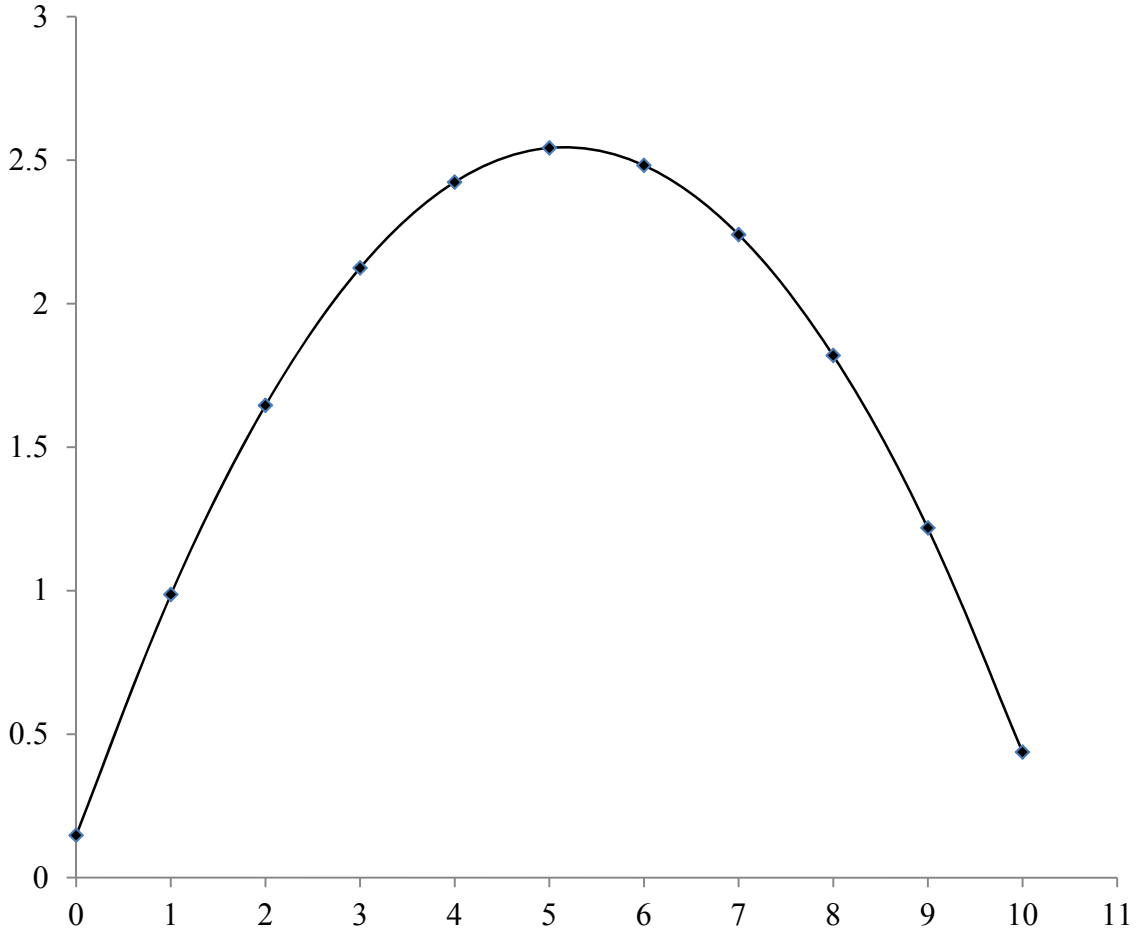


Figure 6.1
Ln odds of Alliance Formation as a Function of Multimarket Contact
(Full Dataset)[3]



[3]This graph is based on Model 5 in Table 6.3. For statistically significant index variables, means are implemented while statistically significant dichotomous variables are set to 1.

Figure 6.2
Ln odds of Alliance Formation as a Function of Multimarket Contact
(Stratified Sample)[4]



[4]This graph is based on Model 5 in Table 6.4. For statistically significant index variables, means are implemented while statistically significant dichotomous variables are set to 1.

TABLES

Table 5.1
Major Measures of Strategic Similarity (by year)

Reference	Key variables	Sample and method
Hatten & Schendel (1977)	• Manufacturing strategy (number of plants, newness of plants, and capital intensity) • Marketing strategy (number of brands, price, and receivables /sales)	• 13 public brewing companies for differing periods between 1952-71 • Firms grouped to homogeneous classes with Chow test (equivalence of β) • Johnson clustering program (based on F/F_c matrix)
Porter (1979)	• Firms' relative size	• 42 consumer goods industries • Firms divided into two groups (leaders and followers)
Dess & Davis (1984)	• 21 variables of competitive methods • Content of Porter's three generic strategies • Performance (ROA, sales growth)	• 78 executive managers of 22 firms in the US paints and allied products industry in the late 70s • Cross-sectional design • Survey • Factor analysis • One-way analysis of variance
Harrigan (1985)	• Pretax ROA (DV) • Employee profitability • Product differentiability • Inventory turnover	• 92 US retailers • Subsample of 34 department and discount stores • Data from COMPUSTAT • Cluster analysis

Reference	Key variables	Sample and method
Cool & Schendel (1987)	• Performance (market share, weighted segment share, infl. adjusted return on sales) • Scope commitments (range of market segments, types of products, commit. to the generic drug market, geographic scope). • Resource commitments (R&D, Marketing commit., promotion strategy, size)	• 22 firms in the US pharmaceutical industry between 1963 and 1982 • Variance-covariance matrix of selected variables to identify strategic groups over time (four periods) • Cluster analysis
Cool & Schendel (1988)	• Performance (ROS, ROA, inflation adjusted return on sales) • Business scope (range of market segments, types of products, geographic scope) • Resource commitments (R&D development comm., marketing comm., size).	• US pharmaceutical industry between 1963 and 1982 (four sub-periods: 1963-69, 1970-74, 1975-79, and 1980-82) • Variance-covariance matrix testing • Cluster analysis
Porac, Thomas, & Baden-Fuller (1989)	• Mental models (consensual identity beliefs define competitive space; enactment of competitive groups through maintenance of perceived boundaries)	• One case on Scottish knitwear manufacturers • 17 companies in the industry • Semi structured interviews with top managers over a six-month period. • Secondary industry data
Mascarenhas (1989)	• Product-line diversity • Technological capability • Global spread • Vertical integration • Marketing orientation	• Firms in international off-shore drilling between 1966 and 1984 • Measures of strategic group defining variables • Nonhierarchical cluster analysis

Reference	Key variables	Sample and method
Fiegenbaum & Thomas (1990)	• Four measures for scope dimension (2 x product scope, product diversity, firm size) • Three measures of resource deployment dimension (production, finance, investment)	• 33 top US insurance companies between 1970 and 1984 • Variance-covariance matrix and mean analysis • ANOVA/MANOVA
Reger & Huff (1993)	• Categories based on informants' cognitive perceptions (geographic scope, target market, growth strategies, location, management, HC structure and management, trust, product/market scope, company success, ownership and control, asset based lending)	• 6 of the 18 largest bank holding companies in the Chicago area (1982-1985) (cases were selected based on their diversity) • Semi-structured interviews with 23 strategists • Cluster analysis of informants' ratings (SAS CLUSTER)
Cool & Dierickx (1993)	• Strategic distance (Herfindahl index)	• U.S. pharmaceutical industry between 1963 and 1982 (four sub-periods – same sample as Cool and Schendel, 1987) • Euclidian distance measures
Duysters & Hagedoorn (1995)	• Organizational structure (overall size, size in sub-fields, diversification) • Firm behavior (diversification, technology strategy)	• European, US, and Japanese IT industry subsectors: data processing, telecommunications, and microelectronics in 1980 • Data from MERIT-CATI database • Principal component analysis • Multi-dimensional scaling (MDS) • Matrix permutation analysis

Reference	Key variables	Sample and method
Fiegenbaum & Thomas (1995)	• Four measures for scope dimension (2 x product scope, product diversity, firm size) • Three measures of resource deployment dimension (production, finance, investment)	• 33 top US insurance companies between 1970 and 1984. • Simple reference-point based adjustment model
Gimeno & Woo (1996)	• Revenue classification by the US Department of Transportation • Age (founding date) • Multivariate measure (market density, geographical market distance, percentage of tourist markets, percentage of direct flights, daily frequency, market share, premium over standard industry fare level)	• Activities of 48 airlines in 3,171 city-pair markets in the US passenger airline industry between 1984-88 (48,644 observations) • Euclidian distance
Nath & Gruca (1997)	• Archival measures: 3 factors (size/scope, location, payer mix) • Perceptual measures: 5 factors (nursing, medical facilities, image, support, appearance) • Direct measures: bipartite graph, hospital named one another as competitors)	• 72 (archival)/67 (perceptual) acute care hospitals in a major metropolitan area in 1987 • Compare results of three methods: (factor analysis and clustering, multidemensional scaling of managerial perceptions, direct identification of competing firms by managers) • Assess convergence with multitrait, multimethod matrix

Reference	Key variables	Sample and method
Houthoofd & Heene (1997)	• Strategic scope (volume, no. of product types, type of firm, channel control)	• Data on 36 Belgian breweries required by law to disclose annual accounts, 'Balanscentrale' database (National Bank of Belgium) between 1985-88 • Surveys by 7 CEOs • Factor analysis • Cluster analysis • Kruskal-Wallis ANOVA
Smith, Grimm, Wally, & Young (1997)	• Resource deployment (firms' cost position, marketing expenditures, management characteristics, scope of operations)	• US domestic airline industry (8-year period) • Cluster analysis • MANOVA
Ferguson, Deephouse, & Ferguson (2000)	• Scope of operations (product scope personal vs. commercial lines, product scope property lines, product scope financial lines, product diversity, size, ownership form, age) • Resource deployment (distribution, production, finance, investment)	• 84 out of the 100 top US property/casualty insurers in 1996 • Two-step cluster analysis of archival strategic data • ANOVA • Bonferroni tests of pairwise differences
Osborne, Stubbart, & Ramaprasad (2001)	• Scope variables (range of market segments, types of products, generic drug market, geographic scope) • Resource variable (R&D, marketing commitment, promotion strategy, size)	• Used Cool and Schendel's (1987) scheme of strategic groups of 22 top firms in the US pharmaceutical industry from 1963 to 1982. • Computer-assisted content analysis of 426 presidents' letters to stockholders on strategic intentions. • Factor analysis • MANOVA • Cluster analysis

Reference	Key variables	Sample and method
Nair & Kotha (2001)	• Dummy variable indicates group membership (integrated group vs. minimill group)	• 12 publicly traded integrated-mills and minimills in the Japanese carbon steel industry between 1980 and 1993.
McNamara, Luce, & Tompson (2002)	• Mangers assign firms to strategies/groups (strategies are identified by managers)	• 76 top management teams (234 top managers and 86 CEOs) of banks in three US cities (Denver, Milwaukee, Minneapolis/St. Paul) in 1993. • Survey (questionnaire)
McNamara, Deephouse, & Luce (2003)	• Managers assign firms to strategies/groups (strategies are identified by managers)	• 27 banks in the Minneapolis/S. Paul metropolitan area in 1994. • 3 groups (two groups of 3 banks and 1 group of 21) • Survey (questionnaire)
Nair, & Filer (2003)	• Dummy variable indicates group membership (integrated group vs. minimill group)	• 8 publicly traded mills (4 integrated and 4 minimills) in the Japanese steel industry from 1980 to 1999.
Mas-Ruiz, Nicolau-Gonzalbez, & Ruiz-Moreno (2005)	• Banks are assigned to one of three groups: large (national) banks, medium-size banks (regional scope), and small banks (local)	• 146 Spanish banks (52 savings banks and 94 banks) in 1994
Fuentelsaz & Gomez (2006)	• 3 scope dimensions: credits/financial investments, treasury/financial investments, portfolio/financial investments • 3 resource dimensions: personnel exp./total revenue, net insolvencies/total revenue, (passive-equity)/passive	• Spanish savings banks 1986-1999 (sample size changed from 77 in 1986 to 49 in 1999)

Reference	Key variables	Sample and method
Leask, & Parker (2007)	• Level of diversification (2) • Level of differentiation (5) • Execution ability (1)	• 32 leading UK pharmaceutical companies between 1998 and 2002 • Cluster analysis
Desarbo & Grewal (2008)	• Market value ratios (4) • Efficiency ratios (4) • Liquidity and leverage ratios (4) • Product ratios: loans (2) • Product ratios: deposits (4) • Firm size (7)	• Analysis of archival data on 131 banks in the tri-state area of New Jersey, New York, and Pennsylvania • Combinatorial optimization-based classification procedure (bilinear model)

Table 6.1
Descriptive Statistics and Correlations - Complete Dataset

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Industry concentration													
2	Software producers	0.10												
3	Hardware producers	-0.02	-0.08											
4	Entry - acquisition	-0.01	-0.02	0.01										
5	Entry - internal	0.03	0.04	-0.01	-0.23									
6	Previous alliance	-0.01	-0.04	0.02	0.03	-0.07								
7	Uncertainty	0.44	0.06	-0.01	-0.01	0.02	0.01							
8	Public firms	-0.02	-0.16	0.10	0.17	-0.18	0.11	-0.01						
9	Private firms	0.02	0.23	-0.04	-0.10	0.30	-0.19	0.01	-0.30					
10	Regulatory change period	-0.27	-0.14	0.01	-0.01	0.01	-0.09	-0.11	0.03	-0.04				
11	Competitive intensity	-0.10	-0.19	0.05	0.07	-0.14	0.24	-0.06	0.16	-0.22	0.18			
12	Similarity - founding date	-0.01	0.22	-0.06	-0.04	0.13	-0.17	0.01	-0.11	0.22	0.01	-0.15		
13	Similarity - complexity	-0.01	0.01	0.01	0.01	0.01	-0.03	-0.01	0.01	0.01	0.03	-0.02	0.01	
14	Similarity - software	-0.02	0.02	0.01	0.01	0.01	-0.01	-0.01	0.01	0.05	-0.02	-0.05	0.01	0.02
15	Similarity - customer base	0.04	0.12	-0.04	-0.03	0.08	-0.23	0.02	-0.14	0.21	-0.08	-0.36	0.11	0.03
16	Strategic Group identical	0.03	0.04	0.04	0.01	0.04	0.03	0.03	0.02	-0.01	-0.05	-0.02	-0.03	0.01
17	Multimarket contact	-0.01	-0.09	0.04	0.07	0.07	0.20	-0.01	0.12	-0.14	0.03	0.70	-0.09	0.18
18	Multimarket contact^2	0.01	-0.04	0.02	0.06	0.03	0.15	0.01	0.10	-0.09	-0.01	0.49	-0.07	0.14
	Mean	0.37	0.75	0.01	0.01	0.75	0.29	1.58	0.08	0.50	0.09	0.27	0.92	0.35
	Std. dev.	0.03	0.43	0.04	0.12	0.42	0.45	1.06	0.27	0.49	0.29	0.16	0.11	0.47
	Min	0.28	0	0	0	0	0	-0.87	0	0	0	0	0	0
	Max	0.98	1	1	1	1	1	3.41	1	1	1	1	1	1

Table 6.1 - continued
Descriptive Statistics and Correlations - Complete Dataset

		14	15	16	17	18
1	Industry concentration					
2	Software producers					
3	Hardware producers					
4	Entry - acquisition					
5	Entry - internal					
6	Previous alliance					
7	Uncertainty					
8	Public firms					
9	Private firms					
10	Regulatory change period					
11	Competitive intensity					
12	Similarity - founding date					
13	Similarity - complexity					
14	Similarity - software					
15	Similarity - customer base	0.01				
16	Strategic Group identical	0.01	-0.01			
17	Multimarket contact	0.01	-0.23	-0.23		
18	Multimarket contact^2	0.02	-0.19	-0.19	0.82	
	Mean	0.56	0.96	0.43	0.58	1.21
	Std. dev.	0.37	0.10	0.49	0.93	4.69
	Min	0	0	0	0	0
	Max	1	1	1	12	144

Table 6.2
Descriptive Statistics and Correlations - Endogenous Stratification

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Industry concentration													
2	Software producers	-0.02												
3	Hardware producers	-0.01	-0.10											
4	Entry - acquisition	-0.05	-0.02	-0.01										
5	Entry - internal	0.01	0.08	0.01	-0.21									
6	Previous alliance	-0.05	-0.18	0.00	0.03	-0.06								
7	Uncertainty	0.38	0.04	-0.07	-0.06	0.05	0.02							
8	Public firms	0.01	-0.24	0.07	0.20	-0.20	0.19	-0.03						
9	Private firms	-0.01	0.32	-0.06	-0.06	0.31	-0.27	0.04	-0.35					
10	Regulatory change period	-0.20	-0.10	-0.01	-0.10	0.00	-0.09	-0.09	-0.02	-0.01				
11	Competitive intensity	0.02	-0.21	0.03	0.00	-0.16	0.34	-0.02	0.23	-0.29	0.08			
12	Similarity - founding date	0.02	0.29	-0.12	0.08	0.11	-0.24	0.02	-0.09	0.24	0.01	-0.20		
13	Similarity - complexity	-0.01	-0.01	0.01	-0.03	-0.03	0.00	0.01	0.02	-0.01	0.02	0.06	0.00	
14	Similarity - software	-0.04	-0.03	0.01	-0.01	0.00	0.04	-0.06	0.06	0.01	0.00	0.01	-0.02	-0.02
15	Similarity - customer base	-0.01	0.11	0.00	0.03	0.06	-0.28	0.02	-0.24	0.25	-0.04	-0.45	0.08	-0.03
16	Strategic Group identical	-0.01	-0.05	-0.05	0.01	-0.04	0.04	0.00	0.04	-0.07	-0.06	0.04	-0.09	-0.01
17	Multimarket contact	0.01	-0.13	0.01	0.05	-0.10	0.26	0.01	0.17	-0.20	0.00	0.76	-0.13	0.25
18	Multimarket contact^2	0.01	-0.10	0.00	0.02	-0.05	0.18	0.02	0.11	-0.13	-0.02	0.57	-0.11	0.21
	Mean	0.37	0.67	0.00	0.02	0.72	0.39	1.68	0.14	0.42	0.04	0.30	0.91	0.36
	Std. dev.	0.03	0.46	0.06	0.12	0.44	0.48	1.01	0.35	0.49	0.19	0.18	0.12	0.48
	Min	0.28	0	0	0	0	0	-0.87	0	0	0	0.01	0.02	0
	Max	0.65	1	1	1	1	1	3.41	1	1	1	0.97	1	1

Table 6.2 - continued

Descriptive Statistics and Correlations - Endogenous Stratification

		14	15	16	17	18
1	Industry concentration					
2	Software producers					
3	Hardware producers					
4	Entry - acquisition					
5	Entry - internal					
6	Previous alliance					
7	Uncertainty					
8	Public firms					
9	Private firms					
10	Regulatory change period					
11	Competitive intensity					
12	Similarity - founding date					
13	Similarity - complexity					
14	Similarity - software					
15	Similarity - customer base	-0.03				
16	Strategic Group identical	0.03	-0.03			
17	Multimarket contact	0.07	-0.36	0.03		
18	Multimarket contact^2	0.06	-0.28	0.01	0.87	
	Mean	0.57	0.95	0.45	0.82	2.32
	Std. dev.	0.35	0.14	0.49	1.28	7.91
	Min	0	0	0	0	0
	Max	1	1	1	10	100

Table 6.3

Logistic Regression Estimates (coefficients) – Complete Dataset

	(1)	(2)	(3)	(4)	(5)	(6)
Industry concentration	4.664**	5.065***	5.932***	5.547**	5.561**	5.087***
	(1.607)	(1.525)	(1.798)	(1.890)	(1.936)	(1.593)
Software producers	-1.231***	-1.353***	-1.355***	-1.327***	-1.296***	-1.259***
	(0.136)	(0.138)	(0.135)	(0.135)	(0.135)	(0.139)
Hardware producers	-0.205	-0.198	-0.111	-0.121	-0.242	-0.474
	(0.510)	(0.512)	(0.511)	(0.510)	(0.510)	(0.514)
Entry – acquisition	-0.878*	-0.748+	-0.767+	-0.890*	-0.888*	-0.870*
	(0.422)	(0.422)	(0.422)	(0.422)	(0.422)	(0.422)
Entry - internal	-0.023	-0.131	-0.099	-0.029	-0.027	-0.023
	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)	(0.130)
Previous alliance	1.534***	1.658***	1.795***	1.643***	1.564***	1.431***
	(0.162)	(0.164)	(0.160)	(0.162)	(0.163)	(0.167)
Uncertainty	0.041	0.054	-0.013	0.001	0.008	0.036
	(0.061)	(0.062)	(0.063)	(0.063)	(0.062)	(0.063)
Public firms	0.713***	0.724***	0.861***	0.749***	0.732***	0.591***
	(0.132)	(0.132)	(0.130)	(0.132)	(0.132)	(0.134)
Private firms	-1.780***	-1.893***	-1.956***	-1.911***	-1.857***	-1.767***
	(0.296)	(0.297)	(0.294)	(0.295)	(0.295)	(0.298)
Regulatory change period	-1.179***	-1.153***	-0.811*	-0.882**	-0.955**	-1.165***
	(0.314)	(0.317)	(0.316)	(0.319)	(0.315)	(0.320)
Competitive intensity	3.126***					1.918**
(H_1)	(0.323)					(0.622)
Similarity – founding date		-0.369				-0.036
(H_{2a+b})		(0.355)				(0.360)
Similarity – complexity		0.329**				0.175
(H_{2a+b})		(0.123)				(0.138)
Similarity – software type		1.011***				0.971***
(H_{2a+b})		(0.199)				(0.202)
Similarity – customer base		-1.517***				-0.825***
(H_{2a+b})		(0.223)				(0.253)
Strategic Group identical			0.365**			0.353**
(H_{3a+b})			(0.125)			(0.126)
Multimarket contact				0.251***	0.703***	0.385**
(H_{4a+b})				(0.028)	(0.093)	(0.128)
Multimarket contact square					-0.064***	-0.049***
(H_5)					(0.013)	(0.143)
Constant	-11.209***	-9.176***	-10.687***	-10.588***	-10.885***	-10.708***
	(0.622)	(0.754)	(0.687)	(0.713)	(0.731)	(0.928)
Observations #	1,191,813	1,191,813	1,191,813	1,191,813	1,191,813	1,191,813
LR Chi2 (d.f.)	788.88 (11)	772.54 (14)	707.65 (11)	757.52 (11)	785.79 (12)	847.49 (18)

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10 (robust standard errors in parentheses)

Table 6.4

Logistic Regression Estimates (coefficients) – WESML Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Industry concentration	0.194	2.505	0.534	-0.030	1.253	2.969
	(2.435)	(2.731)	(3.141)	(3.122)	(3.004)	(2.450)
Software producers	-1.362***	-1.531***	-1.316***	-1.383***	-1.518***	-1.648***
	(0.194)	(0.224)	(0.176)	(0.188)	(0.208)	(0.243)
Hardware producers	1.678*	1.765*	1.626+	1.823*	1.765*	1.883*
	(0.843)	(0.834)	(0.843)	(0.832)	(0.851)	(0.859)
Entry – acquisition	-1.090+	-1.117+	-1.136+	-1.133+	-1.273*	-1.219+
	(0.596)	(0.628)	(0.602)	(0.596)	(0.639)	(0.658)
Entry - internal	-0.179	-0.272	-0.085	-0.173	-0.003	-0.067
	(0.212)	(0.209)	(0.199)	(0.203)	(0.222)	(0.229)
Previous alliance	1.762***	1.850***	2.020***	1.907***	1.824***	1.758***
	(0.232)	(0.234)	(0.217)	(0.223)	(0.245)	(0.268)
Uncertainty	0.151	0.051	0.091	0.101	0.157	0.210
	(0.126)	(0.119)	(0.118)	(0.123)	(0.127)	(0.137)
Public firms	0.747**	0.629**	0.962***	0.840***	0.776***	0.512*
	(0.236)	(0.235)	(0.209)	(0.233)	(0.233)	(0.261)
Private firms	-1.770***	-1.815***	-1.965***	-1.874***	-1.890***	-1.768***
	(0.323)	(0.324)	(0.310)	(0.316)	(0.322)	(0.339)
Regulatory change period	0.334	0.449	0.628	0.523	0.587	0.530
	(0.439)	(0.471)	(0.463)	(0.445)	(0.447)	(0.513)
Competitive intensity	3.334***					2.414*
(H_1)	(0.629)					(1.051)
Similarity – founding date		-0.095				0.895
(H_{2a+b})		(0.509)				(0.629)
Similarity – complexity		0.060				0.022
(H_{2a+b})		(0.208)				(0.243)
Similarity – software type		1.076***				1.226***
(H_{2a+b})		(0.327)				(0.338)
Similarity – customer base		-1.969***				-0.670
(H_{2a+b})		(0.476)				(0.587)
Strategic Group identical			0.443*			0.492*
(H_{3a+b})			(0.185)			(0.218)
Multimarket contact				0.244***	0.929***	0.658**
(H_{4a+b})				(0.064)	(0.162)	(0.241)
Multimarket contact square					-0.090***	-0.092**
(H_5)					(0.023)	(0.032)
Constant	-9.938***	-8.075***	-9.221***	-8.892***	-9.957***	-12.282***
	(1.030)	(1.280)	(1.190)	(1.175)	(1.818)	(1.474)
Observations #	1,638	1,638	1,638	1,638	1,638	1,638
LR Chi2 (d.f.)	197.18 (11)	218.35 (14)	227.30 (11)	211.83 (11)	197.62 (12)	214.15 (18)

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10 (robust standard errors in parentheses)

Table 6.5

Logistic Regression Estimates (coefficients) – WESML Estimates

	(7)	(8)	(9)	(10)	(11)
Industry concentration	3.692	2.515	3.161	2.937	3.572
	(2.519)	(2.354)	(2.423)	(2.466)	(2.454)
Software producers	-0.720	-1.728***	-1.665***	-1.654***	-0.298
	(0.505)	(0.251)	(0.243)	(0.245)	(0.506)
Hardware producers	2.019*	1.830*	1.855*	1.879*	1.971*
	(0.877)	(0.871)	(0.854)	(0.859)	(0.895)
Entry – acquisition	-1.277+	-1.174+	-1.223+	-1.217+	-1.216+
	(0.679)	(0.644)	(0.655)	(0.660)	(0.662)
Entry - internal	-0.083	-0.011	-0.074	-0.073	-0.037
	(0.233)	(0.233)	(0.228)	(0.231)	(0.240)
Previous alliance	1.800***	1.742***	1.739***	1.753***	1.773***
	(0.277)	(0.268)	(0.268)	(0.268)	(0.281)
Uncertainty	0.233	0.210	0.197	0.210	0.218
	(0.143)	(0.134)	(0.138)	(0.137)	(0.142)
Public firms	0.506+	1.613**	0.517*	0.516*	1.939***
	(0.269)	(0.549)	(0.259)	(0.262)	(0.576)
Private firms	-1.785***	-1.701***	-3.056***	-1.766***	-2.974**
	(0.339)	(0.346)	(0.940)	(0.339)	(0.929)
Regulatory change period	0.650	0.471	0.526	-0.079	-0.059
	(0.528)	(0.516)	(0.509)	(2.419)	(2.695)
Competitive intensity	2.973**	3.219**	2.108*	2.378*	4.025**
(H_1)	(1.134)	(1.097)	(1.068)	(1.056)	(1.308)
Similarity – founding date	0.947	1.020	0.868	0.888	1.098
(H_{2a+b})	(0.650)	(0.635)	(0.627)	(0.629)	(0.669)
Similarity – complexity	-0.004	-0.001	0.003	0.018	-0.066
(H_{2a+b})	(0.248)	(0.245)	(0.244)	(0.244)	(0.255)
Similarity – software type	1.266***	1.224***	1.248***	1.217***	1.293***
(H_{2a+b})	(0.349)	(0.332)	(0.335)	(0.344)	(0.349)
Similarity – customer base	-0.816	-0.924+	-0.782	-0.685	-1.346*
(H_{2a+b})	(0.649)	(0.561)	(0.596)	(0.594)	(0.643)
Strategic Group identical	0.524*	0.513*	0.500*	0.492*	0.586*
(H_{3a+b})	(0.225)	(0.215)	(0.217)	(0.218)	(0.226)
Multimarket contact	0.732**	0.669**	0.659**	0.656**	0.786**
(H_{4a+b})	(0.260)	(0.234)	(0.242)	(0.242)	(0.258)
Multimarket contact square	-0.105**	-0.086**	-0.091**	-0.092**	-0.101**
(H_5)	(0.036)	(0.028)	(0.032)	(0.032)	(0.033)
CI x Resource redundancy	-2.119+				-3.302**
(H_{6a+b})	(1.547)				(1.272)
CI x Public firms		-2.465*			-3.279*
(H_{7a+b})		(1.255)			(1.417)
CI x Private firms			3.127		2.630
(H_{8a+b})			(2.027)		(2.080)
CI x Period (1981-1985)				1.316	1.493
(H_9)				(5.118)	(5.650)
Constant	-10.678***	-12.369***	-12.070***	-12.218***	-13.006***
	(0.755)	(1.442)	(1.475)	(1.511)	(1.584)
Observations #	1,638	1,638	1,638	1,638	1,638
LR Chi2 (d.f.)	239.78 (19)	210.28 (19)	189.53 (19)	214.16 (19)	206.26 (22)

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10 (robust standard errors in parentheses)

APPENDICES

Appendix A
Formal Expressions of Measures

Competitive intensity

$$COMP_{ij} = \frac{\sum_{m=1}^{M} I_{im} + I_{jm}}{max_{k,l} \sum_{m=1}^{M} I_{km} + I_{lm}}$$

with

$COMP_{ij}$ = relative dyadic competition faced by firms *i* and *j*,
I_{im} = count of firms in market segment *m* in which firm *i* is present,
I_{jm} = count of firms in market segment *m* in which firm *j* is present,
$max_{k,l}$ = maximum density of two firms in the particular year,
I_{km} = count of firms in market segment *m* in which firm *k* is present,
I_{lm} = count of firms in market segment *m* in which firm *l* is present,
M = 13 market segments in the industry.

Similarity

Founding date

$$SIM_{ij}^{date} = 1 - \frac{\left|Founding\ date_i - Founding\ date_j\right|}{max_{k,l} \left|Founding\ date_k - Founding\ date_l\right|}$$

with

SIM_{ij}^{date} = similarity of founding date of firms *i* and *j,*
$max_{k,l}$ = maximum difference of founding dates.

Technology – Software type

$$SIM_{ij}^{tec} = \frac{\sum_{p=1}^{P} I_{ip} \times I_{jp}}{\sum_{p=1}^{P} I_{ip} + \sum_{p=1}^{P} I_{jp} - \sum_{p=1}^{P} I_{ip} \times I_{jp}}$$

with

SIM_{ij}^{tec} = technological similarity of two firms, *i* and *j*,
I_{ip} = firm *i* produces software for platform *p* (coded 1, 0 otherwise),
I_{jp} = firm *j* produces software for platform *p* (coded 1, 0 otherwise),
P = 3 different software platforms (mainframe, minicomputer, personal computer).

Technology – Complexity

$$SIM_{ij}^{clx} = \begin{cases} 1 \text{ if firms } i \text{ and } j \text{ have same complexity classification} \\ 0 \text{ if firms } i \text{ and } j \text{have different complexity classification} \end{cases}$$

with

SIM_{ij}^{clx} = similarity in product complexity of firms *i* and *j*.

Customer base

$$SIM_{ij}^{cust.base} = 1 - \frac{\left|Sales_i - Sales_j\right|}{max_{k,l}\left|Sales_k - Sales_l\right|}$$

with

$SIM_{ij}^{cust.base}$ = normalized difference between the sales of firms *i* and *j,*
$max_{k,l}$ = maximum difference of sales between firm *k* and *l*.

Multimarket Contact

$$MMC_{ij} = \sum_{m=1}^{M} I_{im} \times I_{jm}$$

with

MMC_{ij} = multimarket contact between two firms (*i* and *j*),
I_{im} = presence of firm *i* in market m (coded 1, 0 otherwise),
I_{jm} = presence of firm *j* in market m (coded 1, 0 otherwise),
M = 13 market segments in the industry.

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